Factors influencing physical activity among diabetics in Malta and Gozo

A dissertation submitted in partial fulfilment of the requirements of the degree of Master of Science in Public Health

Kristina Cassar

Department of Public Health

Faculty of Medicine and Surgery

University of Malta

December 2023

L-Università ta' Malta

FACULTY/~~INSTITUTE/CENTRE/SCHOOL~~ OF MEDICINE AND SURGERY

DECLARATIONS BY POSTGRADUATE STUDENTS

(a) Authenticity of Dissertation

I hereby declare that I am the legitimate author of this Dissertation and that it is my original work.

No portion of this work has been submitted in support of an application for another degree or qualification of this or any other university or institution of higher education.

I hold the University of Malta harmless against any third party claims with regard to copyright violation, breach of confidentiality, defamation and any other third party right infringement.

(b) Research Code of Practice and Ethics Review Procedures

I declare that I have abided by the University's Research Ethics Review Procedures. Research Ethics & Data Protection form code MED-2022-00243.

As a Master's student, as per Regulation 77 of the General Regulations for University Postgraduate Awards 2021, I accept that should my dissertation be awarded a Grade A, it will be made publicly available on the University of Malta Institutional Repository.

Acknowledgements

I would like to acknowledge all the people who were involved in one way or another in this dissertation and without whom this research project would not have been possible.

My sincere gratitude goes to my supervisor, Dr. Kathleen England, for her continuous guidance and support. Her contribution ensured that this dissertation was of a high quality and that all necessary milestones were achieved.

I am also thankful for the expert advice offered by my co-supervisor and adviser, Prof. Josanne Vassallo, who provided crucial insights on the subject matter.

I would also like to thank Prof. Neville Calleja for his assistance with the study methodology and the more complex statistical analyses.

A heartfelt thanks goes to the intermediaries, nurses, and patients who willingly participated in this study and without whom none of this would have been possible.

A special thanks goes to my family and my fiancé for their patience, support, and encouragement throughout this journey.

I am also grateful to the ENDEAVOUR Scholarships Scheme for providing funding to pursue my studies.

The research work disclosed in this publication is partially funded by the Endeavour Scholarship Scheme (Malta). Project part-financed by the European Social Fund - Operational Programme II – European Structural and Investment Funds 2014-2020 *"Investing in human capital to create more opportunities and promote the well-being of society".*

Operational Programme II - European Structural and Investment Funds 2014-2020
"Investing in human capital to create more opportunities and promote the well-being of society"
Project part-financed by the European Social Fund
Co-financing rate: 80% European Union; 20% National Funds

Summary

Background

Diabetes mellitus is one of the fastest growing global health emergencies of the 21st century. Type 2 diabetes, which is the most common type, was historically a disease of adults but is increasingly presenting itself as a concern in children and young people due to the rising obesity rates. The prevalence of diabetes among adults in Malta was estimated at 11.2% in 2021 and local mortality rates from diabetes are on the increase, demonstrating worse outcomes than the European average. While treatment guidelines recommend regular physical activity, individuals living with diabetes are generally inactive, which may be a result of both internal and external factors. The purpose of this study was to examine the knowledge, adherence to physical activity, and explore perceived benefits and barriers to physical activity among adults with type 2 diabetes mellitus in Malta and Gozo.

Methodology

A cross-sectional survey was conducted between March and August 2023 by distributing a paper-based questionnaire to type 2 diabetic adults aged 18-69 years attending diabetes clinics at two hospitals and three health centres. Knowledge about physical activity was assessed and physical activity level was measured by the International Physical Activity Questionnaire (IPAQ) short form. Benefits and barriers were assessed using the Exercise Benefits/Barriers Scale (EBBS) and Barriers to Physical Activity in Diabetes (BAPAD) scale. Anthropometric measurements and glycated haemoglobin were obtained. The tool was tested for validity and reliability and piloted. Data was analysed using SPSS and NVivo.

Results

384 questionnaires were collected (response rate of 95.5%). Participants demonstrated good knowledge of the importance of physical activity and recommended levels, although most (41.7%) were inactive. The majority (over 90%) were overweight/obese and had an increased waist circumference. Physical activity level was significantly associated with body mass index ($p=0.016$) and waist circumference ($p<0.01$). The most recognised exercise benefits were those related to physical performance and psychological outlook. The greatest perceived barriers were physical health status, having a low fitness level, the perception that exercise is tiring/fatiguing, and weather conditions. Barriers to physical activity were significantly associated with activity level, such that higher barriers scores predicted lower physical activity levels ($p<0.01$). Enablers to physical activity were improved health and well-being, environmental factors, and receiving encouragement and support from family, peers, and healthcare professionals.

Conclusions

This was the first local study to explore the perceived benefits, enablers, and barriers to physical activity among type 2 diabetic adults. The study findings revealed that multiple factors can influence adherence to physical activity and a one-size-fits-all approach is unlikely to reap the intended benefits on a national scale. The outcomes of this study may be utilised to inform future national policies and strategies and clinical practice to improve diabetes outcomes among the population of Malta and Gozo.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ADA - American Diabetes Association

ANOVA - Analysis of Variance

BAPAD - Barriers to Physical Activity in Diabetes

BMI - Body Mass Index

CI - Confidence Interval

CVD - Cardiovascular Disease

DKD - Diabetic Kidney Disease

DM - Diabetes Mellitus

DR - Diabetic Retinopathy

EBBS - Exercise Benefits/Barriers Scale

EHIS - European Health Interview Survey

GGH - Gozo General Hospital

GLUT/GLUT4 - Glucose Transporter/Glucose Transporter Type 4

HbA1c - Glycated Haemoglobin

HBM - Health Belief Model

IDF - International Diabetes Federation

IPAQ - International Physical Activity Questionnaire

IQR - Interquartile Range

LAU - Local Administrative Units

MDH - Mater Dei Hospital

MET - Metabolic Equivalent of Task

NICE - National Institute for Health and Care Excellence

NUTS - Nomenclature of Territorial Units for Statistics

PA - Physical Activity

PHC - Primary HealthCare

PRISMA - Preferred Reporting Items for Systematic Reviews and Meta-Analyses

SCT - Social Cognitive Theory

SGLT2 - Sodium-glucose Cotransporter-2

T1DM - Type 1 Diabetes Mellitus

T2DM - Type 2 Diabetes Mellitus

WHO - World Health Organization

Introduction

The pathophysiology of diabetes mellitus

Diabetes mellitus (DM) is one of the fastest growing global health emergencies of the 21st century. It is a chronic condition characterised by raised blood glucose levels due to the body's inability to produce sufficient insulin and/or inability of the body to effectively respond to the insulin produced (insulin resistance). Insulin is a hormone produced by the pancreas which is essential for the absorption of glucose from the bloodstream into the body's cells where it is subsequently converted into energy or stored. The elevated blood glucose (hyperglycaemia) resulting from insulin deficiency or resistance is the clinical indicator of diabetes (International Diabetes Federation [IDF], 2021).

There are two main types of diabetes, namely type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM), with genetic and environmental factors implicated in the pathogenesis of both types. T1DM results from an autoimmune destruction of the insulin-producing beta-cells of the pancreas, resulting in very little or no insulin produced, hence requiring daily insulin therapy to control and maintain adequate blood glucose levels. T2DM, which accounts for 90-95% of global diabetes cases, results from a non-autoimmune progressive loss of insulin secretion, often on a background of insulin resistance and metabolic syndrome. Until recently, this type of diabetes was predominantly seen in adults; however, it is increasingly presenting itself as a concern in children and young adults due to the increased worldwide prevalence of obesity. The cornerstone of T2DM management is promoting a healthy lifestyle. If this fails, pharmacological therapy is initiated, although not necessarily involving insulin (American Diabetes Association [ADA], 2023; IDF, 2021).

In the presence of hyperglycaemia, individuals with any form of diabetes would be at an increased risk of developing long-term macrovascular and microvascular complications, including cardiovascular disease, kidney disease, retinopathy, and neuropathy, although the rate of progression may differ (ADA, 2023). Early detection and initiation of treatment may prevent or delay the onset of complications and associated morbidity, mortality, and impact on quality of life. Optimal glycaemic control requires not only compliance with pharmacological therapy where indicated, but largely depends on patient self-management which includes blood glucose monitoring, undertaking regular physical activity (PA), and adopting a healthy diet (IDF, 2021).

Epidemiology of diabetes mellitus

The International Diabetes Federation (IDF) estimated that 537 million adults aged 20-79 years were living with diabetes globally in 2021. This is projected to increase by 46% to a predicted 783 million people living with diabetes by 2045 (IDF, 2021).

The Saħħtek study, a nationally representative health examination survey carried out in Malta between 2014 and 2016, estimated a prevalence for T2DM of 10.39% in adults aged between 18 and 70 years, with 6.31% having been previously diagnosed and 4.08% being unaware of their condition. Additionally, the diabetic population was found to be predominantly overweight or obese (92.20%) (Cuschieri et al., 2016). More recently, the European Health Interview Survey (EHIS) 2019/2020 reported a lifetime and 12-month prevalence of diabetes of 7.9% and 7.5%, respectively, in adults aged 15 years and over (England et al., 2022). However, the EHIS collects self-reported data, and the prevalence is likely to be higher due to undiagnosed individuals, as demonstrated in the Saħħtek study. The IDF estimated a diabetes prevalence of 11.2% among adults aged 20-79 years in Malta in 2021 (IDF, 2021).

In 2019, 1.5 million deaths worldwide were directly caused by diabetes, with almost half of all deaths occurring before the age of 70 years (World Health Organization [WHO], 2023). The latest available mortality data for Malta shows that diabetes directly accounted for 5.4% and 6.3% of deaths in males and females, respectively, in 2020, registering an upward trend in deaths since 2010 and scoring worse than the European average for both genders (Directorate for Health Information and Research, 2023).

Scope and rationale

As previously mentioned, engaging in regular PA is one of the cornerstones of diabetes management. Regular PA improves body composition and contributes to weight loss, reduces cardiovascular risk factors, improves glycaemic control, insulin sensitivity, and quality of life, and ultimately reduces cardiovascular and overall mortality (Colberg et al., 2016). The integration of regular PA into patients' self-management plans is recommended by all international treatment guidelines and standards for diabetes (ADA, 2023; WHO, 2020; Williams et al., 2018).

Despite the well-recognised benefits of PA and attempts at promoting this, the majority of individuals with T2DM do not achieve the recommended levels of PA (Vilafranca Cartagena et al., 2021). Similarly, rates of inactivity in T1DM individuals are higher than in the general population, indicating that persons living with diabetes may experience additional barriers to maintaining adequate PA levels (Brennan et al., 2021). The international literature demonstrates that diabetic individuals experience both general and disease-specific barriers to PA participation. The most commonly reported barriers include lack of time, medical co-morbidities, lack of infrastructure or access to facilities, as well as psychosocial factors such as embarrassment, low confidence, and lack of motivation. Diabetes-specific barriers include lack of knowledge, awareness, and

confidence in managing diabetes around exercise, loss of control over diabetes, and limited professional support and advice (Advika et al., 2017; Brazeau et al., 2008; Kime et al., 2018; Lascar et al., 2014, Pati et al., 2019). Moreover, the fear of low blood sugar (hypoglycaemia) and/or actual episodes of hypoglycaemia featured as a prominent barrier to PA in T1DM individuals in multiple studies (Brazeau et al., 2008; Kennedy et al., 2018; Kime et al., 2018). International studies have shown that patient knowledge and perceived benefits such as control of diabetes, weight management, and feel-good factor, family support, advice and encouragement from health professionals, and social interaction and having company to exercise with, are prominent enablers to PA (Advika et al., 2017; Lascar et al., 2014; Pati et al., 2019).

Given the unique local cultural context and the high rates of both DM and overweight/obesity, this topic was deemed to be very important for further local research as findings from the international literature cannot be assumed to be valid for the Maltese Islands. As far as the researcher is aware, perceived benefits, barriers, and enablers to PA among the Maltese type 2 diabetic population have not been studied to date. Such a study would help inform the design and planning of future policies and health promotion interventions aimed at encouraging PA participation among diabetics.

Study aim and objectives

Aim

The purpose of this study is to examine the knowledge and adherence to PA recommendations and explore perceived benefits and barriers to PA among diabetic adults in Malta and Gozo.

Objectives

- To assess the knowledge and practice of PA among T2DM individuals.
- To compare PA levels between different age groups and gender.
- To investigate whether there is an association between PA level and glycaemic control, overweight/obesity, and duration of diabetes.
- To identify possible barriers and enablers to PA among adults with T2DM.
- To investigate whether there is an association between perceived barriers and PA level in adults with T2DM.
- To develop recommendations for future interventions to overcome barriers and enhance enabling factors to encourage diabetic individuals to increase and maintain their PA levels.

Conclusion

This study is expected to provide a deeper understanding of the knowledge of PA recommendations and perceived benefits and barriers towards PA participation among adults living with T2DM in Malta and Gozo. It will also attempt to delineate any specific demographic characteristics associated with PA participation amongst type 2 diabetic patients and whether current PA practices are aligned with international guidelines.

The researcher envisages that the results arising from this study, together with the recommendations to be proposed, would be useful to policymakers and clinicians in Malta and Gozo who are involved directly and indirectly in the care of T2DM individuals in order to improve outcomes in diabetes at the national level.

Literature Review

Introduction

This chapter explores the key concepts discussed in this dissertation related to PA in diabetes, presenting the global recommendations, benefits of PA, as well as local and international literature on PA participation among adults living with T2DM. This is followed by a systematic review of the literature available regarding the knowledge and perceptions towards PA in T2DM.

Global recommendations on PA

Definitions

The World Health Organization (WHO) defines PA as "any bodily movement produced by skeletal muscles that requires energy expenditure". Exercise is a subset of PA and refers to any activity which is planned, structured, and repetitive. The terms "exercise" and "exercise training" are often used interchangeably and refer to PA undertaken during leisure time with the aim of improving or maintaining physical fitness, performance, or health (WHO, 2020).

PA guidelines recommend a combination of aerobic and resistance training. Aerobic PA refers to any activity engaging larger muscles for a sustained period. This type of PA enhances cardiorespiratory fitness (endurance) and includes walking, running, swimming, and bicycling. Muscle-strengthening activity, which includes resistance training, refers to activities aimed at increasing skeletal muscle strength, power, endurance, and mass (WHO, 2020).

Recommended PA levels

The adoption and maintenance of PA is crucial for disease management in T2DM. The global PA recommendations for optimal glycaemic control and improved health outcomes are summarised in Table 1.

Table 1

Summary of PA recommendations for individuals with T2DM

Recommendations	**Organisation issuing guidance**
<u>Adults:</u> Adults should engage in at least 150-300 minutes of moderate intensity aerobic PA per week, or at least 75-150 minutes of vigorous intensity aerobic PA per week, or an equivalent combination, over at least three days, whilst ensuring that no more than two consecutive days elapse between activity sessions. This should be supplemented with two to three sessions per week of resistance training/muscle-strengthening activities involving all major muscle groups, undertaken on non-consecutive days. If not contraindicated, adults may increase their activity to more than 300 minutes of moderate intensity or more than 150 minutes of vigorous intensity aerobic PA, or an equivalent combination, throughout the week for enhanced health benefits. If unable to meet these recommendations, adults with T2DM should aim to engage in PA according to their abilities. Furthermore, new evidence shows that bouts of activity of any duration are associated with improved health outcomes, such as all-cause mortality.	American College of Sports Medicine (Kanaley et al., 2022); American Diabetes Association (ADA, 2023); World Health Organization (WHO, 2020)
<u>Older adults:</u> In addition to the above, older adults should carry out multicomponent PA which incorporates flexibility and balance training, at least twice or three times per week. Flexibility exercises improve joint range of motion and thus help to counteract the limitation in joint mobility which may result in part from the accumulation of glycation end products occurring with normal ageing and which is further exacerbated by hyperglycaemia. Although such exercises do not directly impact glucose control, they facilitate participation in other types of PA. Balance exercises may decrease the risk of falls in this population by improving balance and gait.	American College of Sports Medicine (Kanaley et al., 2022); American Diabetes Association (ADA, 2023); World Health Organization (WHO, 2020)

Children and adolescents: Children and adolescents with diabetes are encouraged to follow the recommendations set for youth in the general population, that is, engaging in at least 60 minutes per day of moderate-to-vigorous intensity, mostly aerobic PA, with vigorous intensity activity and muscle-strengthening and bone-strengthening activities incorporated on at least three days per week.	American College of Sports Medicine (Kanaley et al., 2022); American Diabetes Association (ADA, 2023); World Health Organization (WHO, 2020)
All ages: All individuals are encouraged to limit the amount of time spent in sedentary behaviour and replace this with activity of any intensity for additional health benefits. In adults with T2DM, prolonged sitting should be interrupted every 30 minutes (Grade C recommendation) (ADA, 2023). Prolonged sedentary time is associated with poorer glycaemic control and increased morbidity and mortality, irrespective of the level of PA.	American College of Sports Medicine (Kanaley et al., 2022); American Diabetes Association (ADA, 2023); World Health Organization (WHO, 2020)

Benefits of PA in T2DM

The above global recommendations are based on strong evidence that PA improves markers of disease progression in adults with T2DM, namely glycated haemoglobin (HbA1c), together with body mass index (BMI), blood pressure, and lipid profile (WHO, 2020). Various types of PA promote health and improve glycaemic control in individuals with T2DM, although structured exercise has been studied most frequently. Many of the proven benefits are thought to result from improved insulin sensitivity and post-prandial hyperglycaemia, together with cardiovascular disease risk reduction (Kanaley et al., 2022).

Acute effects of exercise

PA plays a role in blood glucose regulation by stimulating increased glucose uptake into active muscles, while blood glucose levels are maintained by hepatic glucose production and mobilisation of alternative sources of energy. Glucose transport from the bloodstream into skeletal muscles is mediated by glucose transporter (GLUT) proteins, particularly GLUT4. At rest and post-prandially, this process depends on the presence of

insulin and is generally impaired in T2DM. However, during exercise, muscle glucose uptake utilises a separate mechanism independent of the presence of insulin. Glucose delivery and uptake is further facilitated by increased blood flow to contracting muscles. Furthermore, exercise may acutely improve systemic insulin action, whereby muscle glucose uptake continues post-exercise through both the insulin-dependent and insulin-independent pathways (Colberg et al., 2010). Regular exercise has been shown to improve insulin sensitivity for at least 72 hours following the last bout of exercise. This implies that patient adherence to long-term regular exercise participation produces persistent physiological adaptations that improve insulin sensitivity, and this may be maintained despite periods of inactivity (Way et al., 2016).

Chronic effects of exercise

Glycaemic control. Regular exercise can promote better glycaemic control in diabetic individuals. All exercise training forms, be it aerobic, resistance, or combined training, can significantly reduce HbA1c, with combined exercise training having a greater effect than isolated forms of exercise (Rohling et al., 2016). Most of the benefits of exercise are likely due to the attenuation of insulin resistance which may be attributed to changes in several potential factors, including body fat mass, fat distribution, lean mass, and maximal aerobic performance. Aerobic exercise has been shown to increase the peak oxygen consumption (a measure of cardiorespiratory fitness), while resistance training contributes to increased muscle mass (Bacchi et al., 2012). While there has been debate on the effects of exercise on pancreatic beta-cells, animal and human studies have shown that exercise enhances beta-cell mass and function. This is important since impairment in beta-cell insulin secretion is fundamental to the pathogenesis of diabetes (Curran et al., 2020).

Cardiovascular disease and its risk factors. In addition to poor metabolic control, obesity is a major risk factor for cardiovascular disease (CVD). Most individuals with diabetes are found to be overweight or obese, which has led to the connotation 'diabesity' (Leitner et al., 2017). Individuals with diabetes generally find it more difficult to lose weight and/or maintain weight loss. Studies examining the effects of combined aerobic and resistance exercise interventions in individuals with T2DM and concurrent overweight/obesity demonstrated that combined exercise significantly decreased BMI, together with a decline in HbA1c and improved insulin sensitivity, with supervised longer-term interventions achieving the greatest benefits (Zhao et al., 2021). Nakanishi et al. (2020) found that total PA was significantly related to waist circumference and visceral fat accumulation, while BMI was positively related to sedentary time. This cross-sectional study highlighted the importance of both limiting sedentary time and increasing PA volume for the prevention of overweight/obesity in T2DM (Nakanishi et al., 2020).

Apart from overweight/obesity, T2DM is often associated with other CVD risk factors, including high blood pressure and dyslipidaemia. Evidence supports the role of exercise in improving systolic blood pressure and triglycerides, in addition to BMI and waist circumference, with combined aerobic and resistance exercise producing the greatest benefits (Chudyk and Petrella, 2011; Mannucci et al., 2021).

Several studies and meta-analyses have demonstrated the benefits of exercise on cardiac function (Anand et al., 2018), vascular function (Magalhães et al., 2019), and endothelial dysfunction which is consistently seen in T2DM and is recognised as an important factor in development and progression of microvascular and macrovascular complications (Qiu et al., 2018). The above findings support the role of exercise in reducing the risk of cardiovascular morbidity and mortality, both in terms of primary and secondary prevention (Martín-Timón et al., 2014).

Other diabetes-related complications. PA has been reported to be a significant protective factor against diabetic retinopathy (DR) (Trott et al., 2022) and DR progression in a dose-response relationship, such that individuals with higher PA levels demonstrated a further reduced risk of developing severe DR progression (Yan et al., 2021). Sedentary behaviour was found to be significantly associated with increased DR risk (Trott et al., 2022). Potential mechanisms underlying the reduced risk of DR with PA include alteration of retinal blood flow, better glycaemic control, alteration of 25-hydroxyvitamin D levels, and reduced oxidative stress and inflammation (Ren et al., 2019).

Exercise training can contribute to preventing and attenuating the progression of diabetic kidney disease (DKD). The plausible mechanisms explaining the relationship between exercise and DKD include improved glycaemic control, reduced renal injury and microalbuminuria, preserved renal function, preserved endothelial function, reduced inflammation and oxidative stress, and a beneficial effect on blood pressure and lipid profile in the context that disruptions in lipid metabolism may promote glomerular and tubulointerstitial injury (Amaral et al., 2020; Cai et al., 2021).

PA has also been shown to reduce the risk of diabetic foot complications. Exercises such as aerobic exercise and Tai Chi can improve nerve conduction velocity of the lower limbs and reduce overall distal latency. Additionally, exercise improves skin sensitivity and intraepidermal nerve fibre density, which can delay peripheral neuropathy, skin damage and ulceration. Exercise may also improve peripheral circulation and decrease peak plantar pressures, thus reducing foot ulcer risk and improving diabetic foot outcomes. Despite these findings, multi-disciplinary interventions including PA, diet, and foot care education demonstrated a higher impact with greater gains in nerve conduction velocity and a greater reduction in the long-term incidence of foot lesions (Matos et al., 2018).

PA precautions in T2DM

PA participation may lead to adverse events in certain individuals with T2DM, particularly exercise-related hypoglycaemia and hyperglycaemia (Kanaley et al., 2022).

Individuals on insulin and insulin secretagogues, namely sulfonylureas and meglitinides, are at an increased risk of exercise-induced hypoglycaemia, including later-onset hypoglycaemia which occurs when glycogen stores become depleted following longer duration, high intensity activity. Individuals on alternative treatment do not have such risk. On the contrary, performing a short, high intensity exercise bout at the end of a session has been shown to be beneficial in preventing hypoglycaemia in individuals not on insulin (Kanaley et al., 2022).

Hyperglycaemia may be worsened by exercise in insulin deficient and ketotic type 1 diabetics, although this is less common in T2DM (Colberg et al., 2010), except for individuals on oral sodium-glucose cotransporter-2 (SGLT2) inhibitors with euglycemia or only moderate hyperglycaemia who may experience diabetic ketoacidosis. Short, intense activities may transiently increase blood glucose following exercise, and this may be mitigated by extra insulin and/or lower intensity cool-down. Notwithstanding this, it is recommended for T2DM individuals with elevated blood glucose levels exceeding 16.7 mmol/L and without ketosis to only engage in PA if well-hydrated and asymptomatic (Kanaley et al., 2022).

Other considerations include the increased risk of heat-related illness due to impaired thermoregulation as well as increased risk of abnormal heart rate and blood pressure responses due to autonomic neuropathy; avoiding foot trauma and activities requiring excessive balance ability in the presence of peripheral neuropathy; avoidance of vigorous, high intensity activity in unstable proliferative and severe retinopathy; avoidance of any exercise in unstable or untreated proliferative retinopathy, recent

panretinal photocoagulation, or other recent surgical intervention; and avoiding activities which excessively raise blood pressure in individuals with nephropathy (Kanaley et al., 2022).

PA participation among T2DM individuals

While regular PA is recommended as part of the holistic management plan for individuals with T2DM, multiple factors may influence the level of adherence to PA, both internal and external factors, as will be highlighted in the coming paragraphs.

Adherence to PA recommendations

International epidemiology. In their systematic review, Kennerly and Kirk (2018) reported that, regardless of measurement method, data reported, or study location, adults with T2DM generally have low levels of PA and high levels of sedentarism. The proportion of this population meeting the recommendation of at least 150 minutes of moderate-to-vigorous activity per week ranges from approximately 9% using objective data to 15-61% in studies using the International Physical Activity Questionnaire (IPAQ) as a self-report measure of PA. Furthermore, studies report around 5.5 hours of sedentary time daily and approximately 70% of the waking day being spent in sedentary behaviour among T2DM adults (Kennerly and Kirk, 2018).

Studies using both subjective and objective methods of PA measurement and including an age-appropriate comparison group of persons without T2DM reported that individuals with T2DM tend to be less active than non-diabetic individuals. Furthermore, two of the three studies in this systematic review which compared PA levels among people with T1DM and T2DM found that individuals with T2DM had lower levels of PA, which may in part be due to the younger age of T1DM participants. Similarly, individuals

with T2DM were reported to have higher levels of objectively measured sedentary behaviour when compared with non-diabetic individuals (Kennerly and Kirk, 2018).

Local epidemiology. Data regarding self-reported diabetics from the results of the EHIS 2019/2020, which interviews a representative sample of the resident population of Malta and Gozo aged 15 years and over, indicates high levels of inactivity among the diabetic population.

In this survey, respondents were asked about their physical effort when performing work tasks, including both paid and unpaid work activities such as housework, on an average day. Among diabetic individuals aged 18-69 years, 60% reported spending most of their day sitting or standing, 28% said that their work activities consist mostly of walking or tasks of moderate physical effort, while only 2% reported physically demanding work which requires heavy labour. 10% reported not performing any working tasks at the time.

Respondents were asked about their participation in sports, fitness, or recreational PA at a moderate pace, that is, activities causing at least a small increase in breathing or heart rate, for at least 10 minutes continuously. Among diabetic adults aged 18-69 years, 85% reported never engaging in such activities and only around 9% reported engaging in moderate activities on at least three days per week. Furthermore, 95.5% reported never engaging in vigorous recreational physical activities that cause heavy breathing for at least 10 minutes continuously.

46% of diabetics aged 18-69 years reported going on leisure walks for at least 10 minutes continuously at least once per week. Such individuals spend on average around two hours per week on such activities. A higher proportion (75%) reported walking for at least 10 minutes continuously to get to and from places on at least one day in a typical

week. With respect to sitting and reclining time, diabetic adults spend on average 5.5 hours of sedentary time per day (K. England, personal communication, October 16, 2023).

A local study by Carabott Pawley (2020) sought to identify PA patterns among a sample of 104 T2DM individuals aged 18-69 years recruited from a local hospital and three primary healthcare centres. This was done using the IPAQ self-report measure combined with data from a smaller subgroup of seven participants using wearable accelerometers. Findings showed that 55.6% (n=56) of participants engaged in a high level of PA, 34.3% (n=34) engaged in a moderate level, and 10.1% (n=10) engaged in little or no PA when considering overall PA across the occupational, domestic, commuting, and recreational PA domains. The greatest contributor to the total amount of PA was housework among females and work in males. There was no significant difference between the self-reported PA levels and objective data on energy expenditure from the wearable device, although data for the average daily step count showed that participants were not active, implying that they may be leading a predominantly sedentary life. Furthermore, sedentary time was significantly underreported by participants. It must be noted that the sample utilised for collection of objective data (n=7) was small and not statistically robust to generate conclusions (Carabott Pawley, 2020).

Correlates of PA

It is likely that multiple factors play a role in influencing PA participation in individuals with T2DM, including personal factors such as age, co-morbidities and/or complications, as well as societal influences (Kennerly and Kirk, 2018). Age, gender, education level and income are demographic factors which have been found to influence PA participation among T2DM adults. Older age and female gender are associated with

less PA, while a higher socioeconomic status is associated with more PA (Heiss & Petosa, 2014). Smoking is an additional factor, such that every day smokers are less likely to adhere to PA recommendations compared with non-smokers (Martinez-Harvell et al., 2020). Overweight/obesity is associated with lower PA levels. Individuals who perceive themselves to be unhealthy or perceive their disease as serious are less likely to be active. Attitude towards PA and perceived barriers are important correlates of PA, such that negative attitudes and more barriers limit PA participation. Conceptually linked to barriers is self-efficacy, or perceived ability to overcome barriers, which is positively associated with PA, although adults with T2DM tend to have more negative attitudes and lower self-efficacy when compared with non-diabetic individuals. On the contrary, knowledge was not found to be correlated with PA, which indicates that it is rarely sufficient to promote behaviour change. Moreover, having a supportive environment in terms of adequate facilities and social support is known to contribute to more PA (Heiss & Petosa, 2014).

Models of behaviour change

Several theoretical models have been developed which endeavour to explain, predict, and influence behaviour. The Health Belief Model (HBM) was traditionally based on the concepts of perceived susceptibility or vulnerability, perceived severity of the condition, perceived benefits and barriers, together with health motivation which refers to the incentive to behave. The model posits that health-related action depends on the presence of sufficient motivation or health concern, the belief that one is susceptible to a health problem or its sequelae, and the perceived benefit of adopting a particular health action at an acceptable cost, whereby cost refers to the barriers to action. Cues to action, which may be internal, for example symptoms, or external, such as health

education, act as a trigger and also predict health behaviour. Furthermore, demographic variables, socio-psychological characteristics, and structural variables may affect an individual's perceptions and indirectly influence behaviour (Janz & Becker, 1984; Rosenstock et al., 1988).

The HBM is closely related to Bandura's Social Cognitive theory (SCT). The latter theory holds that behaviour is determined by expectancies and incentives. Expectancies refer to beliefs about environmental cues (similar to the HBM concept of perceived threat), opinions about the consequences of one's actions (outcome expectation; similar to the HBM concept of perceived benefits minus the barriers to action), and expectancies about one's own capability of performing a given behaviour needed to produce an outcome (efficacy expectation or self-efficacy). Incentive, or reinforcement, refers to the value an individual places on an outcome, which may be health status, physical appearance, or other consequences. This is similar to the HBM concept of health motive (Rosenstock et al., 1988).

An important aspect unique to the SCT is the concept of self-efficacy, which has received much recognition in relation to behaviour change. In individuals living with chronic illnesses such as diabetes, complex lifestyle changes are required, including modifying exercise habits. In order to succeed and before successful interventions are possible, individuals do not only require incentive or health motivation, perceived threat of the illness, and perceived benefit in relation to the barriers, but require enhancement of their confidence in the ability to implement the necessary behaviour change, that is, self-efficacy (Rosenstock et al., 1988).

Health beliefs determine the degree to which patients follow advice on self-care behaviours in diabetes. Patients are motivated to carry out self-care behaviours by their perceptions on the likelihood that adverse events will occur, perceived impact on their

everyday activities, perceptions of the effectiveness of preventative and treatment strategies, and personal control (Harvey and Lawson, 2009). The concept of self-efficacy is also associated with self-care behaviours. A local study among adults over 50 years of age with T2DM, based on the Theory of Planned Behaviour, showed that perceived behavioural control, which may be regarded as equivalent to self-efficacy, was the most predictive of behavioural intent and self-care behaviour. In fact, participants were found to be least confident with exercise and this was the self-care activity least performed by the participants (Gatt & Sammut, 2008). Reiff (2015) sought to explore the relationship between self-efficacy, self-care, and diabetic outcomes in persons aged 18 years and over with T2DM living in Malta. The findings showed that, even though respondents reported high levels of self-efficacy, the latter was not correlated with higher levels of exercise. In fact, exercise self-care was low, even in individuals with high self-efficacy, suggesting the existence of additional barriers which hinder diabetic individuals from undertaking sufficient PA (Reiff, 2015).

Systematic review of studies exploring the knowledge and perceptions towards PA among diabetic adults

A systematic literature search was conducted to look for studies exploring the knowledge and perceptions towards PA, in particular barriers and enablers towards PA participation, among adults living with T2DM.

Methodology

Search strategy. The research question was split into three search concepts: type 2 diabetes mellitus; physical activity; and knowledge, barriers, and enablers. The search string comprised free text terms and subject headings, where applicable. This was initially

developed in PubMed (Appendix A) and then adapted to the other databases which were considered relevant to the research topic and were thus used for the search, namely CINAHL Complete, Scopus, and Cochrane Database of Systematic Reviews. A search for grey literature was conducted in Google search and relevant websites. The Malta Medical Journal and the University of Malta library's institutional repository were searched for local studies. Additional relevant material was identified by screening the bibliography of articles included in the search.

Eligibility criteria. The search was limited to material published in English and from 2010 onwards, although relevant earlier publications were also considered. This date limit was set as the first global recommendations on PA were published by the WHO in 2010 (WHO, 2010). In the same year, the American College of Sports Medicine and the American Diabetes Association released a joint position statement with evidence-based recommendations on optimal PA levels in T2DM and emphasised the importance of identifying predictors of PA participation among such individuals to encourage them to meet recommendations (Colberg et al., 2010). Furthermore, the date restriction ensured that the findings were relevant to current practice. Table 2 outlines the inclusion and exclusion criteria applied.

Table 2

Inclusion and exclusion criteria applied to the search strategy

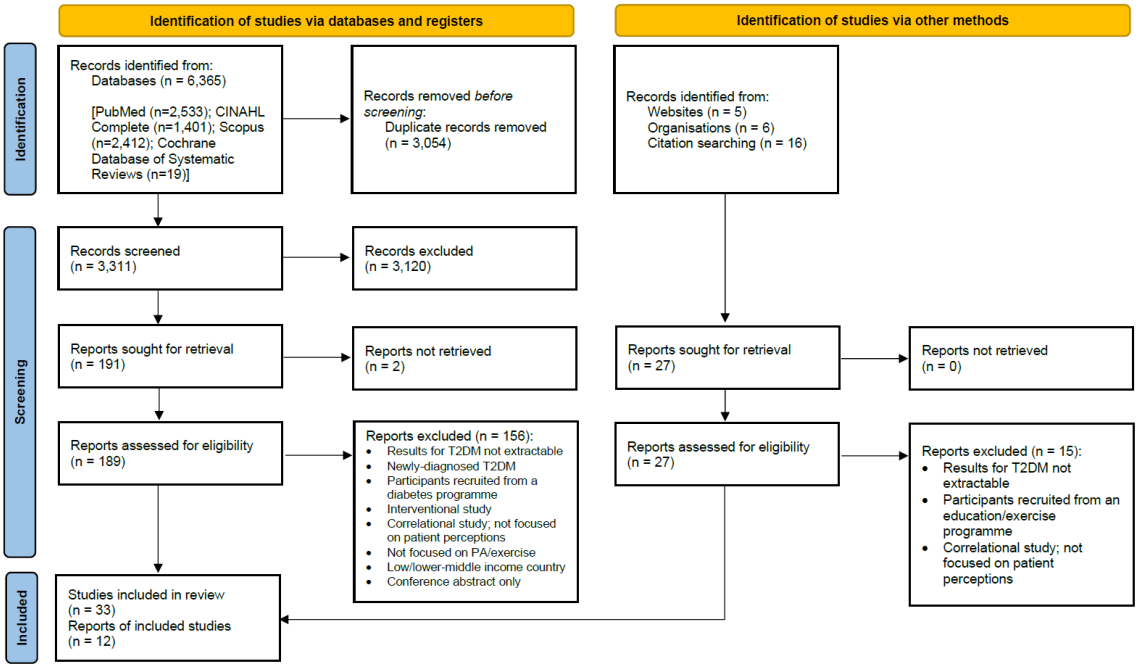
Inclusion criteria
• Material published in the English language • Material published between January 2010 and November 2022 • Studies published from the year 2000 onwards were included in bibliographic searching • Studies focused on type 2 diabetic adults • Studies focused explicitly on the knowledge, perceptions, and/or barriers and enablers towards physical activity/exercise

• Studies focused on any form of physical activity/exercise, but not prescribed exercise therapy or individual sports • Observational studies including quantitative and qualitative research and mixed methods research
Exclusion criteria
• Studies which dealt exclusively with diseases other than diabetes mellitus and with types of diabetes other than type 2, such as type 1 diabetes mellitus, gestational diabetes, and pre-diabetes • Studies among newly-diagnosed type 2 diabetic individuals • Studies which solely examined the views of healthcare professionals in relation to PA among their diabetic patients • Studies focused solely on children and/or adolescents • Studies conducted in low and lower-middle income countries, as defined by the World Bank (The World Bank, n.d.) • Feasibility studies or studies describing study protocol only • Interventional studies or studies conducted on patients recruited from an exercise or education programme • Correlational studies which do not explore the participants' perceptions • Systematic reviews • Only conference abstract available

Screening process. 6,365 articles were identified through database searching, together with a number of studies from other sources. After removing duplicates and screening according to the eligibility criteria, a total of 45 studies were deemed eligible for inclusion in the systematic review, as shown in the PRISMA diagram in Figure 1. A summary of included studies is presented in Appendix B.

Figure 1

PRISMA flow diagram showing the selection process of search results. Source: (Page et al., 2021)



Results

Knowledge and perceived benefits of PA. A number of studies examined the perceived benefits of PA among T2DM individuals. Some participants recognised the benefits on their well-being and perceived PA as providing them with more energy, reducing stress, helping them feel better through endorphin release, and providing them with a sense of accomplishment (Vanden Bosch et al., 2021; Whipple et al., 2019). Some participants felt that exercising helps them sleep better at night, and this was one of the most highly rated exercise benefit items (Hsu et al., 2021).

Perceived benefits related to the individuals' health status included the perception that PA improved their physical health, mobility and flexibility, physical endurance, and muscle tone, and reduced the risk of heart disease (Dye et al., 2003; Hsu et al., 2021; Whipple et al., 2019). Additionally, in the study by Hsu et al. (2021), the belief that

participants will live longer if they exercise was also one of the most highly rated benefit items. Awareness of the impact of PA on weight loss was demonstrated in two studies among women with T2DM (Miller & Marolen, 2012; Vanden Bosch et al., 2021).

Several studies assessed knowledge and awareness of the benefits of PA in the management of diabetes. The majority of subjects recognised the importance of PA (Al-Kaabi et al., 2009; Dutton et al., 2005; Dye et al., 2003), although one study revealed how few participants acknowledged that PA was fundamental to their diabetes self-care, and this was attributed to the vague and non-specific guidance received from their healthcare providers (Peel et al., 2010). Similarly, Okonta et al. (2014) reported that 92.1% of participants demonstrated poor knowledge of the benefits of exercise and weight loss; however, the vast majority of participants either had no formal education or had achieved primary school education. Most participants were aware that PA positively impacts their blood glucose level (AlKhudidi et al., 2021; Che et al., 2022; Ganiyu et al., 2013; Vanden Bosch et al., 2021). Peter et al. (2022) also demonstrated that, while over half of respondents were aware that regular exercise can improve blood glucose, 35.6% believed that weight control also plays a role. Furthermore, almost all participants in the study recognised that engaging in exercise (94.6%) and controlling one's weight (94.5%) is important (Peter et al., 2022). Chadchavalpanichaya and Intaratep (2010) went a step further to examine different aspects of exercise knowledge among T2DM individuals. Again, most participants were aware of exercise benefits, namely improving cardiorespiratory fitness, reducing stress, strengthening muscles, enhancing lipid, blood pressure, and diabetic control, improving gastrointestinal function, and preventing osteoporosis, with the least recognised benefit being that exercise can increase endorphin release (Chadchavalpanichaya and Intaratep, 2010).

Preventing diabetes-related complications through PA was also mentioned (Dutton et al., 2005). These results were mirrored in the study by Vilafranca Cartagena et al. (2022) whereby all participants believed that once diagnosed with T2DM, PA is key in improving the disease's prognosis. All participants in this study were aware of the psychological and physiological benefits of PA; however, most participants had no or very limited knowledge of sedentarism and how to avoid it (Vilafranca Cartagena et al., 2022).

Despite recognition of the various health benefits attributed to PA among most individuals with T2DM, Gordon and Nelson (2019) demonstrated that the mean percentage score on knowledge of the benefits of exercise among persons with T2DM was 64.4%, suggesting some deficit and the need for more education. In another study, level of PA knowledge was assessed by asking participants about their understanding of PA benefits, health benefits with respect to diabetes, and PA as part of diabetic treatment. The average knowledge score was 12.85 +/- 3.46 out of 20, suggesting that participants could correctly answer more than half of questions. Participants lacked knowledge of how to exercise to achieve health benefits, particularly the benefits which may be gained from resistance training (Hui et al., 2014).

When assessing the results by socio-demographic characteristics, participants with higher educational level were found to have higher PA knowledge scores (p-value <0.05), although no significant differences were observed according to gender, age group, BMI category, smoking status, income, and marital status (all p-value >0.05) (Hui et al., 2014). AlKhudidi et al. (2021) found that participants who were educated and those who were married were more aware of the positive impact of exercise and diet on blood glucose control. Similarly, in another study, the good knowledge of lifestyle modification

practices among participants was partly attributed to higher-than-expected literacy levels, as most had completed at least secondary school training (Peter et al., 2022).

Review of the literature demonstrated varying results when it comes to knowledge of PA recommendations. Hui et al. (2014) found that 72.5% of participants were aware that patients with T2DM should be physically active on at least five days per week, although Chadchavalpanichaya and Intaratep (2010) reported that only 50.5% of respondents in their study knew the proper frequency of practising aerobic exercise, while just over 60% knew the proper duration and intensity. In the study by Peter et al. (2022), participants were asked for how long patients with DM should exercise daily; the majority (61.2%) believed that this should be done for at least 30 minutes per day, 11.6% responded less than 30 minutes daily, 6.8% stated less than 15 minutes daily, and 20.4% did not know.

Among the included studies in this review, only one study assessed knowledge of abnormal symptoms related to exercise, with worrying findings. Chadchavalpanichaya and Intaratep (2010) showed that awareness that severe leg pain should prompt cessation of exercise was only present among 70% of respondents. Participants also lacked knowledge of hypoglycaemia symptoms, including dizziness, hunger, and sweating, with less than 70% being aware of such symptoms (Chadchavalpanichaya and Intaratep, 2010).

Barriers to PA participation. The following section describes the findings from the literature regarding barriers to PA in diabetic adults. The results are heterogeneous due to the different ways of evaluating barriers and social and cultural factors that influence them (Martin et al., 2021). The most frequent barriers which were repeatedly cited can be grouped into four themes:

Negative attitude towards PA. Esteves et al. (2019) reported that participants perceived exercise as providing few benefits, while some even viewed exercise as potentially exacerbating their condition. Some reported a lack of information on exercise benefits and how it should be undertaken (Che et al., 2022; Ganiyu et al., 2013). Two studies reported how participants perceived medication as the most important component in the management of their condition, despite advice by their general practitioners to engage in PA (Albuquerque et al., 2021; Lanhers et al., 2015). Lack of skills was also cited as a barrier in three studies (Alghafri et al., 2017; Alzahrani et al., 2019; Martin et al., 2021).

Lack of enjoyment of activity and lack of interest were also commonly cited as barriers (Al-Kaabi et al., 2009; Chadchavalpanichaya & Intaratep, 2010; Whipple et al., 2019; Zavala et al., 2022), with the latter more commonly reported by diabetic compared with non-diabetic individuals (Esteves et al., 2019).

Fear of injury, including fear of falling, was commonly cited as a barrier (Alghafri et al., 2017; Alzahrani et al., 2019; Bruce et al., 2015; Martin et al., 2021; Vanden Bosch et al., 2021; Whipple et al., 2019). Fear of falling with subsequent activity restriction was found to be more common among diabetic compared with non-diabetic individuals, which may be due to balance and mobility impairments, as well as obesity, diabetes-related complications, and depression (Bruce et al., 2015). Fear of injury was highly scored by older adults, those who were unemployed or uneducated, and those who reported being in the inactive stage of PA (Alghafri et al., 2017).

Fear of exercise-related hypoglycaemia was not commonly mentioned among the included studies, with Lanhers et al. (2015) reporting that this was the lowest rated barrier among T2DM individuals. Drummond et al. (2022) assessed perceived barriers to PA in older adults living with T1DM and T2DM and noted that the fear of hypoglycaemia was

more commonly reported by T1DM individuals. Fear of hypoglycaemia was cited as a barrier in the study by Vanden Bosch et al. (2021) among middle-aged women with T2DM. The authors noted that the contrast with previous findings that hypoglycaemia was not an exercise deterrent could be explained by differences in gender and treatment modality, whereby most participants in this study took oral medications or insulin (Vanden Bosch et al., 2021). Akinci et al. (2019) compared reasons for inactivity among T2DM individuals on oral hypoglycaemic agents and those who were also on insulin and reported that the distinctive barrier to PA was the experience of hypoglycaemia in the group on insulin (30.8% reported this barrier). The perception of diabetes itself being a limitation to performing PA was reported by one study, albeit being the least commonly mentioned barrier in the study. The uncommon perception of diabetes acting as a barrier may be due to the fact that the disease can be asymptomatic for many years and that the risk of hypoglycaemia is generally low in many T2DM patients (Martin et al., 2021).

Discouragement. Lack of willpower, lack of energy, and lack of time were strongly related to low personal motivation to perform PA (Martin et al., 2021). Lack of willpower, energy, and a lack of motivation were reported as barriers to PA by numerous studies (Alghafri et al., 2017; Alzahrani et al., 2019; Dye et al., 2003; Chadchavalpanichaya & Intaratep, 2010; Drummond et al., 2022; Martin et al., 2021; Nor Shazwani et al., 2010; Vanden Bosch et al., 2021; Whipple et al., 2019; Zavala et al., 2022). Negative emotions can also negatively influence enthusiasm and motivation, even among individuals who routinely exercise (Che et al., 2022). Miller and Marolen (2012) and Peel et al. (2010) described how study participants described themselves as being lazy, while Zavala et al. (2022) reported how some participants preferred sedentary activities.

Lack of time is an important barrier to performing PA and was the most encountered barrier among the included studies (Akinci et al., 2019; Alghafri et al., 2017; Alzahrani et al., 2019; Al-Kaabi et al., 2009; Chadchavalpanichaya & Intaratep, 2010; Drummond et al., 2022; Gordon & Nelson, 2019; Hsu et al., 2021; Kang et al., 2021, Martin et al., 2021; Nor Shazwani et al., 2010; Peter et al., 2022; Zavala et al., 2022). Hsu et al. (2021) found that the highest rated barriers among study participants were that exercise takes too much time in general and takes too much time from family responsibilities and relationships. Furthermore, participants also mentioned that being in certain stages of their life affected their PA participation due to competing priorities, namely continuing education, work, and family demands. The latter was pronounced among females (Che et al., 2022; Miller & Marolen, 2012; Vanden Bosch et al., 2021) and older adults who were grandparents (Scavarda et al., 2023).

Lack of companionship was cited as a barrier in five studies (Chadchavalpanichaya & Intaratep, 2010; Drummond et al., 2022; Duclos et al., 2015; Ganiyu et al., 2013; Peter et al., 2022). Moreover, lack of social support or emotional support from the spouse/partner, friends, or family members was identified as a barrier to performing PA by several studies (Alghafri et al., 2017; Alzahrani et al., 2019; Ganiyu et al., 2013; Gordon & Nelson, 2019). Beverly and Wray (2010) sought to explore the individual and spousal experiences of adhering to exercise, given that this often requires changes in established marriage routines. Lack of motivation was the most mentioned barrier for couples attempting to incorporate exercise into their daily management. Individuals with T2DM acknowledged differences in viewpoints and discordant beliefs towards exercise between themselves and their spouses. Additionally, although participants recognised that exercise was not only the responsibility of the individual with diabetes, not all spousal involvement was appreciated. Men were more likely to report

feeling that their spouses' reminding, encouraging, or urging interfered with their ability to manage their condition (Beverly & Wray, 2010).

Physical problems and health concerns. Physical limitations emerged as important barriers. Pain hindering from PA participation, including pain from knee or hip arthritis, was cited by several studies (Akinci et al., 2019; Al-Kaabi et al., 2009; Peel et al., 2010; Vanden Bosch et al., 2021; Vilafranca Cartagena et al., 2022; Whipple et al., 2019). In the study on adults with and without T2DM by Felix et al. (2017), over half (56.6%) of participants with T2DM reported experiencing pain when walking for more than five minutes, with a significant difference between those with and without T2DM.

Health-related issues were cited as barriers in several studies, particularly those involving middle-aged and older adults (Che et al., 2022; Drummond et al., 2022; Dye et al., 2003; Kang et al., 2021; Scavarda et al., 2023; Vanden Bosch et al., 2021; Wanko et al., 2004; Zavala et al., 2022) and among those with co-morbidities and diabetes-related complications (Nor Shazwani et al., 2010). Esteves et al. (2019) compared exercise barriers between diabetic and non-diabetic individuals, with the most significant finding being that diabetic individuals were more likely to perceive exercise as not being suitable for their health, and even perceived exercise as potentially dangerous. Furthermore, some participants mentioned not feeling healthy enough and having poor health (Chadchavalpanichaya & Intaratep, 2010; Peter et al., 2022). In the study by Akinci et al. (2019), participants mentioned experiencing stiffness, fatigue, and dyspnoea during PA as some of the reasons for their inactivity. Three studies examined barriers using the Exercise Benefits/Barriers scale (EBBS) and found that fatigue, tiredness, and exercise being perceived as hard work were highly rated barriers (Gordon & Nelson, 2019; Hsu et al., 2021; Whipple et al., 2019). Similarly, Lanhers et al. (2015) reported a low fitness

level, fear of being tired, and physical health status as the highest rated barriers. Low fitness and negative self-image were cited as the most prominent barriers in one study among active and inactive patients, and these were particularly reported by inactive patients who were more likely to be obese (Duclos et al., 2015).

Environmental factors. Various factors related to the external environment were identified as barriers to PA. These include lack of accessibility in terms of transportation, timing, and safety, lack of resources in terms of high cost and limited facilities, and adverse weather conditions (Akinci et al., 2019; Alghafri et al., 2017; Alzahrani et al., 2019; Che et al., 2022; Drummond et al., 2022; Esteves et al., 2019; Ganiyu et al., 2013; Hsu et al., 2021; Lanhers et al., 2015; Martin et al., 2021; Peter et al., 2022; Vanden Bosch et al., 2021; Whipple et al., 2019; Zavala et al., 2022).

Scavarda et al. (2023) provided a qualitative insight of how physical and social elements of the urban environment may encourage or hinder treatment adherence of older adults living in a deprived neighbourhood in Italy. Physical elements of the environment, such as poorly maintained parks and green areas as well as poorly managed pavements and roads which made them feel unsafe, limited participants' engagement in PA. Participants also stressed the importance of social cohesion and networks in helping them to engage in activities, with most participants complaining about the lack of social participation opportunities and cultural activities (Scavarda et al., 2023). Although the study was set in a specific neighbourhood, these findings may probably be applied to similar environments in other countries, including locally.

Specific populations. Two studies sought to identify barriers to PA practice among overweight and/or obese T2DM individuals. Lidegaard et al. (2016) studied

barriers among overweight/obese individuals with varying co-morbidities. Poor physical condition was a prominent barrier, whereby participants claimed that they felt restricted by their medical problems and highlighted the need for professional guidance due to a lack of confidence and knowledge on how much and what type of exercises were suitable for them (Lidegaard et al. 2016). Other striking findings included physical discomfort particularly among older adults and those with a higher BMI, depression, negative past experiences, and embarrassment about their physical appearance, with unmarried and female patients more likely to report embarrassment as a major barrier (Egan et al., 2013). The latter finding was reiterated in the study by Vanden Bosch et al. (2021) who reported embarrassment, poor body image and lack of self-confidence due to being overweight or obese as barriers to PA in middle-aged women with T2DM.

A number of studies assessed PA perceptions among minority, ethnic, low-income groups. Unique findings included barriers related to gendered norms, social rules, and cultural expectations and pertained more to women. Lack of time due to a strong work ethic and family obligations was prominent, whereby participants claimed that their dedication to their families is within their culture. Women claimed that they were expected to stay indoors and attend to domestic chores, this combined with a feeling of vulnerability if they were to go out due to lack of familiarity with their neighbourhood. Women also mentioned the lack of culturally sensitive facilities, particularly single-sex facilities. Some participants blamed external factors for their condition, believing that they had little control over their health. Some studies mentioned health-related limitations as major barriers, as well as unsafe neighbourhoods and lack of access to nearby facilities (Cooper et al., 2015; Dutton et al., 2005; Lawton et al., 2006; Mier et al., 2007; Wanko et al., 2004).

Enablers of PA participation. T2DM adults who successfully adopted PA practices explained how being diagnosed with a chronic condition created negative affective responses, which together with inspiration and guidance from others with T2DM, influenced their decision to take up PA. Setting achievable, behaviour-oriented goals and monitoring short-term biological, psychological, and affective gains were key to adopting PA. Sustained PA maintenance was motivated by enjoyment and the accrued benefits of PA, as well as habit and a new sense of identity and belonging to a PA community (Blicher-Hansen et al., 2022).

***Positive attitude towards PA*.** Motivation and self-confidence were identified as important motivators to take up PA among middle-aged women with T2DM (Vanden Bosch et al., 2021). When it comes to adaptation and maintenance of PA, Vilafranca Cartagena et al. (2022) reported that once participants had acquired the habit of engaging in PA, they felt the need to do so, even if conditions were not favourable. Additionally, some participants did not perceive that major changes to their lifestyle were required for them to start or increase their PA and this allowed them to adhere to their activity (Vilafranca Cartagena et al., 2022). Furthermore, Lidegaard et al. (2016) found that goal setting and self-tracking acted as motivating factors in overweight/obese T2DM individuals, in that observing improvement in health parameters increased their motivation. In line with this, Miller and Marolen (2012) found that underactive women also recognised their health responsibility and autonomy as motivating factors, irrespective of their physician's advice.

Enjoyment of the activity was identified as a motivating factor by three studies (Nor Shazwani et al., 2010; Vanden Bosch et al., 2021; Whipple et al., 2019). Feasibility of the exercise regimen and having sufficient skills to engage in PA were also found to

influence the level of adherence to PA (He et al., 2013). Older adults explained how building self-efficacy requires starting with small steps that one feels capable of doing and this helps to build the mindset and willpower to exercise (Dye et al., 2003).

Consistent with the finding that lack of time was a commonly encountered barrier, underactive women reported how fewer competing priorities or better management of such priorities would allow them more time to be physically active (Miller & Marolen, 2012).

Encouragement. Social support, including the support of family and friends and the presence of positive role models, was recognised as an important motivator in numerous studies (Che et al., 2022; He et al., 2013; Miller & Marolen, 2012; Vanden Bosch et al., 2021; Whipple et al., 2019). Participants explained how family members, friends, and healthcare professionals encouraged them to change their lifestyle (Vilafranca Cartagena et al., 2022). Family was not only considered as a source of support but a critical motivator as participants wanted to be as healthy as possible to be able to take care of their family (Mier et al., 2007). Social support can also refer to simply having company to exercise with, particularly as this acts as a source of commitment and interaction with others (Lidegaard et al., 2016).

Beverly and Wray (2010) explored the couple relationship in diabetes management and found that spousal support was a crucial element when encouraging persons with diabetes to adopt and maintain exercise. Although not all couples shared a collective motivation to exercise, some participants mentioned finding motivation through identifying shared goals and positive outcome expectations. This study, which was conducted in the United States of America, did not address cultural and social

variations regarding marital roles, diabetes beliefs and management among varied ethno-cultural groups, which limits its generalisability (Beverly & Wray, 2010).

The role of the physician in providing reassurance on potential health issues and their involvement and interest emerged as an important motivator in both active and inactive patients (Duclos et al., 2015). The level of adherence to PA can be influenced by the type of communication between patients and their healthcare professionals. The more respect health professionals show to patients, the more likely it is that they would follow the proposed advice. Collaborative health communication, with consideration of the patients' own preferences and opinions, acted as a motivator to PA participation among some participants (He et al., 2013). Similarly, in the study by Miller and Marolen (2012), underactive women reported a desire for praise and encouragement for their behavioural efforts in lieu of the advice that they so often received. Older adults identified how physicians' advice, including consideration of their feelings, and supervision at exercise facilities would act as motivators (Dye et al., 2003).

Health benefits. Many participants were motivated by the perceived or observed health benefits of PA in terms of maintaining or improving their health, promoting a better physical sensation and sense of well-being, reducing stress, gaining energy, observing an improvement in clinical indicators such as better glycaemic control, as well as the fear of developing complications (Dye et al., 2003; He et al., 2013; Lidegaard et al., 2016; Mier et al., 2007; Vanden Bosch et al., 2021; Vilafranca Cartagena et al., 2022). Willingness to be healthy and the realisation of the importance and health benefits of PA motivated participants (Che et al., 2022; Nor Shazwani et al., 2010). In one study, participants described how the fear and dislike of having to inject themselves if their condition

progressed to require insulin was motivating, together with the avoidance of stigma around injecting (Lawton et al., 2006).

Environmental factors. Environmental factors which were cited as PA enablers included factors related to the natural environment such as weather conditions (He et al., 2013) and those related to the built environment in terms of accessibility and convenience of opportunities to engage in exercise (Whipple et al., 2019). In the study by Vilafranca Cartagena et al. (2022), most participants reported how walking is an accessible, cost-free activity that persons can perform at their convenience. However, this study was conducted in a rural region of Catalonia (Spain), thus the findings may not be transferable to the local context. Similarly, Peel et al. (2010) revealed how walking was the one activity that some participants successfully adopted and maintained, and owning a dog played a vital role in this as it provided an extrinsic incentive for those who lacked the intrinsic motivation to exercise.

Local studies. Two studies explored the knowledge of PA among T2DM individuals recruited from primary healthcare. Cutajar (2008) reported that 54% of participants did not know the amount of PA they should engage in, although over 75% were found to engage in PA of adequate frequency and duration. In the small-scale study by Baldacchino (2012), participants seemed to be aware of the importance of exercise regularity for managing diabetes and reducing the need for diabetic medications, with half of participants (n=10) recognising exercise as a way to manage their diabetes.

Two qualitative studies assessed self-care practices among T2DM individuals and identified some barriers and enablers to PA. Participants who were not active from a young age experienced difficulty in adjusting their lifestyle and lacked motivation to

exercise (Fonk, 2021). Adults over the age of 69 years expressed apathy and disinterest in the role of PA in diabetes, especially those who were inactive and had poor glycaemic control. Among those who walked daily, the psychological benefits, such as feeling calm and relaxed, motivated them to do so (Duncan, 2016). Barriers to PA included medical conditions such as asthma, cardiac conditions, osteoarthritis, foot and back pain, cancer, and fatigue, as well as environmental factors including inadequate spaces, unsafe roads, and adverse weather conditions (Duncan, 2016; Fonk, 2021). Family was identified as a prominent source of support for adherence to diabetes self-management, including PA (Baldacchino, 2012; Duncan, 2016; Fonk, 2021).

Conclusion

Adults with T2DM generally have low levels of PA and high levels of sedentarism. Knowledge about PA varied among different studies, which may be attributed to the different educational status of participants. Barriers to PA among T2DM individuals include negative attitude, discouragement, and poor body image and lack of self-confidence among overweight/obese individuals. Health-related factors limit PA, while at the same time, the benefits associated with PA encourage some individuals to be active. Additional enablers include positive attitude and external factors, namely the environment and support from family, friends, and health professionals, with the absence of these being highlighted as barriers in some studies. Diabetes-related barriers were not prominent, with only two studies reporting fear of exercise-related hypoglycaemia.

Local studies demonstrated a deficit in the areas of PA knowledge and self-care and were of a small scale. These findings underpinned the motivation behind this study and the overall aim of attempting to identify predictors of PA participation in further depth to be able to propose recommendations aimed at counteracting the high levels of

physical inactivity and overweight/obesity in Malta. To this end, several hypotheses were formulated to be tested in this study:

- There is no significant association between age and PA level
- There is no significant association between gender and PA level
- There is no significant association between PA level and overweight/obesity
- There is no significant association between PA level and HbA1c
- There is no significant association between duration of DM and PA level
- There is no significant association between knowledge and PA level
- There is no significant association between barriers and PA level

The international literature presented in this chapter demonstrated significant associations between PA level and socio-demographic characteristics, metabolic and glycaemic markers, and barriers to PA, while knowledge was not found to be significantly associated with PA. The results of this locally based study will confirm, or otherwise, these findings and will also help to identify at-risk groups for future interventions.

Materials and Methods

Introduction

This chapter describes the materials and methodology utilised to conduct this study. The sections in this chapter outline the research approach and design, the study population and sampling methodology, the process of developing the research instrument, as well as data management and ethical considerations.

Research approach

A quantitative research approach was chosen for this study. Quantitative research involves the use of formal instruments to collect and generate numeric information which can be analysed using statistical procedures to examine the relationship among variables and test objective theories (Creswell & Creswell, 2018). The literature review demonstrated that the research topic chosen for this study has been studied by means of both qualitative and quantitative research. The purpose of this study was to test a number of hypotheses and a quantitative, deductive research approach was deemed as the most appropriate way to do so.

Research design

A cross-sectional survey was carried out between March and August 2023. Data was collected using a paper-based questionnaire which was distributed to T2DM individuals attending diabetes clinics. This mode of administration was chosen to enable the researcher to collect measurements of the participants' weight, height, and waist circumference, which were additional variables studied. This would not have been possible through a postal, telephone, or online survey. While distributing the questionnaires in-person required more time and effort, this option allowed for a better

response rate and ensured that no subgroups were excluded. Although the questionnaire was developed to be self-administered, the researcher was physically present to offer assistance to all participants without prejudice, ensuring that individuals unable to complete the questionnaire, such as those who are illiterate, would still be represented.

Sampling and Recruitment

Study population

The population of interest consisted of persons with T2DM aged 18 to 69 years attending the diabetes clinics of the two main local public hospitals, namely Mater Dei Hospital (MDH) and Gozo General Hospital (GGH), and three Primary HealthCare (PHC) centres, namely Mosta, Floriana, and Paola health centres. This specific age limit was chosen since the tool measuring PA participation was designed and validated in young and middle-aged adults up to 69 years of age (IPAQ, 2022). Measurement of PA levels in older adults beyond this age range would have necessitated the use of separate tools.

Sample size and sampling method

Due to logistical and time constraints, it was not feasible to include the entire population with T2DM aged 18 to 69 years and residing in Malta and Gozo (the target population) in this study. Also, since no national diabetes register exists that would record all diabetic patients living in Malta and Gozo, it was not possible to obtain a representative sample from such a register. Thus, the study population which was assumed to be representative of the target population consisted of diabetic patients attending outpatient diabetes clinics within the public sector, specifically at MDH, GGH, and three health centres within PHC.

Considering a 95% confidence level, the sample needed to have a confidence interval of +/- 5% was of 384 respondents. In order to obtain as representative a sample of the diabetic population as possible, the sample was weighted in such a way to reflect the population distribution between Malta and Gozo. Thus, the study population was divided into two cohorts: a sample population for Malta and that for Gozo, based on the size and distribution of the general population aged 18 to 69 years residing in Malta and Gozo. This information was obtained from the Census of population and housing in the Maltese Islands carried out in 2021. Within this age group, for every one person living in Gozo (and Comino), approximately 12.5 individuals live in Malta (National Statistics Office [NSO], 2023). Thus, it was calculated that 356 participants would be required from Malta, whilst 28 participants would need to be recruited from Gozo. The sample population for Malta was then split equally between participants recruited from MDH and those recruited from the PHC department. The latter population was further split between the three major health centres in Malta, namely Mosta, Floriana, and Paola health centres, chosen to represent the northern, central, and southern regions of Malta, respectively.

Consecutive sampling was then applied to recruit all individuals from the accessible population attending the diabetes clinics at MDH, GGH, and PHC.

Inclusion and exclusion criteria

The inclusion and exclusion criteria are summarised in Table 3.

Table 3

Inclusion and exclusion criteria

Inclusion criteria
Individuals with a history of T2DM for at least 12 months Individuals attending a follow-up appointment at the clinic (not a new case visit) Individuals aged between 18 and 69 years

Individuals who have lived in Malta or Gozo for the past 12 months
Exclusion criteria
Individuals having a diagnosis of diabetes other than T2DM Pregnant individuals Individuals with mobility impairment hindering them from physical activity Individuals unable to communicate in Maltese or English Non-consenting individuals

Response rate

To calculate the response rate, all eligible individuals who attended the clinics on the days when the researcher was present and were given the opportunity to participate were counted and used as the denominator. The number of individuals who were approached and accepted to participate in the study was used as the numerator.

Research instrument

A questionnaire was compiled by the researcher to collect primarily quantitative data, keeping in mind the aim and objectives of the research project. The questionnaire tool was translated into the Maltese language, tested for validity and reliability, and then piloted.

Development of the research tool

The questionnaire used in the study was compiled by the researcher and was predominantly based on validated tools from the literature. Three tools that measured the level of PA and the perceived benefits and barriers to PA formed the basis of the research instrument and are described below.

Level of PA: The International Physical Activity Questionnaire (IPAQ) was used to measure engagement in moderate and vigorous physical activities, walking, and sitting time over the previous seven days (IPAQ, 2022). The IPAQ was developed between 1997

and 1998 by an International Consensus Group with the intention of creating a self-report measure of PA suitable for population surveillance of PA across countries. The long version of the instrument collects detailed information on PA levels within the domains of occupation, household, transportation, and recreation, as well as sitting time. The short version collects information on PA levels and time spent walking and sitting across all domains. The IPAQ instruments underwent rigorous reliability and validity testing in 14 centres across 12 countries in 2000 and demonstrated measurement properties which are comparable to other established self-reporting tools. The IPAQ was targeted at young and middle-aged adults, hence measurement properties of this tool in adolescents and older adults are unknown (Craig et al., 2003). In fact, the IPAQ is recommended for use among adults aged 15 to 69 years (IPAQ, 2022). The IPAQ short form was deemed more suitable for this study as the focus of the study was not to solely evaluate PA levels in detail across different domains. Adopting the longer version would have resulted in participants potentially omitting the subsequent questions on PA benefits and barriers due to a lengthy questionnaire, thus failing to achieve the aim of this study. Furthermore, Craig et al. (2003) reported that the short form is feasible to administer and demonstrated no differences in reliability and validity from the long IPAQ form. The IPAQ tool is publicly available, open access, and no permissions were required to use it.

Perceived benefits and barriers to PA: The Exercise Benefits/Barriers Scale (EBBS) is a 43-item tool containing two sub-scales, a 29-item benefits scale and a 14-item barriers scale. A four-point forced-choice Likert scale determines the strength of agreement with statements related to exercise benefits and barriers. The EBBS has been tested for internal consistency, construct validity, and test-retest reliability. Content validity of the tool was based on participant interviews and review of the literature. The authors concluded that the EBBS appears to have sufficient reliability and validity to

warrant its use for describing exercise perceptions across populations and evaluating the effects of perceived exercise benefits and barriers on their behaviour (Sechrist et al., 1987). Permission to use the EBBS in this study was sought and obtained (Appendix C).

Perceived barriers to PA in diabetes: The Barriers to Physical Activity in Diabetes (BAPAD) scale was developed to measure the perceived barriers towards PA among individuals with T1DM. The scale asks participants to rate the probability that the mentioned factors would prevent them from practising regular PA in the future, with answers coded on a seven-point scale ranging from one (extremely unlikely) to seven (extremely likely). The scale demonstrated good validity and reliability (Dube et al., 2006; Brazeau et al., 2012). Lanhers et al. (2015) tested the BAPAD scale in T2DM individuals and confirmed its reliability in such a population. Since the EBBS was developed for use across all populations and does not specifically target diabetes-related barriers, the BAPAD scale was added to the final research instrument to study the impact of diabetes-related factors on PA participation which were not tackled by the EBBS. Permission to use the BAPAD scale was sought and obtained (Appendix C).

Other tools which were considered included the Global Physical Activity Questionnaire (WHO, 2021) which measures PA level across three domains as well as sedentary behaviour; however, the IPAQ short form was favoured due to its short length and as it was the most widely used instrument to measure PA level encountered in the literature search. Other tools considered to assess PA benefits and barriers were the Exercise barriers scale of the Diabetes Care Profile (Fitzgerald et al., 1996) and PA questions from the Diabetes Self-Management Questionnaire (Schmitt et al., 2013). However, the EBBS and BAPAD tools were chosen in favour of the others as they are more comprehensive and captured all information relevant to the research topic.

The above-mentioned instruments do not include demographic characteristics, medical history, knowledge about PA, and enablers towards performing PA. Thus, in addition, questions tackling these areas were subsequently added to the research tool. These included questions on PA knowledge taken from two studies (Eigenmann et al., 2011; Pati et al., 2019) after obtaining the necessary permissions (Appendix C), as well as questions adapted from the European Health Interview Survey (EHIS) 2019/2020 (European Commission, 2020).

Study participants were given the option of filling in the questionnaire in either English or Maltese depending on their preference. The final questionnaire was translated into Maltese and back-translated to English for confirmatory validation. Translation of the English questionnaire into Maltese was done by a bilingual professional translator. This was back-translated into English by a second bilingual translator. Following this, a bilingual educator reviewed the two questionnaires to ensure that all the questions retained their original meaning. The Maltese version was also tested during the pilot study phase to gauge its acceptability and understanding, and no additional changes were deemed necessary.

Content of the research tool

The final questionnaire consisted of four sections which collected information on the items shown in Table 4. All questions were closed-ended, with the exception of the final two.

Table 4

Content of the research tool

Section	Information collected
1: General Information	Sociodemographic details including age, gender, locality of residence, and highest level of educational attainment - question adapted from the European Health Interview Survey (EHIS) 2019/2020 (European Commission, 2020).
2: Medical history	Duration of diabetes, type of diabetes, current treatment for diabetes, presence of medical conditions/diseases, presence of diabetes-related complications, smoking status, and anthropometric measurements: weight, height, and waist circumference (measured). The question on medical conditions was adapted from the European Health Interview Survey (EHIS) 2019/2020 (European Commission, 2020) and provided participants with a list of conditions which were deemed most relevant to the study topic, asking them to indicate whether they suffered from any of these or any other conditions not listed.
3: Physical activity knowledge and participation	Knowledge of the importance of exercise for controlling diabetes - question taken from Pati et al. (2019); knowledge of physical activity recommendations - question taken from the Diabetes Knowledge Questionnaire (Eigenmann et al., 2011); measurement of physical activity level and sitting time - using the International Physical Activity Questionnaire (IPAQ) short form (IPAQ, 2022).
4: Barriers and enablers towards physical activity participation	Exercise benefits and barriers - using the Exercise Benefits/Barriers Scale (EBBS) (Sechrist et al., 1987); barriers to physical activity in diabetes - using the Barriers to Physical Activity in Diabetes (BAPAD) scale (Dube et al., 2006); other factors hindering from physical activity participation (open-ended question); enablers towards physical activity participation (open-ended question).

Psychometric evaluation

As highlighted above, the research instrument was predominantly based on three tools, with further questions added from other studies. In view of this, psychometric evaluation of the tool was carried out, whereby it was tested for validity and reliability, and piloted to produce the final instrument utilised during the fieldwork. The final English and Maltese versions of the questionnaire can be found in Appendix D.

Validity testing. Although the research instrument was predominantly comprised of previously validated tools from the literature, since questions were added from various studies, and considering the need for cultural adaptability where applicable, validity testing by peer review was conducted. Content and face validity of the questionnaire were assessed by a number of local experts including a Public Health Medicine Specialist, a Specialist in Diabetes and Endocrinology, a General Practitioner with special interest in diabetes, and a medical doctor with special interest in sport and exercise medicine. Three diabetic individuals also reviewed the questionnaire to assess clarity. The feedback resulting from the peer review process was evaluated together with the research supervisor and the tool was adjusted to incorporate the suggestions, as shown in Table 5.

Table 5

Changes to the research tool following peer review

Question	**Amendments done to question**	**Reason/s for amendment**
Smoking status: Current, Ex-smoker, Never	Smoking status: Current smoker, Ex-smoker, Non-smoker	Clearer for those participants who smoked cigarettes on rare occasions but were not or are not regular smokers.
Physical activity participation (IPAQ)	Additional examples of vigorous and moderate physical activities were included from the long version of the IPAQ tool covering different domains.	Examples make it clearer for participants to comprehend what vigorous and moderate activity entails.
Physical activity participation (IPAQ)	The duration of vigorous, moderate, and walking activities was requested in minutes per day (instead of both hours and minutes per day).	Less confusing for participants if only one response option is provided.
Sitting time (IPAQ)	The duration of sitting time was requested in hours per day (instead of both hours and minutes per day).	Less confusing for participants if only one response option is provided. It is easier for participants to quantify sitting time in hours rather than minutes per day.
Barriers to Physical Activity in	The seven response options were clarified; thus, the wording was changed from "*1, extremely*	The range of response options was elaborated to facilitate scoring by the participants.

Diabetes (BAPAD) scale	*unlikely to 7, extremely likely*" to "*1 = very unlikely, 2 = unlikely, 3 = rather unlikely, 4 = uncertain, 5 = rather likely, 6 = likely, 7 = very likely*".	

Reliability testing. Test-retest reliability refers to the extent to which the tool is consistent over time with repeated administrations (Creswell & Creswell, 2018). Reliability was tested by distributing the Maltese version of the questionnaire to 10 diabetic individuals aged 18 to 69 years, collecting their responses, and then distributing the questionnaire in Maltese again to the same individuals after two weeks. The individuals were asked to maintain the same PA habits as much as possible during this period. This was done to test the reproducibility and consistency of the research tool. In order to test for reliability between the English and Maltese versions of the tool, the same process was repeated whereby the English version was distributed to another 10 individuals, with the Maltese version distributed after two weeks. A hypothesis was formulated that there was no statistically significant difference between the replies of the same individual over time. This was tested using the Wilcoxon-signed rank test, which resulted in p-values greater than 0.05 thus proving the null hypothesis correct, meaning that there was no difference between the two versions.

Pilot study. The questionnaire was piloted among 30 T2DM individuals, split equally between MDH and PHC. The pilot study was carried out in March 2023 and enabled the researcher to gauge whether the questions were comprehensible and accepted by study participants, test the methodology, and allowed the researcher to make any necessary changes to the tool prior to the main fieldwork.

The main changes to the research tool which were implemented following review of the questionnaires collected and feedback received from participants during the pilot study are shown in Table 6.

Table 6

Changes to the research tool following the pilot study

Question	**Amendments done to question**	**Reason/s for amendment**
Current treatment for diabetes: Diet control only, Tablets/pills only, Insulin injections only or with tablets/pills	Current treatment for diabetes: Diet control only, Tablets/pills, Insulin injections only or with tablets/pills	The "Tablets/pills" response option was modified as individuals on oral hypoglycaemic agents who were also careful of their diet were selecting two responses. The change was done to make a clearer distinction between individuals solely on diet control and those on oral medications.
Barriers to Physical Activity in Diabetes (BAPAD) scale	Change in wording from "Indicate the likelihood that each of these items would keep you from practicing regular physical activity during the next 6 months" to "Indicate the probability that each of the factors listed below would keep you from practicing regular physical activity during the next 6 months".	The wording of the question was changed to improve its understanding among the study participants.

Other sources of information

Although the questionnaire captured information on the presence of any diabetes-related complications, the glycated haemoglobin (HbA1c) was obtained to give a more accurate measure of glycaemic control. Each participant's most recent HbA1c blood result was obtained from the hospital laboratory information system through an intermediary person working within the respective institution.

Information on weight status was obtained by calculating the body mass index (BMI) from the weight and height which were measured for each participant by the nurse in charge of the clinic, and the waist circumference which was measured by the researcher for those who consented to this.

Ethical considerations

The research study proposal was submitted to and approved by the Faculty (of Medicine and Surgery) Research Ethics Committee of the University of Malta. Approval to conduct the study was also granted by the Chief Executive Officer and Data Protection Officer of MDH, Executive Director and Data Protection Officer of GGH, and Data Protection Officer of PHC. Permissions were also obtained from the Head of Department or equivalent at MDH and GGH, and the Principal General Practitioners of the three health centres from which participants were recruited. Additionally, permissions from the individual consultants at MDH and GGH were obtained in order to recruit diabetic patients under their care (Appendix E).

Participants were invited to participate in the study by an intermediary, namely the nurse in charge of the clinic. The intermediaries distributed the information letter and consent form, both of which were made available in English and Maltese (Appendix F), to the patients who fit the inclusion criteria. The researcher was available to address any queries prior to them signing the consent form. Individuals who agreed to participate and signed the consent form were approached by the researcher who then distributed the questionnaire. It was made clear by the intermediaries, and this was further reiterated by the researcher, that participation was completely voluntary and that they could withdraw from the study at any time. Furthermore, participants were assured that they could stop filling in the questionnaire once called in for their appointment.

To correlate the participants' questionnaire replies with their HbA1c level, which would indicate how well controlled their condition is, the name, surname, and ID number of the participants were collected solely for this purpose. The most recent HbA1c blood result was obtained from the hospital laboratory information system through an intermediary, one intermediary for each institution from which participants were recruited, that is, MDH, PHC, and GGH. Once the questionnaire replies were linked with the HbA1c result via a unique study code assigned to each respondent, the personal identifiers were eliminated, thus ensuring pseudonymity, as explained in detail in the next section. This was explained to the participants on the information letter, consent form, and verbally by the researcher.

Fieldwork

Data collection and management

The fieldwork for this study was carried out between March and August 2023. The researcher visited the diabetes clinics on all days of the week when clinics were held (Monday-Friday), except when the researcher was unavailable due to work commitments or examinations. The researcher also attended afternoon clinics held at MDH.

Data was collected through a paper-based questionnaire, together with physical measurements and assessment of glycaemic control via the HbA1c. First contact was made by the clinic nurse, who distributed the information letter and consent form to those patients who fit the inclusion criteria. Those who agreed to participate were approached by the researcher, who collected the signed consent form, distributed the questionnaire in the language preferred by the participant (English or Maltese), and a pen. All participants were offered assistance to complete the questionnaire by the researcher. Participants filled in the questionnaire in the waiting area, prior to and/or following their appointment. The

consent forms and completed questionnaires were returned to the researcher directly and kept securely in an envelope.

Apart from filling in the questionnaire, participation also involved measurement of the participants' waist circumference in a private room by the researcher (only for those who marked the relevant section on the consent form and thus agreed to this). The waist (abdominal) circumference was measured at a point midway between the lower border of the rib cage and the iliac crest, ensuring that the measuring tape was snug but not too tight, and measured at the end of a normal expiration. Weight and height were measured by the nurse as is normally done during the diabetic appointment using weighing scales with a built-in height rod, and the participants recorded these measurements on the questionnaire. Given that these instruments were being utilised in a healthcare setting, it was assumed that the weighing scales used for such measurements were regularly maintained and calibrated.

Participants were asked to provide their name, surname, and ID number on the first page of the questionnaire for the sole purpose of obtaining their most recent HbA1c blood result via an intermediary. In order to obtain the HbA1c results from the hospital laboratory information system, information from the first page of the questionnaire, namely name, surname, ID number, and the corresponding unique study code attributed to each questionnaire, was inputted into an Excel spreadsheet by the researcher, transferred onto an encrypted USB drive, and passed on to the intermediaries by hand. The intermediaries inputted the corresponding HbA1c results in a separate column in the spreadsheet and deleted the columns containing the names and ID numbers, thus providing the researcher with the HbA1c results and corresponding study codes only. The intermediaries did not retain any data but worked directly on the USB drive. This was completed within one month from data collection. The first page of the questionnaires

was stored in a locked cabinet at the researcher's end until this process was done, and then shredded.

Data from the second page of the questionnaire onwards was inputted into an Excel spreadsheet by the researcher using the unique study code attributed to each response. This was done on the same day of data collection. All hard copy materials were placed in a locked cabinet at the researcher's end. The first page of the questionnaires was stored separately from the rest of the questionnaires. The signed consent forms were also safety stored throughout the research project.

Data was stored in an encrypted file on the researcher's password-protected computer, for which only the researcher had access.

Data analysis

The questionnaire replies were coded and inputted into a spreadsheet. Comments and answers provided for the open-ended questions were documented into the spreadsheet. Data was cleaned and checked for errors. Blank replies were considered as missing data.

A detailed description of the categorisation of data related to socio-demographic variables, variables related to medical history, PA participation, and PA barriers and enablers is provided in Appendix G.

Statistical analysis

Analysis of pseudonymised data was carried out using Microsoft Excel and the statistical software package IBM SPSS Statistics version 20.

Initially, a descriptive analysis of the variables collected was conducted using SPSS and the results were presented as text, tables, and charts. The variables were defined

as categorical or continuous. Continuous variables were tested for normality of distribution using the Shapiro-Wilk test and for those variables that did not follow a normal distribution ($p<0.05$), the median with interquartile range (IQR) was used to describe the sample and non-parametric tests were utilised in the inferential analyses.

The variables were further defined as independent (explanatory) and dependent (outcome) variables for the purposes of inferential analysis. Univariate analysis was conducted to assess for any association between the independent and dependent variables. The decision of which test of significance to use depended upon whether the variables were continuous or categorical in nature. The tests used were Chi-squared test, Fisher's exact test, unpaired t-test, Mann-Whitney U test, Analysis of variance (ANOVA), Kruskal-Wallis test, and Spearman's rank correlation coefficient. P-values that could be rounded down to 0.05 or less were considered to be statistically significant.

Following univariate analysis, the independent variables that were found to be significantly associated with the dependent variables were considered for multivariate analysis. This was performed using linear regression and binary logistic regression techniques. Transformation was applied to the dependent variables which did not follow a normal distribution. Using the Generalised Linear Model within SPSS, a forward stepwise approach was taken whereby independent variables were inputted into the model in order of decreasing significance. The resulting models from this approach retained solely those independent variables which remained significant (p-value 0.05 or less) after adjusting for the influence of confounding variables.

Qualitative data analysis of free text from the open-ended questions was carried out using the software package NVivo version 14 by QSR International. Replies written in Maltese were translated into English by the researcher prior to the analysis. Thematic

analysis was carried out whereby the data was inputted into the software and coded to identify themes and patterns emerging from the data.

Conclusion

This chapter provided a detailed description of the materials and methods used to reach the aim and objectives of this study. The results obtained from the data analysis are presented in the following chapter.

Results

Introduction

This chapter presents the results obtained following analysis of the data collected during the fieldwork. A descriptive overview of the results is initially presented. This is followed by the results obtained from univariate and multivariate statistical analyses, with the results split into four sections, namely PA knowledge, PA level and sitting time, anthropometric and physiological variables, and exercise benefits and barriers. A summary of the main study findings concludes the chapter.

Descriptive statistics

Response rate

A total of 384 questionnaires were collected. 402 eligible individuals were approached to participate in the study, giving an overall response rate of 95.52%.

Participants were recruited from diabetes clinics at Mater Dei Hospital (MDH), three health centres within Primary HealthCare (PHC), and Gozo General Hospital (GGH) (Table 7).

Table 7

Distribution of the study population by healthcare setting of recruitment

Healthcare setting	Frequency (n=384)	Percentage (%)
MDH	178	46.35
PHC	178	46.35
GGH	28	7.29
Total	384	100.00

All (n=384) participants included in the final study population were confirmed to have satisfied the inclusion criteria as specified in the methodology chapter.

Socio-demographic variables

Age. All (n=384) participants provided their age. The age of the recruited participants ranged from 21 to 69 years, with the median age being 62.5 years (IQR 56-67). As shown in Figure 2, the majority (62.24%; n=239) were aged between 60 and 69 years, followed by 50 to 59 years of age (26.56%; n=102).

Figure 2

Distribution of the study population by age group

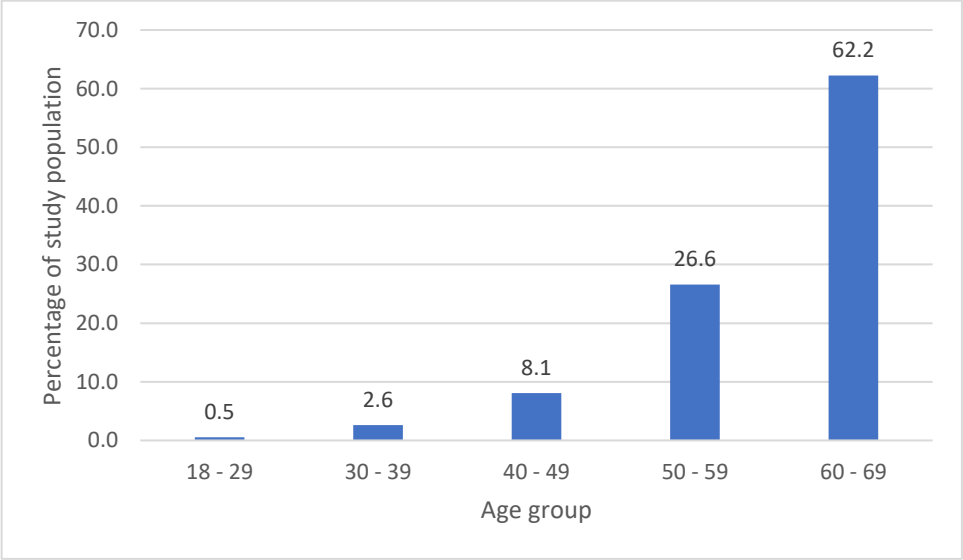


Table 8 shows the median age (with IQR) of the participants recruited from each of the three healthcare settings included in the study.

Table 8

Median age (with IQR) and number sampled from the diabetes clinics within the three healthcare settings

Healthcare setting	Median age (years)	IQR (years)	*N*
MDH	62.00	53.00 - 66.00	178
PHC	64.00	58.00 - 67.00	178
GGH	62.50	52.50 - 67.75	28

Gender. All (n=384) participants provided their gender. Just over 65% (n=250) of the study population consisted of males, as shown in Table 9.

Table 9

Distribution of the study population by gender

Gender	Frequency (n=384)	Percentage (%)
Male	250	65.10
Female	134	34.90
Other	0	0.00
Total	384	100.00

District. All (n=384) participants provided their locality of residence. The localities were grouped into the six districts as defined by the National Statistics Office (NSO, 2014). Table 10 shows the distribution of the study participants by district.

Table 10

Distribution of the study population by district

District	Frequency (n=384)	Percentage (%)	Crude rate per 100,000 population
Southern Harbour	103	26.82	171.86
Northern Harbour	81	21.09	65.04
South Eastern	56	14.58	99.41
Western	20	5.21	43.01
Northern	95	24.74	129.61
Gozo and Comino	29	7.55	104.09
Total	384	100.00	/

The district from which most participants were recruited was the Southern Harbour (26.82%; n=103), followed by the Northern (24.74%; n=95) and Northern Harbour (21.09%; n=81) regions. The crude participation rate (per 100,000 population) for each district was calculated by dividing the number of participants by the population aged 18-69 years residing within that district as at the end of 2022 (NSO, 2023) and

multiplying by 100,000. Indeed, the crude rate shows that the Southern Harbour, Northern, and Gozo and Comino districts were those districts from which most participants were recruited. The lack of participants from the Western district may be explained by the fact that the localities within this district do not fall in the catchment areas of the health centres chosen for the study.

Education level. 383 (99.74%) participants reported their highest completed level of education. Most participants (45.69%; n=175) had a secondary school level of education. Only 15.67% (n=60) had completed the tertiary level of education (Table 11).

Table 11

Distribution of the study population by the highest completed level of education

Education level	Frequency (n=383)	Percentage (%)
No education	9	2.35
Primary	72	18.80
Secondary	175	45.69
Post-secondary	65	16.97
Tertiary	60	15.67
Other	2	0.52
Total	383	100.00

Smoking status. 374 (97.40%) participants indicated their smoking status. 18.45% (n=69) of participants reported that they were currently smoking and around one third (32.89%; n=123) reported being ex-smokers, while almost half of participants (48.66%; n=182) were non-smokers (Figure 3).

Figure 3

Distribution of the study population by smoking status

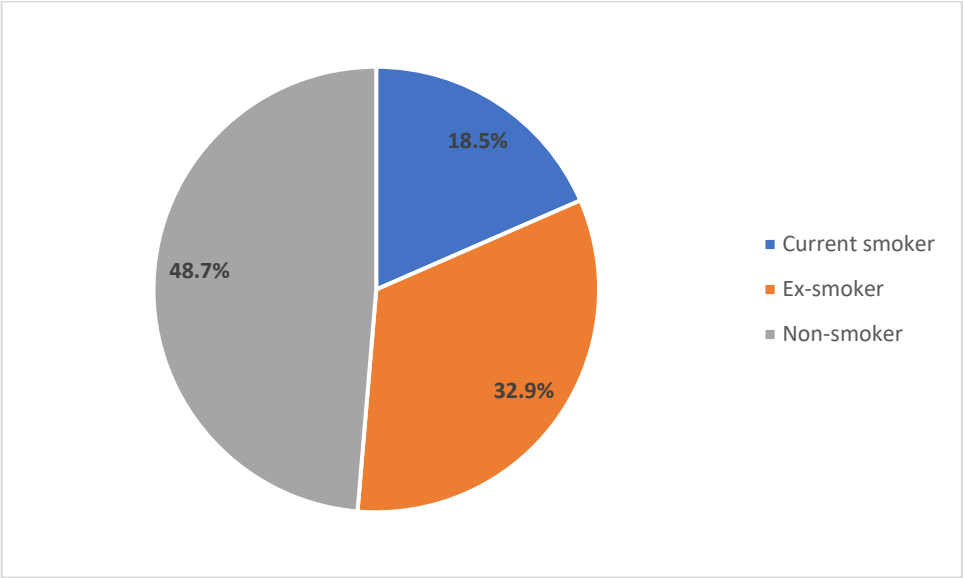


Table 12 shows the distribution of the study population by smoking status and gender. Most female participants were non-smokers (62.50%; n=80). A higher proportion of females reported being current smokers (22.66%; n=29) when compared with males (16.26%; n=40), while a larger proportion of males were ex-smokers (42.28%; n=104) when compared with females (14.84%; n=19).

Table 12

Distribution of the study population by smoking status and gender

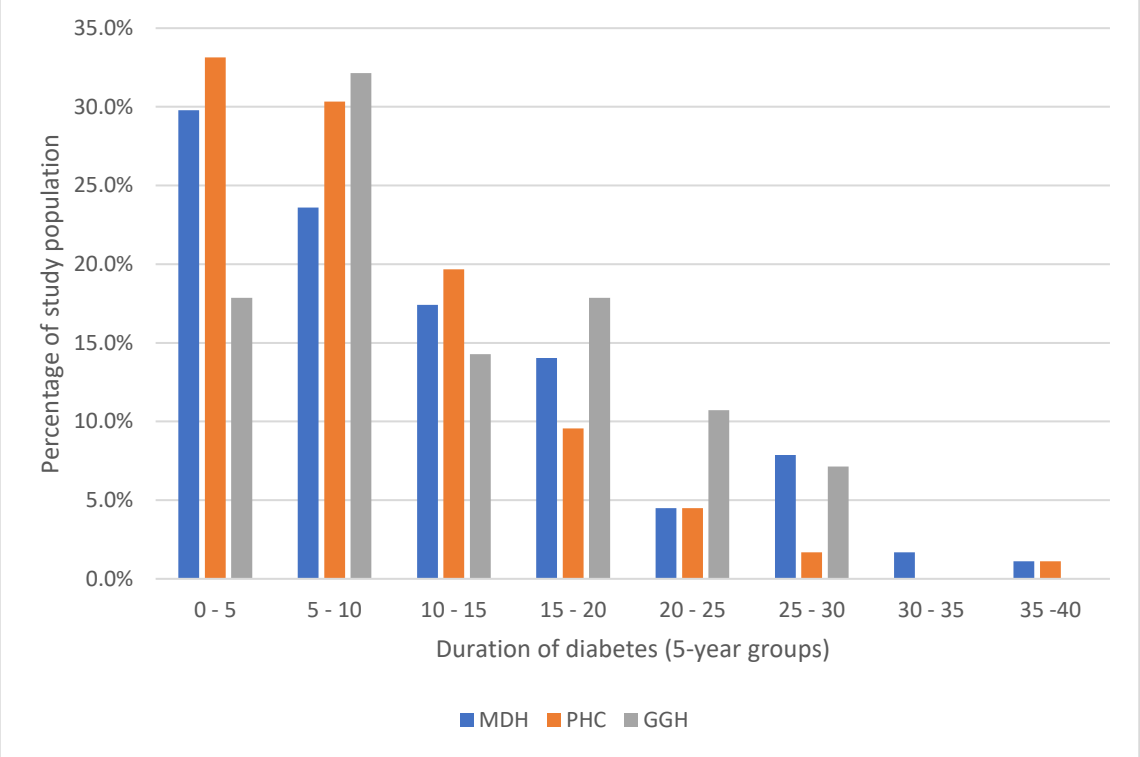
Smoking status	Male		Female	
	Frequency (n=246)	Percentage (%)	Frequency (n=128)	Percentage (%)
Current smoker	40	16.26	29	22.66
Ex-smoker	104	42.28	19	14.84
Non-smoker	102	41.46	80	62.50
Total	246	100.00	128	100.00

Medical history

Duration of diabetes. All (n=384) participants indicated for how long they had been living with T2DM. The median duration of diabetes was 10 years (IQR 5-15). Overall, most participants (30.47%; n=117) had been living with T2DM for a period of between one and five years, although among participants recruited from GGH, the majority had a diabetes duration of between five and 10 years (Figure 4). Study participants recruited from MDH had a median duration of diabetes of 10 years (IQR 5.00-19.00), those recruited from PHC had a median duration of 10 years (IQR 4.38-13.00), and those from GGH had a median duration of 11 years (IQR 6.00-19.50).

Figure 4

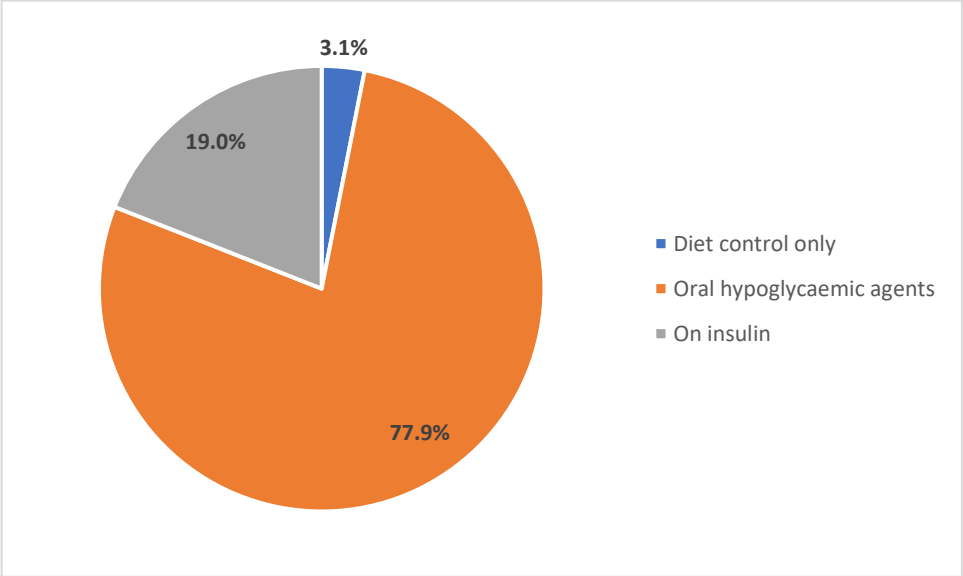
Distribution of the study population by duration of diabetes (in 5-year groups) and healthcare setting



Type of diabetes control. All (n=384) participants indicated their current treatment for the management of their condition. Overall, 299 participants (77.86%) reported being on oral hypoglycaemic agents while almost one in five participants (19%; n=73) were dependent on insulin. Only a small minority of the study population (3.13%; n=12) reported managing their condition through diet control (Figure 5).

Figure 5

Distribution of the study population by type of diabetic treatment



Diabetes clinics at MDH see a higher proportion of patients who are dependent on insulin (30.90%; n=55) compared with PHC (6.74%; n=12), as shown in Table 13. This distinction cannot be made for Gozo since all diabetic patients receiving care from the public health sector are followed up at GGH.

Table 13

Distribution of the study population by type of diabetic treatment and healthcare setting

Type of diabetes control	MDH		PHC		GGH	
	Frequency (n=178)	Percentage (%)	Frequency (n=178)	Percentage (%)	Frequency (n=28)	Percentage (%)
Diet control only	4	2.25	5	2.81	3	10.71
Oral hypoglycaemic agents	119	66.85	161	90.45	19	67.86
On insulin	55	30.90	12	6.74	6	21.43
Total	178	100.00	178	100.00	28	100.00

Diabetic complications. All (n=384) participants indicated whether they suffered from any complications related to their diabetes. The most commonly reported diabetes-related complications were eye problems (14.58%; n=56), followed by foot complications including amputation of toe/s, foot, or leg (10.94%; n=42), and renal disease (5.99%; n=23) (Table 14).

Table 14

Number and proportion of the study population who have experienced complications attributed to their diabetes

Diabetic complications	Frequency (n=121)	Percentage (%)
Foot complications	42	10.94
Kidney disease	23	5.99
Eye disease	56	14.58

31.46% (n=56) of study participants recruited from MDH reported having at least one diabetes-related complication, compared with 17.42% (n=31) of participants being followed up within PHC and 14.28% (n=4) of participants from GGH (Table 15).

Table 15

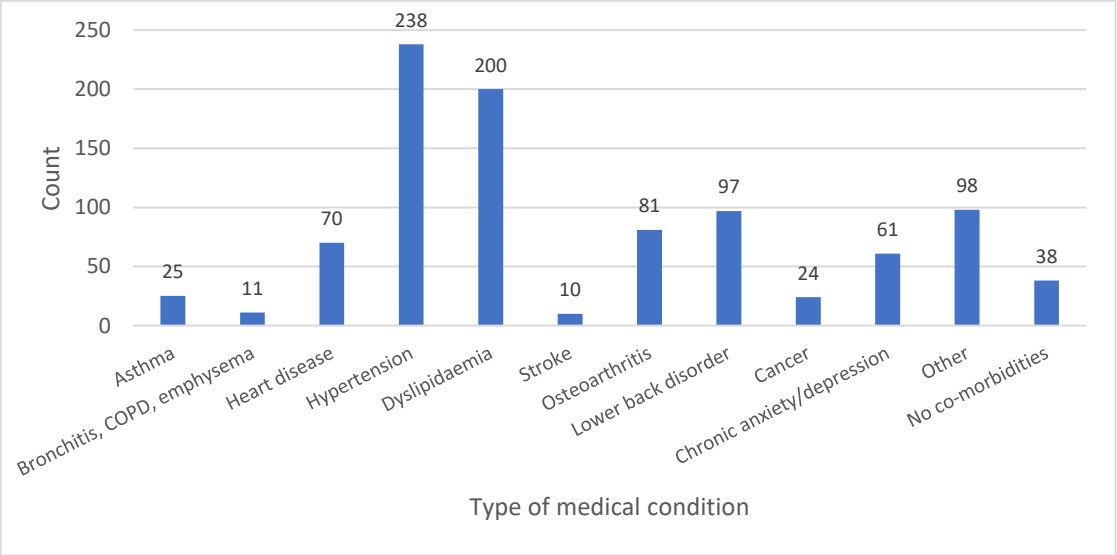
Number of diabetes-related complications among study participants sampled from the diabetes clinics within the three healthcare settings

Number of complications	MDH		PHC		GGH	
	Frequency (n=178)	Percentage (%)	Frequency (n=178)	Percentage (%)	Frequency (n=28)	Percentage (%)
No complications	122	68.54	147	82.58	24	85.71
1 complication	36	20.22	26	14.61	3	10.71
2 complications	16	8.99	5	2.81	1	3.57
3 complications	4	2.25	0	0.00	0	0.00
Total	178	100.00	178	100.00	28	100.00

Co-morbidities. All (n=384) participants reported whether they suffered from any medical conditions other than T2DM and, if so, indicated which. The most commonly reported medical co-morbidities were hypertension (61.98%; n=238) and dyslipidaemia (52.08%; n=200). Only 38 study participants (9.90%) reported suffering from no medical conditions other than T2DM, as shown in Figure 6.

Figure 6

Frequency and types of medical conditions reported by study participants



98 study participants (25.52%) reported suffering from other medical conditions, which included thyroid disease, obstructive sleep apnoea, cataract disease, fibromyalgia, and osteopenia/osteoporosis, amongst others.

43.75% (n=168) of study participants reported suffering from a total of three (3) or more medical co-morbidities apart from T2DM. PHC had the lowest proportion of study participants who suffered from no medical conditions other than T2DM and participants were also more likely to report suffering from three or more co-morbidities (Table 16).

Table 16

Number of medical co-morbidities among study participants sampled from the diabetes clinics within the three healthcare settings

Number of co-morbidities	MDH		PHC		GGH		Total	
	Frequency (n=178)	Percentage (%)	Frequency (n=178)	Percentage (%)	Frequency (n=28)	Percentage (%)	Frequency (n=384)	Percentage (%)
0	25	14.04	9	5.06	4	14.29	38	9.90
1	38	21.35	35	19.66	4	14.29	77	20.05
2	43	24.16	49	27.53	9	32.14	101	26.30
>= 3	72	40.45	85	47.75	11	39.29	168	43.75
Total	178	100.00	178	100.00	28	100.00	384	100.00

Glycated haemoglobin (HbA1c) as an indicator of diabetic control. The latest HbA1c blood result was obtained for 383 (99.74%) participants, using the methodology described in the previous chapter. One participant provided an incorrect ID number, thus the HbA1c result could not be extracted.

The median HbA1c of the study participants was 7.40% (IQR 6.60-8.40). Most study participants (60.57%; n=232) had an HbA1c level above 7%, particularly females, exceeding the recommended target for good glycaemic control in T2DM (Table 17).

Table 17

Distribution of the study population by HbA1c cut-off level and gender

HbA1c (%)	Male		Female		Total	
	Frequency (n=250)	Percentage (%)	Frequency (n=133)	Percentage (%)	Frequency (n=383)	Percentage (%)
7 or less	101	40.40	50	37.59	151	39.43
More than 7	149	59.60	83	62.41	232	60.57
Total	250	100.00	133	100.00	383	100.00

Participants recruited from secondary care were more likely to have elevated HbA1c levels above 7% when compared with participants recruited from PHC, as shown in Table 18.

Table 18

Distribution of the study population by HbA1c cut-off level and healthcare setting

HbA1c (%)	MDH		PHC		GGH	
	Frequency (n=178)	Percentage (%)	Frequency (n=177)	Percentage (%)	Frequency (n=28)	Percentage (%)
7 or less	43	24.16	99	55.93	9	32.14
More than 7	135	75.84	78	44.07	19	67.86
Total	178	100.00	177	100.00	28	100.00

Body mass index (BMI). Weight and height measurements were obtained for all (n=384) participants. This enabled the researcher to calculate the BMI in kg/m^2 for all participants. The BMI results were then classified into five categories as outlined in the National Institute for Health and Care Excellence (NICE) guidance on obesity (NICE, 2023).

The median BMI among all study participants was 32.33 kg/m^2 (IQR 28.36-37.02). As shown in Figure 7, the majority of participants (31.25%; n=120) had a BMI ranging from 30 to 34.9 kg/m^2 and were classified as obese class 1.

Figure 7

Distribution of the study population by BMI category and gender

A minority of the study population (8.07%; n=31) had a BMI ranging from 18.5 to 24.9 kg/m^2 and were considered as having a healthy weight. One in four (25.52%; n=98) had a BMI ranging from 25 to 29.9 kg/m^2 and were considered as being overweight. The rest of the study participants (66.40%; n=255) had a BMI of 30 kg/m^2 and over and were considered as obese to differing degrees. None of the study participants had a BMI below 18.5 kg/m^2.

A higher proportion of males were overweight (30.40%; n=76) when compared with females (16.42%; n=22) (Figure 7), although females were more likely to be obese (73.88% (n=99) compared with 62.40% (n=156) in males). As shown in Table 19 below, the proportion of study participants who were obese decreased with age, although older participants were more likely to be overweight when compared with younger participants.

Table 19

Distribution of the study population by BMI category and age group

Age group (years)	Body mass index (BMI)		
	18.5 - 24.9 Healthy weight	25 - 29.9 Overweight	30 and over Obesity
18 - 49	9.30%	16.28%	74.42%
50 - 59	6.86%	24.51%	68.63%
60 - 69	8.37%	27.62%	64.02%

Study participants recruited from MDH were more likely to be obese (72.47%; n=129) when compared with PHC (62.36%; n=111) and GGH (53.57%; n=15). A higher proportion of participants from PHC were overweight (30.34%; n=54) when compared with the other two healthcare settings. Furthermore, one in four participants (25.00%; n=7) recruited from GGH had a healthy weight when compared with 6.18% and 7.30% of participants from MDH and PHC, respectively (Table 20).

Table 20

Distribution of the study population by BMI category and healthcare setting

BMI (kg/m^2)	MDH		PHC		GGH	
	Frequency (n=178)	Percentage (%)	Frequency (n=178)	Percentage (%)	Frequency (n=28)	Percentage (%)
18.5 - 24.9 Healthy weight	11	6.18	13	7.30	7	25.00
25 - 29.9 Overweight	38	21.35	54	30.34	6	21.43
30 - 34.9 Obesity class 1	55	30.90	59	33.15	6	21.43
35 - 39.9 Obesity class 2	44	24.72	29	16.29	6	21.43
40 and over Obesity class 3	30	16.85	23	12.92	3	10.71
Total	178	100.00	178	100.00	28	100.00

Abdominal circumference. 382 (99.48%) participants gave their consent to have their waist circumference measured by the researcher. The waist circumference results were then classified according to the WHO gender-specific cut-off points for the risk of metabolic complications (WHO, 2011).

The median waist circumference among the study participants was 107.75 cm (IQR 99.00-119.00). As shown in Table 21, most study participants (77.49%; n=296) had a waist circumference which signifies a substantially increased risk of metabolic complications, while only 7.33% (n=28) had a waist circumference measurement which does not contribute to an increased risk of metabolic complications.

Table 21

Distribution of the study population according to the risk of metabolic complications as determined by the waist circumference measurement

Risk of metabolic complications (abdominal circumference)	**Frequency (n=382)**	**Percentage (%)**
Up to 94 cm (M); 80 cm (F) (No increased risk)	28	7.33
> 94 cm (M); > 80 cm (F) (Increased risk)	58	15.18
> 102 cm (M); > 88 cm (F) (Substantially increased risk)	296	77.49
Total	382	100.00

Although both genders were found to be more likely to have a waist circumference signifying a substantially increased risk of metabolic complications, this finding was more prominent in females, as shown in Table 22.

Table 22

Distribution of the study population by risk of metabolic complications (as determined by the waist circumference measurement) and gender

Risk of metabolic complications (abdominal circumference)	Male		Female	
	Frequency (n=249)	Percentage (%)	Frequency (n=133)	Percentage (%)
No increased risk	26	10.44	2	1.50
Increased risk	52	20.88	6	4.51
Substantially increased risk	171	68.67	125	93.98
Total	249	100.00	133	100.00

In all healthcare settings, most study participants had a waist circumference indicating a substantially increased risk of metabolic complications. Similar to the BMI measurements, a higher proportion of participants recruited from GGH (28.57%; n=8) had a waist circumference which does not contribute to an increased risk of metabolic complications when compared with the other two healthcare settings (Table 23).

Table 23

Distribution of the study population by risk of metabolic complications (as determined by the waist circumference measurement) and healthcare setting

Risk of metabolic complications (abdominal circumference)	MDH		PHC		GGH	
	Frequency (n=178)	Percentage (%)	Frequency (n=176)	Percentage (%)	Frequency (n=28)	Percentage (%)
No increased risk	9	5.06	11	6.25	8	28.57
Increased risk	23	12.92	31	17.61	4	14.29
Substantially increased risk	146	82.02	134	76.14	16	57.14
Total	178	100.00	176	100.00	28	100.00

The waist-to-height ratio was calculated for those participants who permitted measurement of their waist circumference and who had a BMI below 35 kg/m^2 (n=250). The results were classified into three categories to define the degree of central adiposity as per the NICE guidance on obesity. As shown in Table 24, the majority (71.20%; n=178) had a waist-to-height ratio of 0.6 and above, which signifies high central adiposity associated with increased health risks such as hypertension and cardiovascular disease (NICE, 2023). Only 0.80% (n=2) had a healthy central adiposity ratio.

Table 24

Distribution of the study population according to the degree of central adiposity as determined by the waist-to-height ratio

Degree of central adiposity (waist-to-height ratio)	Frequency (n=250)	Percentage (%)
0.4 - 0.49 (Healthy central adiposity)	2	0.80
0.5 - 0.59 (Increased central adiposity)	70	28.00
0.6 and over (High central adiposity)	178	71.20
Total	250	100.00

Although both genders were found to be more likely to have a waist-to-height ratio signifying high central adiposity, this finding was more prominent in females, while males were more likely to have an increased central adiposity (ratio of 0.5-0.59) when compared with females (Table 25).

Table 25

Distribution of the study population by degree of central adiposity (as determined by the waist-to-height ratio) and gender

	Male		Female	
Degree of central adiposity (waist-to-height ratio)	Frequency (n=174)	Percentage (%)	Frequency (n=76)	Percentage (%)
Healthy central adiposity	1	0.58	1	1.32

Increased central adiposity	55	31.61	15	19.74
High central adiposity	118	67.82	60	78.95
Total	174	100.00	76	100.00

In all healthcare settings, most study participants had a waist-to-height ratio indicating a high degree of central adiposity. A higher proportion of participants recruited from GGH (10.53%; n=2) had a healthy central adiposity ratio when compared with MDH and PHC (both 0.00%; n=0) (Table 26).

Table 26

Distribution of the study population by degree of central adiposity (as determined by the waist-to-height ratio) and healthcare setting

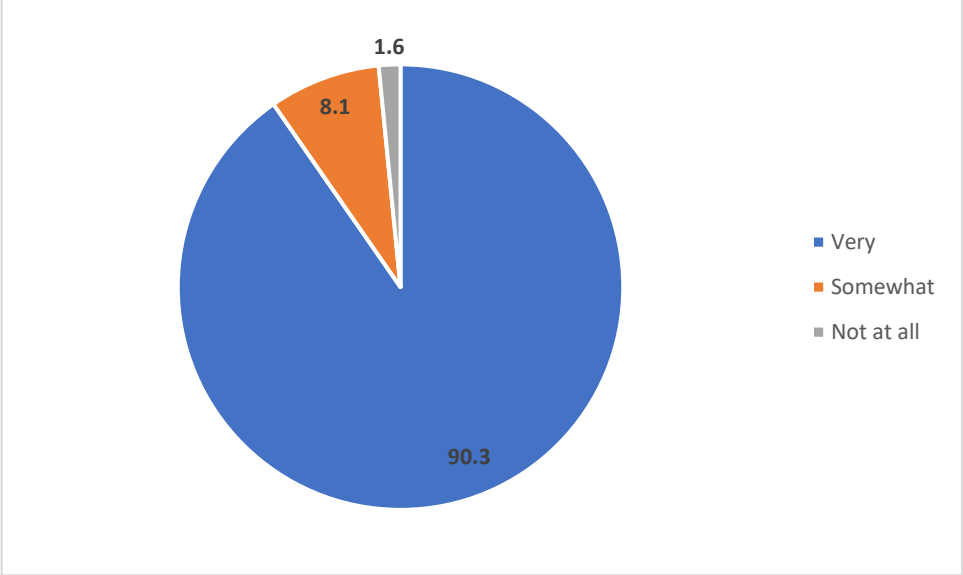
Degree of central adiposity (waist-to-height ratio)	**MDH**		**PHC**		**GGH**	
	Frequency (n=105)	**Percentage (%)**	**Frequency (n=126)**	**Percentage (%)**	**Frequency (n=19)**	**Percentage (%)**
Healthy central adiposity	0	0.00	0	0.00	2	10.53
Increased central adiposity	29	27.62	33	26.19	8	42.11
High central adiposity	76	72.38	93	73.81	9	47.37
Total	105	100.00	126	100.00	19	100.00

Physical activity

Knowledge. 383 (99.74%) participants provided an answer to the question on how important exercise is for controlling diabetes. Most study participants (90.34%; n=346) perceived exercise as very important for controlling diabetes, while an additional 8.09% (n=31) perceived exercise to be somewhat important. Only 1.57% (n=6) thought that exercise is not important for diabetic control (Figure 8).

Figure 8

Distribution of the study population according to the perceived importance of exercise for controlling diabetes



All (n=384) participants provided an answer to the question on PA recommendations for persons with diabetes. Most study participants (86.98%; n=334) provided the correct answer, namely that of engaging in PA on most days of the week for at least 30 minutes. 4.69% (n=18) of participants provided an incorrect answer and an additional 8.33% (n=32) were unaware/unsure of the recommendations (Table 27).

Table 27

Distribution of the study population according to their knowledge of physical activity recommendations for persons with diabetes

Physical activity recommendations	**Frequency (n=384)**	**Percentage (%)**
Most days of the week for at least 30 minutes	334	86.98
Once a week for at least 30 minutes	16	4.17
Once a month for one hour	0	0.00
At least every fortnight for two hours	2	0.52
Unsure/don't know	32	8.33
Total	384	100.00

PA participation and sitting time. The IPAQ instrument was used to assess PA participation and sitting time in the previous seven days among the study participants.

PA level. The results of PA participation were classified into low (inactive), moderate, or high PA levels based on the IPAQ scoring protocol (IPAQ, 2022).

All (n=384) study participants completed the PA participation section. As shown in Figure 9, the majority of participants (41.67%; n=160) were found to engage in low PA levels. Just over a third of participants (33.07%; n=127) had a moderate level of PA and one in four (25%; n=96) had high levels of PA. One participant's results were deemed invalid by the scoring tool due to unrealistic reported PA levels.

Figure 9

Distribution of the study population by level of PA participation

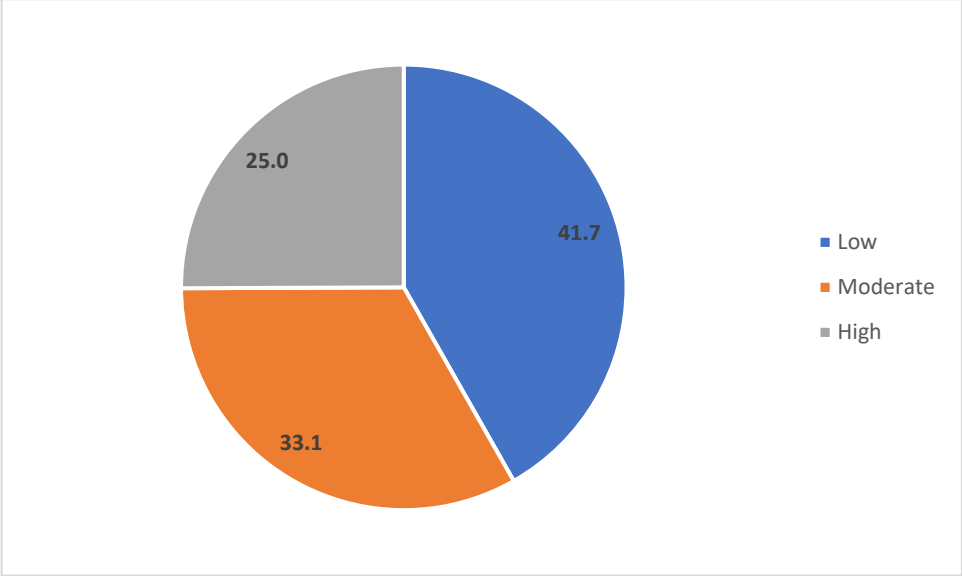


Table 28 demonstrates the PA levels by age group. No major differences were noted in PA levels among the different age groups, although participants aged 50-59 years were more likely to engage in low levels of PA (43.14%; n=44) when compared with the

other age groups. Furthermore, a lower proportion of older participants aged 60-69 years were found to engage in high PA levels (24.79%; n=59) when compared with the other age groups.

Table 28

Distribution of the study population by level of PA and age group

Age group (years)	Physical activity level		
	Low	Moderate	High
18 - 49	41.86%	32.56%	25.58%
50 - 59	43.14%	31.37%	25.49%
60 - 69	41.18%	34.03%	24.79%

Both genders were more likely to engage in low PA levels, although a higher proportion of males engaged in moderate and high PA levels when compared with their female counterparts, as shown in Table 29.

Table 29

Distribution of the study population by level of PA and gender

Physical activity level	Male		Female	
	Frequency (n=250)	Percentage (%)	Frequency (n=133)	Percentage (%)
Low	96	38.40	64	48.12
Moderate	88	35.20	39	29.32
High	66	26.40	30	22.56
Total	250	100.00	133	100.00

Sitting time. 332 (86.46%) participants provided an indication of how many hours they had spent sitting in a week day during the previous seven days. Six (1.56%) participants did not provide an answer, while 46 (11.98%) participants claimed they did not know.

The self-reported sitting time ranged from zero to 16 hours per day, with the median daily sitting time across the respondents being 4 hours (IQR 3.0-6.5). As shown in Table 30, younger participants were found to spend more time sitting per day when compared with older participants.

Table 30

Median daily sitting time (with IQR) and number of study participants by age group

Age group (years)	Median sitting time (hours)	IQR (hours)	*N*
18 - 49	6.00	2.50 - 8.00	31
50 - 59	5.00	3.00 - 8.00	90
60 - 69	4.00	3.00 - 6.00	211

Males were found to spend more time sitting per day when compared with females (Table 31).

Table 31

Median daily sitting time (with IQR) and number of study participants by gender

Gender	Median sitting time (hours)	IQR (hours)	*N*
Male	4.75	3.00 - 7.00	218
Female	4.00	2.88 - 6.00	114

Perceived benefits, barriers, and enablers towards PA participation

Exercise benefits and barriers. Benefits of and barriers to exercise were assessed by the EBBS. The instrument tackles perceived benefits of exercise through 29 items and perceived barriers through 14 items, with participants indicating the degree to which they agreed or disagreed with each statement.

As per scoring information from the authors of the scale, replies with more than 5% of the items missing were eliminated (Appendix H). Overall, 371 (96.61%) replies were valid and included in the analysis.

Possible scores on the total instrument range from 43 to 172. The higher the score, the more positively the individual perceives exercise. As shown in Table 32, among the 371 respondents, the scores ranged from 85 to 160, with a median of 127 and a mean score of 127.86 (95% CI [126.73, 129.00]). The possible range of scores on the benefits scale alone is between 29 and 116. Among the 371 respondents, the scores ranged from 29 to 116, with a median of 86 and a mean score of 87.85 (95% CI [86.86, 88.85]). When the barriers scale is analysed separately, it does not need to be reverse scored, such that the higher the score, the greater the perception of barriers. In this case, the possible range of scores is between 14 and 56. Among the 371 respondents, the scores ranged from 14 to 56, with a median of 30 and a mean score of 29.99 (95% CI [29.50, 30.48]).

Table 32

Range of scores with the median and mean scores (with 95% CI) for the entire benefits/barriers scale and the benefits and barriers scales in isolation

	Possible score	**Median**	**Range**	**Mean with 95% CI**
Benefits/barriers scale	43 - 172	127	85 - 160	127.86 (126.73 - 129.00)
Benefits scale	29 - 116	86	29 - 116	87.85 (86.86 - 88.85)
Barriers scale	14 - 56	30	14 - 56	29.99 (29.50 - 30.48)

Each item of the EBBS instrument was analysed separately. The scores ranged from “4” = strongly agree to “1” = strongly disagree. The higher the mean rating score for each item, the greater the degree of agreement with the statement. The areas assessed in the EBBS and the results, in descending order, are presented in Appendix I. The five highest rated exercise benefits were “exercise decreases feelings of stress and tension for

me", "exercise improves my mental health", "exercising increases my level of physical fitness", "exercising improves functioning of my cardiovascular system", and "I have improved feelings of well-being from exercise". The most recognised exercise barriers were "I am fatigued by exercise" and "exercise tires me". Both items had a mean score of around 2.5, equating to between "agree" (score of 3) and "disagree" (score of 2) on the scoring scale. Thus, around half of participants agreed with these statements.

The 43 items of the scale were categorised into five subscales related to exercise benefits and four subscales related to exercise barriers. These are presented in Table 33.

Table 33

Items in the benefits and barriers subscales of the EBBS (Sechrist et al., 1987)

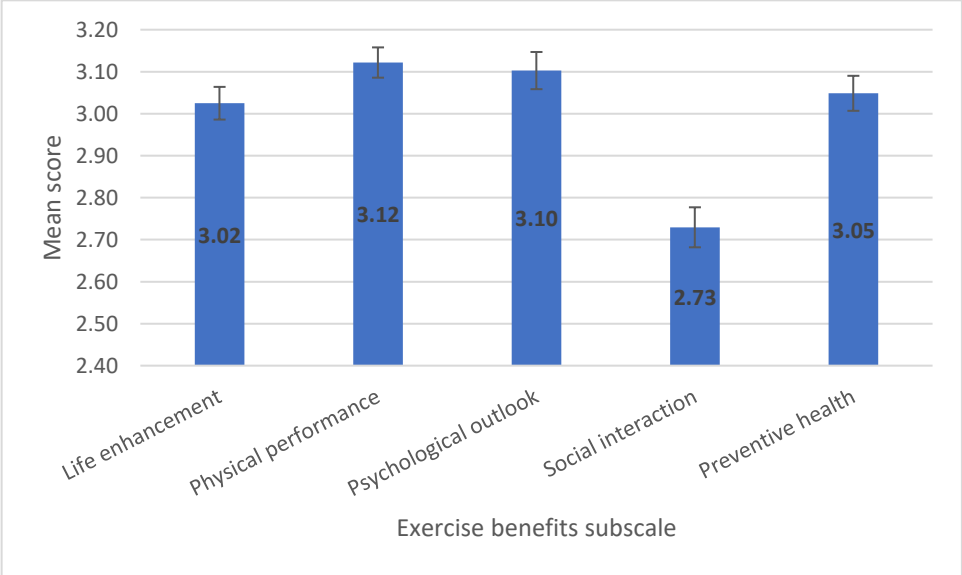
Category	Subscale	Items
Benefits	**Life-enhancement**	Improvement of disposition (mood), ability to sleep better, decreased fatigue, improved self-concept, increased mental alertness, ability to carry out normal activities without getting tired, improved work quality, and improved overall body functioning.
Benefits	**Physical performance**	Increased muscle strength, higher level of physical fitness, improved muscle tone, improved cardiovascular functioning, increased stamina, improved flexibility, improved physical endurance, and improvement in the way the body looks.
Benefits	**Psychological outlook**	Enjoyment of exercise, decreased stress and tension, improvement in mental health, sense of personal accomplishment, feeling relaxed, and improvement in feelings of well-being.
Benefits	**Social interaction**	Having contact with friends, meeting new people, exercise as good entertainment, and increased acceptance by others.
Benefits	**Preventive health**	Prevention of heart attacks, prevention of high blood pressure, and longer life expectancy.
Barriers	**Exercise milieu**	Places to exercise are too far away, exercise is too embarrassing, exercising costs too much, facilities have inconvenient schedules, people in exercise clothes look funny, and places to exercise are too few in number.
Barriers	**Time expenditure**	Exercise takes too much of one's time, exercise takes too much time from family relationships, and exercise takes too much time from family responsibilities.
Barriers	**Physical exertion**	Exercise is tiring, exercise is fatiguing, and exercise is hard work.

Barriers	**Family discouragement**	Lack of encouragement from the spouse and lack of encouragement from family members.

The most recognised exercise benefits were those within the physical performance and psychological outlook subscales (Figure 10). The least perceived exercise benefits were those related to social interaction. All benefits subscales, except for social interaction (mean score 2.73 (95% CI [2.68, 2.78])), had a mean rating score above three (3), which indicates that participants generally agreed with the statements related to exercise benefits.

Figure 10

Mean rating scores for the exercise benefits subscales of the EBBS. Error bars indicate the 95% confidence interval around the mean

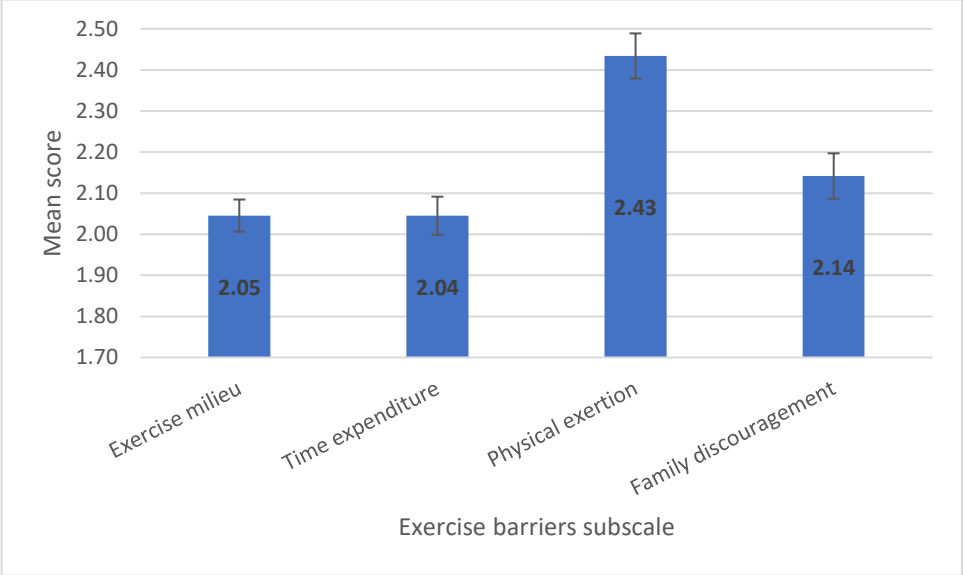


The least perceived exercise barriers were those within the time expenditure and exercise milieu subscales (Figure 11). Time expenditure and exercise milieu both had a mean rating score around two (2), which indicates that most participants disagreed with the barriers statements within these subscales. The physical exertion barriers subscale had

a mean rating score of 2.43 (95% CI [2.38, 2.49]), equating to between "agree" and "disagree" on the scoring scale. Items within this subscale (exercise is tiring/fatiguing) were the greatest perceived barriers to exercise.

Figure 11

Mean rating scores for the exercise barriers subscales of the EBBS. Error bars indicate the 95% confidence interval around the mean



Barriers to PA in diabetes. Barriers to PA in diabetes were assessed by the BAPAD scale. The scale tackles 11 areas which might act as barriers to PA among individuals with diabetes, with participants indicating the likelihood that each item would prevent them from engaging in regular PA. The scores ranged from "1" = very unlikely to "7" = very likely. The higher the mean rating score, the more likely it is that the item is perceived as a barrier. The areas assessed and the results are presented, in descending order, in Table 34.

Table 34

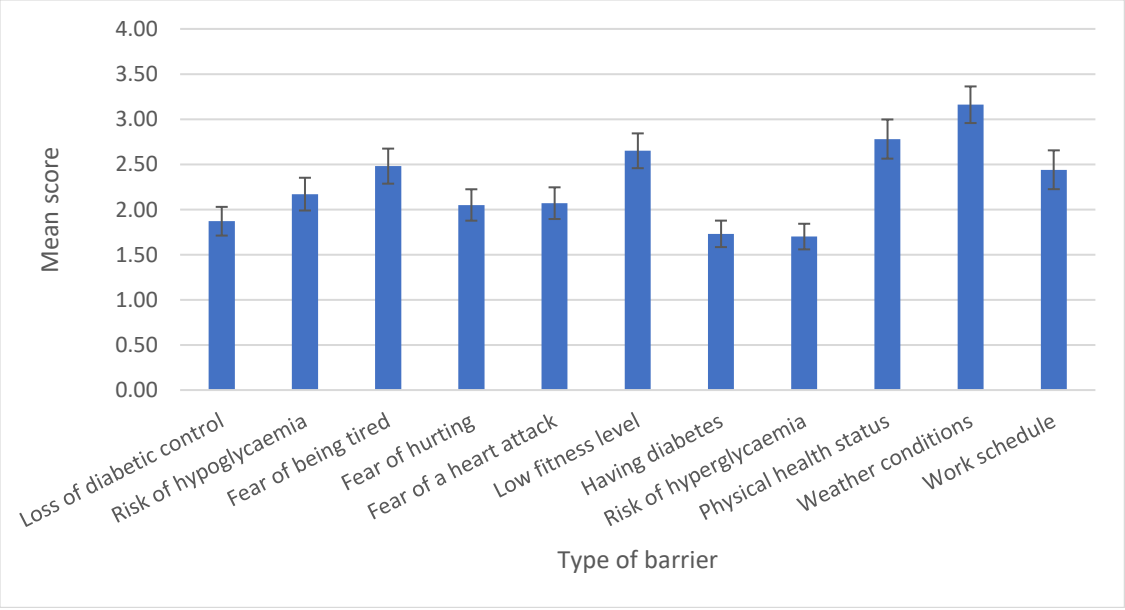
Response rate and mean rating score (with 95% CI) for each item of the BAPAD scale in descending order

Item	Response rate	Mean score	95% CI of mean
Weather conditions	94.53% (n=363)	3.16	2.95 - 3.36
Physical health status	92.97% (n=357)	2.78	2.57 - 3.00
Low fitness level	95.05% (n=365)	2.65	2.45 - 2.84
Fear of being tired	94.79% (n=364)	2.48	2.28 - 2.67
Work schedule	94.01% (n=361)	2.44	2.22 - 2.66
Risk of hypoglycaemia	94.53% (n=363)	2.17	1.99 - 2.36
Fear of suffering a heart attack	95.31% (n=366)	2.07	1.89 - 2.24
Fear of hurting	93.75% (n=360)	2.05	1.88 - 2.23
Loss of control over diabetes	94.27% (n=362)	1.87	1.71 - 2.03
Having diabetes	94.53% (n=363)	1.73	1.58 - 1.87
Risk of hyperglycaemia	94.79% (n=364)	1.70	1.55 - 1.84

The highest rated barriers among the study participants were the weather conditions, followed by physical health status and a low fitness level (Figure 12).

Figure 12

Mean rating scores for the 11 areas of potential exercise barriers of the BAPAD scale. Error bars indicate the 95% confidence interval around the mean



Content analysis: Additional barriers and enablers towards PA participation. Although this was a quantitative study, two open-ended questions were included at the end of the questionnaire tool which the researcher believed would provide further insight into the most important barriers and enablers to PA among the study participants.

Participants were given the opportunity to mention additional barriers or elaborate on the main factors keeping them from engaging in regular PA. The most prominent themes which emerged were health-related barriers; laziness, unwillingness or lack of motivation; and lack of time. More specific barriers mentioned were knee and back pain, tiredness, long working hours, housework and family responsibilities, weather conditions, lack of company, and cost. Various participants mentioned medical conditions as their limiting factors, which included arthritis, anxiety, depression, fibromyalgia, stroke, and obesity. Furthermore, some participants mentioned traffic and the perceived lack of road safety, as well as air pollution.

Participants provided information on those factors which encourage them to carry out PA. The most commonly mentioned factors were those related to their health and well-being, namely to achieve better control of their diabetes, to feel and look better, to lose weight, to lower blood pressure and cholesterol, to reduce body pain, to achieve an improvement in mental health and well-being, the fear of the consequences of poorly controlled diabetes, and being future-oriented and hopeful for the future. Additional external motivating factors included meeting other people, breaking the work/housework routine, and having an energetic dog.

In order to explore the perceived enablers, participants were asked to mention those factors which would encourage them to perform more PA. Most replies were related to the external environment, namely having more accessible facilities closer to their

homes, having activity groups in the community or work initiatives, more open spaces and sports centres particularly access to swimming pools, as well as having better roads and pavements which are adequate for walking. Having company to exercise with, which would provide encouragement from their family and peers, as well as encouragement and information from their doctors or training classes appropriate to their needs were also highlighted. Finally, participants also recognised the need to have the will power and motivation to engage in PA.

Univariate statistical analysis

Univariate statistical analysis was performed to check for any significant associations between the independent and dependent variables listed in Table 35. Some of the variables in the outcome variables list, being intermediary in nature, were also used as independent variables in some of the analyses.

Table 35

List of independent and dependent variables used in the statistical analysis

Independent (explanatory) variables	**Dependent (outcome) variables**
Age	Knowledge of the importance of PA
Gender	Knowledge of PA recommendations
Education level	Physical activity level
Smoking status	Sitting time
Duration of diabetes	HbA1c
Type of diabetic treatment	BMI
Number of co-morbidities	Waist circumference
Number of complications	Risk of metabolic complications
Healthcare setting	Waist-to-height ratio
	Degree of central adiposity
	Exercise benefits/barriers
	Exercise benefits
	Exercise barriers
	Barriers to PA in diabetes

The results of the univariate analysis for the above variables are described below. A p-value that could be rounded down to 0.05 or less was considered to be statistically significant and a p-value of less than 0.01 was taken to imply a high level of statistical significance.

PA knowledge

PA knowledge was assessed by asking participants to indicate the importance of PA and the recommended levels of PA for persons with diabetes.

None of the tested independent variables were found to be significantly associated with knowledge of the importance of PA (Table 36).

Knowledge of PA recommendations was categorised into two to produce a binary outcome variable, namely participants who selected the correct answer of 'most days of the week for at least 30 minutes' versus those who did not select this response. A significant association was found between age, education level, and duration of diabetes, and knowledge of PA recommendations (Table 36). Younger participants, those who had achieved a tertiary level of education, and those with a shorter duration of DM were more knowledgeable of PA recommendations.

Table 36

Results of univariate analysis for physical activity knowledge. (-): p-value is not statistically significant at >0.05

	p-value	
	Knowledge of the importance of PA	**Knowledge of PA recommendations**
Age	-	0.012
Gender	-	-
Education level	-	0.053
Smoking status	-	-
Duration of diabetes	-	0.038
Type of diabetic treatment	-	-
Number of co-morbidities	-	-
Number of complications	-	-
Healthcare setting	-	-

PA level and sitting time

The PA level variable was categorised into two to produce a binary outcome variable, namely participants who engaged in a low level of PA and were considered inactive, versus those who engaged in a moderate or high level of PA. Duration of diabetes, number of co-morbidities, healthcare setting, knowledge of PA recommendations, and exercise benefits and barriers were found to be significantly associated with PA level (Table 37). Low levels of PA were seen among participants with a longer duration of DM, more co-morbidities, those recruited from MDH, those lacking knowledge of PA recommendations, and those with lower benefits scores and higher barriers scores.

Age, gender, level of education, and barriers to PA in diabetes were found to be significantly associated with sitting time (Table 37). Younger age, being a male, having a tertiary level of education, and a higher barriers score were associated with longer sitting time.

Table 37

Results of univariate analysis for physical activity level and sitting time. (-): p-value is not statistically significant at >0.05

	p-value	
	Physical activity level	**Sitting time**
Age	-	0.004
Gender	-	0.046
Education level	-	0.014
Smoking status	-	-
Duration of diabetes	0.050	-
Type of diabetic treatment	-	-
Number of co-morbidities	0.011	-
Number of complications	-	-
Healthcare setting	0.029	-
Knowledge of the importance of PA	-	-
Knowledge of PA recommendations	0.002	-
Exercise benefits/barriers	<0.001	-
Exercise benefits	-	-
Exercise barriers	<0.001	-
Barriers to PA in diabetes	<0.001	0.049

Based on these results, the null hypotheses that age and gender are not significantly associated with PA level can be accepted ($p > 0.05$). The study hypotheses that duration of diabetes, knowledge (of PA recommendations), and barriers are not significantly associated with PA level are rejected in favour of the alternative hypotheses, namely that there is a significant association between these variables and PA level (all $p < 0.05$).

Anthropometric and physiological variables

A number of anthropometric and physiological measurements were tested against the independent variables, as shown in Table 38 below.

Duration of diabetes, type of diabetic treatment, number of diabetic complications, healthcare setting, and PA level were found to be significantly associated

with HbA1c. Higher HbA1c levels were seen in participants with a longer duration of diabetes, those on insulin, participants with more diabetic complications, those recruited from MDH followed by GGH and PHC, and those with lower PA levels.

Gender, smoking status, duration of diabetes, number of co-morbidities, healthcare setting, PA level, and sitting time were significantly associated with BMI. A higher BMI was observed in females, non-smokers, participants with more co-morbidities, those recruited from MDH followed by PHC, and those with lower PA levels and longer daily sitting times. With a longer duration of T2DM, BMI decreased.

Number of co-morbidities, healthcare setting, PA level, and sitting time were found to be significantly associated with waist circumference. A larger waist circumference was observed in participants with more co-morbidities, those recruited from MDH followed by PHC, and those with lower PA levels and longer daily sitting times. The waist circumference measurements were further categorised into 'no increased risk of metabolic complications' and 'increased risk of metabolic complications' to produce a binary outcome variable. Gender, number of co-morbidities, and healthcare setting were found to be significantly associated with the risk of metabolic complications. A higher proportion of females had a waist circumference which signifies an increased risk of complications. Increased risk of metabolic complications was also seen among those with more co-morbidities and those recruited from MDH followed by PHC.

The waist-to-height ratio was calculated for those participants who had a BMI below 35 kg/m^2 (p=250). Age, gender, number of co-morbidities, healthcare setting, and PA level were found to be significantly associated with this outcome variable. An increased ratio was observed with increasing age and number of co-morbidities, in females compared with males, in participants recruited from MDH followed closely by PHC, and in those with a low PA level. The waist-to-height ratio measurements were

categorised into ‘healthy central adiposity’ and ‘increased central adiposity’ to produce a binary outcome variable. Type of diabetic treatment and healthcare setting were found to be significantly associated with this outcome variable, such that participants on diet control and those recruited from GGH were more likely to have a healthy central adiposity.

Table 38

Results of univariate analysis for anthropometric and physiological variables. (-): p-value is not statistically significant at >0.05

	p-value					
	HbA1c	**BMI**	**Waist circumference**	**Risk of metabolic complications**	**Waist-to-height ratio**	**Degree of central adiposity**
Age	-	-	-	-	0.006	-
Gender	-	0.002	-	0.001	0.019	-
Education level	-	-	-	-	-	-
Smoking status	-	0.001	-	-	-	-
Duration of diabetes	<0.001	0.011	-	-	-	-
Type of diabetic treatment	<0.001	-	-	-	-	0.015
Number of co-morbidities	-	<0.001	0.001	0.003	<0.001	-
Number of complications	0.002	-	-	-	-	-
Healthcare setting	<0.001	0.022	0.007	<0.001	0.036	0.005
Physical activity level	0.035	0.005	0.001	-	0.001	-
Sitting time	-	0.042	0.005	-	-	-

The null hypotheses that there is no significant association between PA level and HbA1c and overweight/obesity can be rejected in favour of the alternative hypotheses, namely that there is a significant association between PA level and HbA1c and overweight/obesity in terms of the BMI, waist circumference, and waist-to-height ratio (all $p < 0.05$).

Exercise benefits and barriers

Gender, number of co-morbidities, and PA knowledge were found to be significantly associated with the exercise benefits/barriers score of the EBBS, as shown in Table 39. Higher mean benefits/barriers scores, which indicate that exercise is perceived more positively, were observed in males compared with females, those with less co-morbidities, those who perceived exercise as important, and those with knowledge of PA recommendations.

Assessing the exercise benefits scale in isolation, age, number of co-morbidities, and knowledge of PA recommendations were found to have a significant association (Table 39). Younger participants, those with less co-morbidities, and those knowledgeable of PA recommendations had higher benefits scores.

Assessing the exercise barriers scale in isolation, gender, number of co-morbidities, and PA knowledge were found to have a significant association (Table 39). Higher barriers scores were seen among female participants, those suffering from more co-morbidities, those who perceived exercise as unimportant, and those lacking knowledge of PA recommendations.

For the purposes of statistical analysis, the overall mean barriers to PA in diabetes (BAPAD) score was used. 338 (88.02%) respondents completed the scale, and these were considered valid and included in the analysis. Age, type of diabetic treatment, healthcare setting, and knowledge of the importance of PA for persons with diabetes were found to be significantly associated with the BAPAD score (Table 39). Higher BAPAD scores, indicating greater perceived barriers, were observed among younger participants, those on insulin, those recruited from MDH, and participants who perceived exercise as unimportant.

Table 39

Results of univariate analysis for exercise benefits and barriers. (-): p-value is not statistically significant at >0.05

	p-value			
	Exercise benefits/ barriers (EBBS)	**Exercise benefits (EBBS)**	**Exercise barriers (EBBS)**	**Barriers to PA in diabetes (BAPAD)**
Age	-	0.025	-	<0.001
Gender	0.012	-	0.033	-
Education level	-	-	-	-
Smoking status	-	-	-	-
Duration of diabetes	-	-	-	-
Type of diabetic treatment	-	-	-	0.006
Number of co-morbidities	0.002	0.025	0.001	-
Number of complications	-	-	-	-
Healthcare setting	-	-	-	<0.001
Knowledge of the importance of PA	0.008	-	0.014	0.024
Knowledge of PA recommendations	<0.001	0.003	0.003	-

Multivariate statistical analysis

Regression models were computed for the outcome variables mentioned above, applying transformation to the continuous variables having a non-normal distribution. The models included only those independent variables which were identified as being statistically significantly associated with the outcome variables in univariate analysis. A forward stepwise approach was used, and previously significant variables were eliminated from the model when they lost significance.

PA knowledge

Regression was not carried out for the outcome variable ‘Knowledge of the importance of PA’ as no independent variables were found to be significantly associated with it in univariate analysis.

The following variables were found to be significantly associated with 'Knowledge of PA recommendations' in the univariate analysis:

- Age (p=0.012)
- Education level (p=0.053)
- Duration of diabetes (p=0.038)

The above-mentioned predictors were tested in a binary logistic regression model. Age and education failed to achieve statistical significance at the 0.05 level and were removed from the model. The explanatory variable which remained statistically significant and was thus a significant predictor of whether participants were knowledgeable of the correct PA recommendations for persons with diabetes, after adjusting the model for the other factors, was duration of diabetes (Table 40). **Having a longer duration of diabetes was significantly associated with less knowledge of the correct PA recommendations**.

Table 40

Results of multivariate analysis for knowledge of PA recommendations

	Odds ratio	**95% CI for Odds ratio**		**p-value**
		Lower	**Upper**	
Duration of diabetes	0.963	0.931	0.996	0.026

PA level and sitting time

The following variables were found to be significantly associated with 'Physical activity level' in the univariate analysis:

- Duration of diabetes (p=0.050)
- Number of co-morbidities (p=0.011)

- Healthcare setting (p=0.029)
- Knowledge of PA recommendations (p=0.002)
- Exercise benefits/barriers (p<0.001)
- Exercise barriers (p<0.001)
- Barriers to PA in diabetes (p<0.001)

The above-mentioned predictors were tested in a binary logistic regression model. Exercise benefits/barriers, knowledge of PA recommendations, number of co-morbidities, healthcare setting, and duration of diabetes failed to achieve statistical significance at the 0.05 level and were removed from the model. The explanatory variables which remained statistically significant and were thus a significant predictor of PA level, after adjusting the model for the other factors, were exercise barriers and barriers to PA in diabetes (Table 41). **The higher the barriers scores, the higher the likelihood of having a low PA level**.

Table 41

Results of multivariate analysis for physical activity level

	Odds ratio	**95% CI for Odds ratio**		**p-value**
		Lower	**Upper**	
Exercise barriers	1.098	1.038	1.161	0.001
Barriers to PA in diabetes	1.418	1.139	1.764	0.002

The following variables were found to be significantly associated with ‘Sitting time’ in the univariate analysis:

- Age (p=0.004)
- Gender (p=0.046)
- Education level (p=0.014)

- Barriers to PA in diabetes (p=0.049)

The above-mentioned predictors were tested in a linear regression model with squared transformation of the outcome variable. Education, gender, and barriers to PA in diabetes failed to achieve statistical significance at the 0.05 level and were removed from the model. The explanatory variable which remained statistically significant and was thus a significant predictor of sitting time, after adjusting the model for the other factors, was age (p<0.001). **Younger age was found to be a significant predictor of longer daily sitting time**.

Anthropometric and physiological variables

The following variables were found to be significantly associated with 'HbA1c' in the univariate analysis:

- Duration of diabetes (p<0.001)
- Type of diabetic treatment (p<0.001)
- Number of complications (p=0.002)
- Healthcare setting (p<0.001)
- PA level (p=0.035)

The above-mentioned predictors were tested in a linear regression model with inverse transformation of the outcome variable. Number of diabetic complications and PA level failed to achieve statistical significance at the 0.05 level and were removed from the model. The explanatory variables which remained statistically significant and were thus a significant predictor of the HbA1c, after adjusting the model for the other factors, were duration of diabetes, type of diabetic treatment, and healthcare setting (Table 42).

Increased duration of diabetes and being on insulin were found to be significantly associated with a higher HbA1c level. Healthcare setting was significantly associated with HbA1c, such that participants from MDH had a higher mean HbA1c level, followed by GGH and PHC, respectively.

Table 42

Results of multivariate analysis for HbA1c

		Adjusted means	95% CI		Overall p-value
			Lower	Upper	
Type of diabetic treatment	Diet control only	6.888	6.322	7.564	0.032
	Oral medications	7.370	7.185	7.565	
	On insulin	7.780	7.425	8.171	
Healthcare setting	MDH	7.604	7.311	7.922	<0.001
	PHC	7.053	6.787	7.341	
	GGH	7.347	6.895	7.861	
Duration of diabetes		-	-	-	0.001

The following variables were found to be significantly associated with 'BMI' in the univariate analysis:

- Gender (p=0.002)
- Smoking status (p=0.001)
- Duration of diabetes (p=0.011)
- Number of co-morbidities (p<0.001)
- Healthcare setting (p=0.022)
- PA level (p=0.005)
- Sitting time (p=0.042)

The above-mentioned predictors were tested in a linear regression model with inverse transformation of the outcome variable. Gender and sitting time failed to achieve

statistical significance at the 0.05 level and were removed from the model. The explanatory variables which remained statistically significant and were thus a significant predictor of the BMI, after adjusting the model for the other factors, were smoking status, duration of diabetes, number of co-morbidities, healthcare setting, and PA level (Table 43). **Longer duration of diabetes and current smoking were found to be significantly associated with a lower mean BMI. Having a larger number of co-morbidities, receiving care from MDH, and having a low PA level were found to be significantly associated with a higher mean BMI**.

Table 43

Results of multivariate analysis for BMI

		Adjusted means	95% CI		Overall p-value
			Lower	Upper	
Smoking status	Current smoker	29.916	28.710	31.227	<0.001
	Ex-smoker	31.092	30.033	32.227	
	Non-smoker	32.949	31.963	33.997	
Number of co-morbidities		-	-	-	<0.001
PA level	Low	31.973	30.924	33.096	0.016
	Moderate/high	30.596	29.751	31.491	
Duration of diabetes		-	-	-	<0.001
Healthcare setting	MDH	32.879	31.989	33.821	0.003
	PHC	31.198	30.379	32.062	
	GGH	29.875	28.162	31.811	

The following variables were found to be significantly associated with 'Waist circumference' in the univariate analysis:

- Number of co-morbidities (p=0.001)
- Healthcare setting (p=0.007)
- PA level (p=0.001)
- Sitting time (p=0.005)

The above-mentioned predictors were tested in a linear regression model with inverse transformation of the outcome variable. Sitting time failed to achieve statistical significance at the 0.05 level and was removed from the model. The explanatory variables which remained statistically significant and were thus a significant predictor of the waist circumference, after adjusting the model for the other factors, were number of co-morbidities, healthcare setting, and PA level (Table 44). **Receiving care from MDH, having a larger number of co-morbidities, and engaging in a low PA level were found to be significantly associated with an increased waist circumference.**

Table 44

Results of multivariate analysis for waist circumference

		Adjusted means	95% CI		Overall p-value
			Lower	Upper	
PA level	Low	108.668	106.257	111.192	0.007
	Moderate/high	105.047	103.044	107.130	
Number of co-morbidities		-	-	-	<0.001
Healthcare setting	MDH	110.696	108.709	112.757	0.001
	PHC	106.246	104.356	108.206	
	GGH	103.768	99.484	108.437	

The following variables were found to be significantly associated with 'Risk of metabolic complications' (based on waist circumference) in the univariate analysis:

- Gender (p=0.001)
- Number of co-morbidities (p=0.003)
- Healthcare setting (p<0.001)

The above-mentioned predictors were tested in a binary logistic regression model. All variables remained statistically significant and were thus significant predictors of the risk of metabolic complications (Table 45). **Males and participants receiving care from**

GGH were significantly more likely to have no increased risk of metabolic complications based on their waist circumference. A higher number of co-morbidities was found to be significantly associated with an increased risk of metabolic complications.

Table 45

Results of multivariate analysis for risk of metabolic complications

		Odds ratio	95% CI for Odds ratio		Overall p-value
			Lower	Upper	
Healthcare setting	MDH	0.118	0.038	0.366	0.001
	PHC	0.193	0.065	0.575	
	GGH	1	-	-	
Number of co-morbidities		0.645	0.463	0.898	0.010
Gender	Male	6.46	1.477	28.256	0.013
	Female	1	-	-	

The following variables were found to be significantly associated with 'Waist-to-height ratio' in the univariate analysis:

- Age (p=0.006)
- Gender (p=0.019)
- Number of co-morbidities (p<0.001)
- Healthcare setting (p=0.036)
- PA level (p=0.001)

The above-mentioned predictors were tested in a linear regression model. Gender failed to achieve statistical significance at the 0.05 level and was removed from the model. The explanatory variables which remained statistically significant and were thus a significant predictor of the waist-to-height ratio, after adjusting the model for the other factors, were age, number of co-morbidities, healthcare setting, and PA level (Table 46).

Increasing age and number of co-morbidities were found to be significantly associated with an increased waist-to-height ratio. Participants engaging in a low PA level were also found to have a significantly higher mean waist-to-height ratio. **Participants from GGH had a significantly lower waist-to-height ratio.**

Table 46

Results of multivariate analysis for waist-to-height ratio

		Adjusted means	95% CI		Overall p-value
			Lower	Upper	
PA level	Low	0.623	0.612	0.635	0.002
	Moderate/high	0.603	0.593	0.613	
Number of co-morbidities		-	-	-	0.004
Healthcare setting	MDH	0.627	0.617	0.636	0.006
	PHC	0.625	0.616	0.634	
	GGH	0.588	0.565	0.610	
Age		-	-	-	0.031

None of the independent variables which were found to be significantly associated with 'Degree of central adiposity' in the univariate analysis, namely type of diabetic treatment and healthcare setting, remained significant in the regression model.

Exercise benefits and barriers

The following variables were found to be significantly associated with 'Exercise benefits/barriers' in the univariate analysis:

- Gender (p=0.012)
- Number of co-morbidities (p=0.002)
- Knowledge of the importance of PA (p=0.008)
- Knowledge of PA recommendations (p<0.001)

The above-mentioned predictors were tested in a linear regression model with squared transformation of the outcome variable. Knowledge of the importance of PA and gender failed to achieve statistical significance at the 0.05 level and were removed from the model. The explanatory variables that remained statistically significant and were thus a significant predictor of the exercise benefits/barriers score, after adjusting the model for the other factors, were number of co-morbidities and knowledge of PA recommendations (Table 47). **Better knowledge of PA recommendations was significantly associated with a higher mean exercise benefits/barriers score. The exercise benefits/barriers score decreased with an increase in number of co-morbidities**.

Table 47

Results of multivariate analysis for the exercise benefits/barriers score

		Adjusted means	95% CI		Overall p-value
			Lower	Upper	
Knowledge of PA recommendations	Correct	129.202	128.028	130.366	<0.001
	Incorrect	121.756	118.327	125.091	
Number of co-morbidities		-	-	-	0.005

The following variables were found to be significantly associated with ‘Exercise benefits’ in the univariate analysis:

- Age (p=0.025)
- Number of co-morbidities (p=0.025)
- Knowledge of PA recommendations (p=0.003)

The above-mentioned predictors were tested in a linear regression model with squared transformation of the outcome variable. Number of co-morbidities failed to achieve statistical significance at the 0.05 level and was removed from the model. The explanatory variables that remained statistically significant and were thus a significant

predictor of the exercise benefits score, after adjusting the model for the other factors, were age and knowledge of PA recommendations (Table 48). **Better knowledge of PA recommendations was significantly associated with a higher mean exercise benefits score. The exercise benefits score decreased with increasing age**.

Table 48

Results of multivariate analysis for the exercise benefits score

		Adjusted means	95% CI		Overall p-value
			Lower	Upper	
Knowledge of PA recommendations	Correct	88.991	87.958	90.012	0.001
	Incorrect	83.814	80.778	86.744	
Age		-	-	-	0.034

The following variables were found to be significantly associated with 'Exercise barriers' in the univariate analysis:

- Gender (p=0.033)
- Number of co-morbidities (p=0.001)
- Knowledge of the importance of PA (p=0.014)
- Knowledge of PA recommendations (p=0.003)

The above-mentioned predictors were tested in a linear regression model with squared transformation of the outcome variable. Knowledge of the importance of PA and gender failed to achieve statistical significance at the 0.05 level and were removed from the model. The explanatory variables which remained statistically significant and were thus a significant predictor of the exercise barriers score, after adjusting the model for the other factors, were number of co-morbidities and knowledge of PA recommendations (Table 49). **Better knowledge of PA recommendations was significantly associated**

with a lower mean exercise barriers score. The exercise barriers score was found to increase with an increased number of co-morbidities.

Table 49

Results of multivariate analysis for the exercise barriers score

		Adjusted means	95% CI		Overall p-value
			Lower	Upper	
Knowledge of PA recommendations	Correct	30.143	29.606	30.672	0.016
	Incorrect	31.988	30.588	33.330	
Number of co-morbidities		-	-	-	0.025

The benefits and barriers subscales of the EBBS were subsequently tested via univariate and multivariate analysis. Squared transformation was applied to the life-enhancement, physical performance, psychological outlook, and preventive health subscales, and log transformation was applied to the exercise milieu and time expenditure subscales. Table 50 shows the variables which were found to be significantly associated with each subscale after adjusting the model for the other independent variables in the multivariate linear regression model.

Table 50

Independent variables found to be statistically significantly associated with the exercise benefits/barriers subscales in multivariate analysis

Category	Subscale	Independent variables		
Benefits	**Life-enhancement**	Knowledge of PA recommendations (p=0.001)		
Benefits	**Physical performance**	Age (p<0.001)	Knowledge of PA recommendations (p=0.004)	
Benefits	**Psychological outlook**	Knowledge of PA recommendations (p=0.001)	Education (p=0.025)	Number of co-morbidities (p=0.044)

Benefits	**Social interaction**	Education (p=0.001)	Gender (p=0.041)	Number of diabetic complications (p=0.051)
Benefits	**Preventive health**	Knowledge of PA recommendations (p=0.008)		
Barriers	**Exercise milieu**	Number of co-morbidities (p=0.017)	Knowledge of PA recommendations (p=0.036)	Gender (p=0.040)
Barriers	**Time expenditure**	Knowledge of PA recommendations (p=0.015)	Age (p=0.021)	
Barriers	**Physical exertion**	Number of co-morbidities (p=0.006)	Education (p=0.007)	
Barriers	**Family discouragement**	Knowledge of PA recommendations (p=0.015)	Number of co-morbidities (p=0.039)	

As shown in Table 50, the most prominent predictor variable which was found to be associated with most of the exercise subscales was knowledge of PA recommendations. This was positively associated with the life enhancement, physical performance, psychological outlook, and preventive health benefits subscales, and negatively associated with the exercise milieu, time expenditure, and family discouragement barriers subscales. Having more co-morbidities was found to be associated with more barriers related to the exercise milieu, physical exertion, and family discouragement subscales. Older adults had less recognition of the exercise benefits related to the physical performance subscale and were less likely to perceive exercise as taking too much of their time.

The following variables were found to be significantly associated with ‘Barriers to PA in diabetes’ in the univariate analysis:

- Age ($p<0.001$)
- Type of diabetic treatment (p=0.006)
- Healthcare setting ($p<0.001$)

- Knowledge of the importance of PA (p=0.024)

The above-mentioned predictors were tested in a linear regression model with log transformation of the outcome variable. Type of diabetic treatment failed to achieve statistical significance at the 0.05 level and was removed from the model. The explanatory variables which remained statistically significant and were thus a significant predictor of the barriers to PA in diabetes (BAPAD) score, after adjusting the model for the other factors, were age, healthcare setting, and knowledge of the importance of PA (Table 51). **Increasing age and the perception that exercise is important for diabetes were found to be significantly associated with a lower mean BAPAD score. Participants from MDH had a significantly higher mean BAPAD score, followed by participants from PHC and GGH, respectively**.

Table 51

Results of multivariate analysis for the barriers to PA in diabetes score

		Adjusted means	95% CI		Overall p-value
			Lower	Upper	
Healthcare setting	MDH	3.040	2.459	3.759	<0.001
	PHC	2.283	1.846	2.824	
	GGH	1.845	1.439	2.365	
Age		-	-	-	<0.001
Knowledge of importance of PA	Yes	1.839	1.728	1.957	0.022
	No	2.976	1.977	4.479	

Conclusion

Some important findings from the data analysis and results presented in this chapter are described below.

- The majority of participants (66.40%) were obese, with an additional 25.52% being overweight. Furthermore, 92.67% of the study population had a waist

circumference which signifies an increased risk of metabolic complications. Females were more likely to be obese and have an increased waist circumference.

- Most participants perceived exercise as very or somewhat important for diabetic control (98.43%) and knew the recommended PA levels (86.98%).
- 41.67% of participants were considered inactive, while 33.07% had a moderate level of PA and one in four (25%) had a high level of PA.
- The most recognised exercise benefits were those related to physical performance and psychological outlook, particularly that exercise decreases feelings of stress and tension, improves mental health, and improves feelings of well-being, as well as improves physical fitness and cardiovascular functioning. The mean score (/4) of the physical performance subscale was 3.12 (95% CI [3.09, 3.16]) and that of the psychological outlook subscale was 3.10 (95% CI [3.06, 3.15]).
- The most endorsed exercise barriers were the weather conditions, physical health status, a low fitness level, and the perception that exercise is tiring/fatiguing. Other barriers which emerged from content analysis were medical conditions, laziness, unwillingness or lack of motivation, lack of time, having other responsibilities, lack of company, cost, and lack of road safety.
- The most commonly mentioned enablers were those related to health and well-being. Furthermore, having more accessible facilities and opportunities for PA as well as encouragement from family, peers, and doctors would enable participants to be more active.
- Univariate and multivariate analyses were conducted on a number of variables and statistically significant results were reported. Participants with higher exercise barriers scores were more likely to be inactive. Younger participants had longer daily sitting times. Males perceived exercise more positively than females.

Younger participants had higher exercise benefits scores, meaning that they recognised the benefits of exercise to a greater extent than older participants, but also had more perceived barriers on the BAPAD scale. Participants recruited from MDH had worse parameters in terms of HbA1c, BMI, and waist circumference and also had lower PA levels and higher barriers (BAPAD) scores.

Discussion and Conclusions

Summary of findings and discussion

Study population

The majority of participants in this study were aged 50 years and over, with the age distribution of the study population being consistent with national and international trends of rising prevalence of T2DM with increasing age (Cuschieri, 2020; Khan et al., 2020). T2DM is, however, increasingly becoming a concern among younger individuals. About 3% of the study population consisted of adults aged younger than 40 years. An additional number of participants, albeit a small proportion, indicated that they had been diagnosed with T2DM for over 30 years. Given that the maximum age of the recruited participants was 69 years, this would be in keeping with early-onset adult T2DM, which is defined as that diagnosed before 40 years of age (Royal Australian College of General Practitioners, 2020).

The majority (65%) of the study population consisted of males, with the remainder being females. This distribution is consistent with data from the EHIS 2019/2020 which showed that, among a representative sample of the population of Malta and Gozo, a higher proportion of males (6.7%) than females (3.8%) aged 18-69 years self-reported a diabetes diagnosis (K. England, personal communication, September 25, 2023).

T2DM is widely considered as one component within a group of disorders termed the ‘metabolic syndrome’. The metabolic syndrome represents a cluster of metabolic abnormalities which include central obesity, atherogenic dyslipidaemia, hypertension, insulin resistance, and proinflammatory and prothrombotic states (Tenenbaum et al., 2003). The link between obesity and T2DM is well established through the development of obesity-related insulin resistance. Overweight and/or obesity, as measured by the BMI, and increased central adiposity were recorded in over 90% of the study population, with

the proportion of overweight/obese participants remaining unchanged from a health examination survey conducted locally between 2014 and 2016 (Cuschieri et al., 2016). Although blood pressure and blood cholesterol levels were not measured in this study, most participants reported having been diagnosed with hypertension and/or dyslipidaemia. This is significant considering the role metabolic syndrome plays in predisposing to cardiovascular disease and all-cause mortality (Wang et al., 2020).

In this study, current smokers had a significantly lower BMI than non-smokers and ex-smokers. There is evidence in the literature for the association between current smoking and lower BMI, independent of genetic and shared environmental factors. This may in part be due to the fact that nicotine increases energy expenditure and suppresses appetite. Smoking cessation has been shown to lead to weight gain, although this effect appears to be minimal when comparing ex-smokers with never smokers (Piirtola et al., 2018).

Results from this study shed light on the type of patients seen within the different healthcare settings. Persons with T2DM receiving care at MDH were younger and had a similar duration of diabetes compared with those recruited from PHC; however, they were more likely to be treated with insulin, had poorer glycaemic control, and had more diabetes-related complications. It is expected that patients with worse parameters would be referred to MDH to be followed up at specialist-led clinics. Having poorly controlled diabetes might explain the higher scores obtained in the BAPAD scale which tackles barriers related specifically to diabetes. This would in turn predict the lower PA levels seen among these patients. The higher HbA1c levels may also be a result of their inactivity; however, the cross-sectional nature of this study did not permit determination of causality.

The study population consisted of persons with T2DM recruited from various healthcare settings in Malta and Gozo and thus reflects cooperative attenders and excludes persons with T2DM who do not attend their appointments, as well as those who are undiagnosed and not receiving any treatment. These individuals are likely to have different health behaviours from those included in this study. Thus, the below conclusions may not be reflective of the entire type 2 diabetic population living in Malta and Gozo.

Knowledge on PA

An encouraging finding was that the vast majority of study participants had good knowledge of the role of PA in T2DM and of the recommended PA levels. This represents an improvement from an earlier local study which had shown that just over half (54%) of participants with T2DM were not aware of the amount of PA to engage in (Cutajar, 2008). Although findings from the literature review demonstrated varying results across studies, in all cases, the majority of T2DM participants were aware of the recommended frequency and duration of PA, and this was associated with a higher educational level (Chadchavalpanichaya and Intaratep, 2010; Hui et al., 2014; Peter et al., 2022). The findings in our study may be related to the fact that most study participants had achieved at least a secondary school level of education.

Individuals with a shorter duration of DM were found to be more knowledgeable of the correct PA recommendations. This might indicate that recently diagnosed individuals are being provided with advice upon diagnosis and would be more motivated to change their lifestyle following diagnosis, as opposed to those with a longer duration. This highlights the importance of continued assessment and education on PA at each encounter with the healthcare system.

Knowledge of the recommended PA levels positively influences the level of PA that individuals with diabetes engage in, although knowledge is rarely sufficient to promote behaviour change (Heiss & Petosa, 2014). In this study, participants with good knowledge of the role of PA were found to be more knowledgeable of the benefits and perceived fewer barriers, which would encourage participation in PA.

Practice of PA and sitting time

Despite overall good knowledge of the recommendations and health benefits, around 42% of participants were not achieving a minimum of 150 minutes of moderate intensity activity and/or walking per week, as per recommendations. Although measuring PA level varies among studies, findings from the literature revealed that T2DM individuals are generally inactive (Kennerly & Kirk, 2018).

Studies report that male adults are more likely than females to meet PA guidelines (Whipple et al., 2022). Similar findings were obtained in this study whereby females were more likely to report being inactive, although this association did not reach statistical significance, and additionally had higher obesity rates and a higher risk of metabolic complications based on their waist circumference measurements than males. Contrary to the literature findings, age was not significantly associated with PA level in this study. However, younger participants were found to have significantly longer daily sitting times. Although information on employment status was not collected in this study, a tertiary level of education was also found to be associated with longer daily sitting times. Thus, the more sedentary behaviour in younger individuals may be attributed to sedentary occupations, such as managerial jobs. More time spent in continuous sedentary behaviour is associated with poorer glycaemic control and an increased risk of premature mortality

in diabetes and interrupting sedentary time with PA breaks may counteract this risk (Paing et al., 2018; Zhu et al., 2023).

The longer the duration of DM, the more inactive participants were found to be. This might indicate a lack of interest or motivation to be active over time. Given that a longer diabetes duration was found to be significantly associated with a higher HbA1c, the lack of PA may also be due to progression of disease or the onset of complications. Additionally, a negative association was noted between the number of co-morbidities and PA level, which may be due to health-related barriers to PA which were commonly reported in this study. Furthermore, those considered inactive perceived exercise more negatively and had more perceived barriers. In fact, higher barriers scores were found to be significant predictors of PA participation. Heiss and Petosa (2014) reported that attitude towards PA and perceived barriers are important correlates of PA rates, such that negative attitudes and more barriers limit PA participation.

PA and glycaemic and metabolic markers

Study participants with a low PA level had poorer glycaemic control, although the association between PA and HbA1c did not remain significant in multivariate analysis. In T2DM, glycaemic control is influenced by adherence to several self-care habits, which include dietary behaviour, medication adherence, and glucose monitoring, which were variables not examined in this study. Albuquerque et al. (2021) reported that, among the self-care habits, only glucose monitoring and dietary behaviour were found to be statistically significantly associated with HbA1c, although a negative correlation was established between PA and HbA1c, such that the greater the adherence to PA, the lower the expected HbA1c level.

Significantly higher BMI and waist circumference measurements were reported among participants with low PA levels and longer daily sitting times, although the latter failed to achieve statistical significance in multivariate analyses. The beneficial effects of PA on glycaemic control, BMI, and waist circumference have been well documented (Shah et al., 2021). Furthermore, studies have shown that higher sedentary time may independently account for increases in truncal and body fat percentage and recommend reducing sedentary time due to the impact on metabolic risk, independently of PA participation (Balducci et al., 2015; Li et al., 2022). Among participants with a BMI lower than 35kg/m^2, PA level was found to be a significant predictor of the waist-to-height ratio, the latter being elevated among inactive participants. The waist-to-height ratio is an easy-to-use, anthropometric index for central adiposity. Prospective studies and meta-analyses in adults have revealed that the waist-to-height ratio is equivalent to, or slightly better than, the waist circumference and superior to BMI in predicting higher cardiometabolic risk (Yoo, 2016). Studies among healthy adults reported significant inverse associations between PA and waist-to-height ratio (Lee et al., 2016; Qian et al., 2019).

Perceived benefits, barriers, and enablers to PA

Benefits of PA. Perceived benefits of PA were assessed in this study by the EBBS. The mean benefits score of 87.85 (95% CI [86.86, 88.85]) compares well with the findings from other international studies that reported benefits scores of 90.52 (Hsu et al., 2021) and 64.1 among older adults with peripheral artery disease (Whipple et al., 2019).

The most recognised exercise benefits in this study were those related to physical performance and psychological outlook. Whipple et al. (2019) also reported physical performance as the most endorsed benefits subscale. In line with the findings of Hsu et al. (2021), items related to exercise improving flexibility, physical endurance, and muscle

tone were among the highly rated benefits. The perception that exercise helps one to sleep better and that one will live longer if he/she exercises were not highly rated in the current study, as opposed to the findings of Hsu et al. (2021). Moreover, this study revealed that older adults were less likely to recognise the benefits of PA on their physical performance. This is in keeping with findings from the Eurobarometer 2022 among EU adults which reported that younger individuals were more likely to report engaging in sport or PA to improve their physical performance (European Commission, 2022).

It is encouraging that, apart from recognising the physical improvements from PA participation, study participants also recognised the positive psychological impact of PA and its role in preventing heart attacks and high blood pressure. Benefits related to social interaction were, however, the least endorsed, indicating that, overall, study participants did not consider exercising as an opportunity to interact with friends or meet new people, even though some participants expressed the wish to have company to exercise with. The Eurobarometer 2022 also revealed that 'to make new acquaintances', 'to better integrate into society', and 'to be with friends' were the least endorsed enablers to PA among Maltese adults aged 15 years and over (European Commission, 2022).

Barriers to PA. Perceived barriers to PA as assessed by the EBBS resulted in a mean score of 29.99 (95% CI [29.50, 30.48]). Participants in this study had greater perceived barriers when compared with findings from other studies that reported barriers scores of 29.83 (Hsu et al., 2021) and 26.9 (Gordon & Nelson, 2019). Whipple et al. (2019) reported a higher mean barriers score of 38.0 in older adults with T2DM and peripheral artery disease.

The highest rated exercise barriers as assessed by the EBBS in this study were those related to physical exertion, particularly that exercise is tiring/fatiguing, in keeping

with international studies assessing barriers among T2DM individuals using the same scale (Gordon & Nelson, 2019; Hsu et al., 2021; Whipple et al., 2019). These findings were supported by the results of the BAPAD scale, whereby participants placed more emphasis on physical health status, low fitness level, and the fear of being tired, in addition to weather conditions, as the most significant PA limiting factors, as opposed to diabetes-related limitations. The latter findings are in keeping with the literature, including the study by Lanhers et al. (2015) which reported the same major barriers to PA among T2DM individuals. In contrast with earlier findings, fear of hurting was one of the lowest rated barriers from the BAPAD scale in this study, despite participants highlighting health concerns as PA barriers.

Interestingly, lack of time was not among the top-rated barriers in this study, as opposed to the findings from the literature review, but in keeping with the study by Gordon and Nelson (2019). This may be the result of having a proportion of the study sample being inactive, thus not perceiving exercise as consuming too much of their time. Additionally, the median age of the recruited participants was 62.5 years, by which time most working adults would have retired. In fact, older adults in this study were significantly less likely to perceive exercise as taking too much of their time than younger individuals. Thomas et al. (2004) reported that lack of time was more of a problem for younger individuals. Similarly, the Eurobarometer 2022 demonstrated that, among EU adults, lack of time was commonly cited as a barrier among younger individuals aged less than 55 years (European Commission, 2022).

The themes that emerged from qualitative analysis of the open-ended questions were found to be congruent with the findings from the EBBS and BAPAD scales and provided further depth to the results. Knee and back pain, as well as various medical conditions, were mentioned and relate to the physical health status domain. This is

important as the number of co-morbidities one suffers from was found to have a significant positive association with the physical exertion barriers subscale, indicating that individuals with more co-morbidities perceive exercise as more tiring/fatiguing or as hard work. Lack of motivation, unwillingness, and laziness were additional barriers identified which were not fully tackled by the EBBS or BAPAD scales. Complementing the perceptions that places to exercise are too far away and too few in number, some participants highlighted the lack of road safety due to traffic, thus limiting PA engagement in their neighbourhood. These findings are in keeping with those from the international literature as identified from the literature review. Interestingly, the perception among the general Maltese population is that the majority believe that the neighbourhood offers many opportunities for PA (European Commission, 2022). The contrast in these findings may be due to the fact that individuals with T2DM are more likely to be overweight/obese and have more medical co-morbidities and/or physical limitations, which makes the surrounding environment inadequate for their needs. In fact, a positive association was noted between number of co-morbidities and the exercise milieu barriers subscale of the EBBS.

Enablers to PA. This study revealed that individuals with T2DM are not only aware of the benefits of PA in terms of enhanced physical and psychological health and well-being, but consider the positive impact of PA as a motivator for them to be active. This is consistent with findings of the studies included in the literature review that reported that many participants feel motivated by the perceived or observed health benefits of PA. Furthermore, the Eurobarometer 2022 demonstrated that among the general population of Maltese adults, the most cited reasons for engaging in sport or PA

were to improve health (47%), to relax (39%), to improve fitness, and to control weight (both 37%) (European Commission, 2022).

In addition to the internal motivating factors, external factors were noted to play a significant role in motivating participants to engage in PA in this study. Participants highlighted how encouragement from peers and healthcare professionals would motivate them to be more active. The role of the family also emerged in this study, whereby family discouragement was one of the major barriers to PA and participants expressed the wish to have more encouragement and company to exercise with. In the study by Vilafranca Cartagena et al. (2022), individuals with T2DM explained how family members, friends, and healthcare professionals encouraged them to change their lifestyle towards a more active one. Similarly, Beverly and Wray (2010) reported on the experiences of exercise adherence among couples and noted that spousal support appeared to be crucial when encouraging persons with diabetes to adopt and maintain exercise. Earlier local studies among T2DM individuals also revealed the importance that these individuals place on familial support when it comes to adherence to diabetes self-management (Baldacchino, 2012; Duncan, 2016; Fonk, 2021).

As mentioned earlier, study participants perceived a lack of accessible facilities to exercise. Not surprisingly, most respondents highlighted the role of the external environment as an enabler towards more engagement in PA, namely having more accessible and safe places and more opportunities for PA, and these findings are in keeping with those from the international literature on T2DM individuals.

Strengths and limitations

The generalisability of the results from this study was strengthened by the number of responses obtained, the high response rate, and the sampling methodology, whereby

participants were recruited from various healthcare settings in Malta and Gozo. Notwithstanding this, a number of limitations were encountered which might have affected the study outcomes. Thus, the results should be interpreted in light of the below limitations.

Selection bias

The target population of this study consisted of T2DM individuals living in Malta and Gozo. In view of the lack of a national diabetes register, it was not possible to employ probability sampling to obtain a nationally representative sample. Attempts were made to obtain as representative a sample as possible by recruiting participants from two local hospitals, one in Malta and one in Gozo, and three main health centres within the public sector. However, this excluded a sub-population of individuals not receiving care by the public health service, those who do not attend the selected clinics, and those who are undiagnosed or are not being followed-up. Additionally, those who agreed to participate in this study might have been more health conscious and more likely to have positive health behaviours resulting in more favourable characteristics than those who refused to participate in the study and those who do not attend their appointments altogether. Furthermore, the sampling technique which was deemed appropriate in this study was a consecutive sampling approach, which is a type of non-probability sampling. These limitations may have introduced a selection bias as participants might have different characteristics from the rest of the target population. The researcher attempted to mitigate for this by attending clinics on all days of the week when clinics were held, including afternoon clinics to ensure that working adults who might have been unable to attend in the morning were included in the study. Additionally, all eligible persons were given an equal chance to participate. The researcher was available to offer assistance to ensure that

individuals unable to complete the questionnaire, such as those who are illiterate, would still be represented. Finally, a high response rate of 95.52% was obtained.

Information bias

Response bias in the form of social desirability might have been introduced, whereby participants may feel inclined to provide the answers that the researcher wishes to hear, rather than according to their true beliefs, and this may have also led to overreporting of PA levels and underreporting of sitting time. This may normally be counteracted by ensuring confidentiality and anonymity; however, in this study, personal identifiers could not be omitted since these were required to obtain the HbA1c blood result which was one of the variables studied. The researcher tried to mitigate for this limitation by emphasising the pseudonymity of data analysis.

Recall bias may have been introduced when asking participants to report the frequency of PA. The researcher attempted to mitigate for this limitation by using previously validated tools, limiting the recall period to seven days, and by including examples of different activities to help participants remember whether they participated in any form of PA. Furthermore, using self-report measures as opposed to objective measures may result in an over- or underestimation of the amount of PA carried out. Apart from financial and time constraints, the use of objective measures was beyond the scope of this study. A recent systematic review and meta-analysis recommended the use of the IPAQ short form for assessment of moderate-to-vigorous PA in adults when only self-reporting of PA is feasible (Sember et al., 2020).

Other response bias that could have occurred includes misunderstanding or misinterpretation of questionnaire items, and incomplete questionnaires. To mitigate for misunderstanding, the researcher conducted a pilot study and assessed the test-retest

reliability of the questionnaire tool. This was further mitigated by ensuring that the researcher was present at all times to offer assistance, whilst being cautious not to ask leading questions. The lengthy format of the questionnaire might have led to some participants not fully completing it. This was mitigated by distributing the questionnaire shortly after arrival of each potential participant at the clinic to ensure that they had enough time to complete it while waiting to be called for their appointment. Personally distributing the questionnaire helped to further mitigate for a low response rate as opposed to postal or online surveys.

Observer bias might have been introduced in the measurement of weight and height by nurses. The researcher attempted to mitigate for this by training the nurses. Furthermore, the researcher decided to measure the waist circumference herself to ensure consistency in measurement method.

Instrument bias might have been introduced from calibration differences of the weighing scales used to measure the weight and height in the various clinics. However, given that these instruments are used in a healthcare setting, the researcher assumed that they are regularly inspected and calibrated as required.

Other limitations

This was a cross-sectional study, which is a type of observational study design that analyses data collected from a population through a one-time measurement. Although the association between variables can be studied, this type of study does not allow for causality between independent and dependent variables to be determined. Effects of confounding were minimised as much as possible by using regression analysis which corrected for those factors found to be significant in the univariate analysis.

Deductive research is a structured and systematic way of testing theories or hypotheses and either proving or disproving them, as opposed to inductive research which is exploratory and flexible. Utilising a quantitative, deductive approach in this study did not allow exploration and an in-depth understanding of individuals' thoughts, insights, or experiences. Qualitative data could have helped triangulation and shed further light on the reasons behind some observations. This was mitigated by adding open-ended questions to the research tool to allow participants to add comments or elaborate on a particular aspect and the replies provided were then analysed through thematic content analysis. Furthermore, during the design of the research instrument, the researcher ensured that the tools chosen captured all information relevant to the research topic.

Despite these limitations, most study findings conform with those of the international literature, suggesting that the recommendations emerging from this study are strong enough to inform policy decisions.

Further research

The quantitative nature of this study did not allow an in-depth exploration of knowledge, attitudes, and perceptions towards PA among T2DM individuals. Further research employing qualitative methodology is recommended to provide a more detailed assessment of their perceptions and possibly elucidate additional concepts related to PA barriers and enablers which were not captured in this study.

Future cross-sectional studies could ensure that a nationally representative sample targeting the entire local T2DM population is recruited, including persons from all geographical areas and healthcare settings, if possible also including the private health sector. Furthermore, future studies could focus on type 1 diabetic individuals in order to

determine whether their knowledge, attitudes, and perceptions differ from those of type 2 diabetics.

Future studies could be designed to be prospective in nature, possibly with an experimental element to identify the optimal interventions which enable T2DM patients to successfully overcome barriers and adopt and maintain PA.

Finally, research may be conducted among health professionals, exploring their own barriers and enablers related to prescribing PA to their patients, while assessing their level of knowledge of the PA recommendations for persons with diabetes and whether their practices related to PA promotion conform with international guidelines. Additionally, when health promotion campaigns are designed and implemented, evaluation should be undertaken to monitor for any change in knowledge, attitudes, and practices of PA among T2DM individuals in Malta and Gozo.

Recommendations

This chapter translates the study findings into proposals and recommendations for clinical practice and for the design and planning of future policies and health promotion interventions.

This study demonstrated that, in line with the existing local and international literature, a significant proportion of T2DM individuals are inactive. Future policies in health and other sectors would do well to take into consideration the need for integrating PA into the daily lives of our population to combat the increasingly sedentary lifestyles and rising overweight/obesity rates, adopting a health in all policies approach. Given that younger individuals were found to have more sedentary time, which may be assumed to be related to increasingly sedentary occupations, interventions may include campaigns and policies to increase mobility at workplaces. Furthermore, future policies and interventions should consider facilitating the use of public transport as opposed to private vehicles, as well as promoting walking, cycling, and other forms of micromobility in our natural and built environments by ensuring safer roads and adequate access to designated safe, open spaces for PA.

This study identified a plethora of factors which influence adherence to PA among diabetics, meaning that a one-size-fits-all approach is unlikely to succeed. Healthcare providers are encouraged to seek to identify and assess individual personal characteristics, external factors, and barriers their patients face when trying to engage in PA and formulate patient-centred treatment plans based on individual capabilities, physical limitations, health concerns, and personal interests. Involving the spouse or immediate family members would provide patients with an additional source of support.

Some participants mentioned how the health benefits of PA encourage them to be more active, in addition to encouragement from their caring physician. These findings are

of particular relevance to healthcare providers as they demonstrate the importance of providing continued support to their patients, with counselling sessions going beyond giving advice to offering encouragement and focusing on the patients' needs. Indeed, knowledge of the benefits of PA does not seem to enable or empower such patients to sufficiently overcome the perceived barriers. Monitoring of their parameters, such as glycaemic control, weight, and waist circumference, may provide additional motivation by demonstrating improvement in such parameters with better PA adherence. The finding that both knowledge and level of PA deteriorate with a longer duration of diabetes emphasises the need for healthcare professionals to assess adherence at each clinical encounter and provide appropriate counselling.

The design of nation-wide health promotion and educational interventions would do well to comprehensively consider the influencing factors identified in this study, not only communicating the optimal amount of PA, but also promoting the benefits of PA in diabetes and ways on how to overcome barriers to PA, such as carrying out exercises indoors.

Finally, as demonstrated, various barriers and enablers experienced by T2DM individuals are not related specifically to their condition and reflect those of the general population. Hence, some of the proposed recommendations may also bring about health benefits in the general population and should be considered in policymaking at a national level.

References

Advika, T. S., Idiculla, J., & Kumari, S. J. (2017). Exercise in patients with Type 2 diabetes: Facilitators and barriers - A qualitative study. *Journal of Family Medicine and Primary Care, 6*(2), 288-292. https://doi.org/10.4103/2249-4863.219998

Akinci, B., Yeldan, I., Celik, S., & Satman, I. (2019). Physical Activity Indicators, Metabolic Biomarkers, and Comorbidity in Type 2 Diabetes. *Research Quarterly for Exercise and Sport, 90*(4), 690-698. https://doi.org/10.1080/02701367.2019.1645269

Albuquerque, C., Correia, C., & Oliveira Albuquerque, S. (2021). Adherence to physical activity in people with type 2 diabetes. *INFAD (Barcelona), 1*(2), 475-482. https://doi.org/10.17060/ijodaep.2021.n2.v1.2201

Alghafri, T., Alharthi, S. M., Al Farsi, Y. M., Bannerman, E., Craigie, A. M., & Anderson, A. S. (2017). Perceived barriers to leisure time physical activity in adults with type 2 diabetes attending primary healthcare in Oman: A cross-sectional survey. *BMJ Open, 7*(11), e016946. https://doi.org/10.1136/bmjopen-2017-016946

Al-Kaabi, J., Al-Maskari, F., Saadi, H., Afandi, B., Parkar, H., & Nagelkerke, N. (2009). Physical activity and reported barriers to activity among type 2 diabetic patients in the United Arab Emirates. *The Review of Diabetic Studies, 6*(4), 271-278. https://doi.org/10.1900/RDS.2009.6.271

AlKhudidi, F. H., Alsulaimani, A. I., Alharthi, A. H., Alrumaym, A. H., Alharthi, E. K., Altalhi, W. A., Alkhaldi, L. M., Alhossini, Z. A., & Alzahrani, K. T. (2021). Awareness of Type 2 Diabetic Patients about the Importance of Exercise and

Diet on Diabetes Type 2 in the Western Region of Saudi Arabia. *Materia Socio-Medica, 33*(4), 276-281. https://doi.org/10.5455/msm.2021.33.276-281

Alzahrani, A. M., Albakri, S. B. B., Alqutub, T. T., Alghamdi, A. A., & Rio, A. A. (2019). Physical activity level and its barriers among patients with type 2 diabetes mellitus attending primary healthcare centers in Saudi Arabia. *Journal of Family Medicine and Primary Care, 8*(8), 2671-2675. https://doi.org/10.4103/jfmpc.jfmpc_433_19

Amaral, L. S. d. B., Souza, C. S., Lima, H. N., & Soares, T. d. J. (2020). Influence of exercise training on diabetic kidney disease: A brief physiological approach. *Experimental Biology and Medicine (Maywood, N.J.), 245*(13), 1142-1154. https://doi.org/10.1177/1535370220928986

American Diabetes Association. (2023, January). Standards of Care in Diabetes-2023. *Diabetes Care*, *46*(Suppl 1). https://diabetesjournals.org/care/issue/46/Supplement_1

Anand, V., Garg, S., Garg, J., Bano, S., & Pritzker, M. (2018). Impact of Exercise Training on Cardiac Function Among Patients With Type 2 Diabetes: A SYSTEMATIC REVIEW AND META-ANALYSIS. *Journal of Cardiopulmonary Rehabilitation and Prevention, 38*(6), 358-365. https://doi.org/10.1097/HCR.0000000000000353

Bacchi, E., Negri, C., Zanolin, M. E., Milanese, C., Faccioli, N., Trombetta, M., Zoppini, G., Cevese, A., Bonadonna, R. C., Schena, F., Bonora, E., Lanza, M., & Moghetti, P. (2012). Metabolic effects of aerobic training and resistance training in type 2 diabetic subjects: a randomized controlled trial (the RAED2 study). *Diabetes Care*, *35*(4), 676-682. https://doi.org/10.2337/dc11-1655

Baldacchino, C. (2012). *Knowledge and behaviour amongst clients with Type 2 diabetes regarding their condition and its management*. [Bachelor's dissertation, University of Malta]. OAR@UM. https://www.um.edu.mt/library/oar/handle/123456789/67219

Balducci, S., Sacchetti, M., Haxhi, J., Orlando, G., Zanuso, S., Cardelli, P., Cavallo, S., D'Errico, V., Ribaudo, M. C., Di Biase, N., Salvi, L., Vitale, M., Bollanti, L., Conti, F. G., Nicolucci, A., & Pugliese, G. (2015). The Italian Diabetes and Exercise Study 2 (IDES-2): A long-term behavioral intervention for adoption and maintenance of a physically active lifestyle. *Current Controlled Trials in Cardiovascular Medicine, 16*(1), 569. https://doi.org/10.1186/s13063-015-1088-0

Beverly, E. A., & Wray, L. A. (2010). The role of collective efficacy in exercise adherence: a qualitative study of spousal support and type 2 diabetes management. *Health Education Research, 25*(2), 211-223. https://doi.org/10.1093/her/cyn032

Blicher-Hansen, J., Chilcot, J., & Gardner, B. (2022). Experiences of successful physical activity maintenance among adults with type 2 diabetes: a theory-based qualitative study. *Psychology & Health,* 1-18. https://doi.org/10.1080/08870446.2022.2063863

Brazeau, A. S., Mircescu, H., Desjardins, K., Dubé, M. C., Weisnagel, S. J., Lavoie, C., & Rabasa-Lhoret, R. (2012). The Barriers to Physical Activity in Type 1 Diabetes (BAPAD-1) scale: Predictive validity and reliability. *Diabetes & Metabolism, 38*(2), 164-170. https://doi.org/10.1016/j.diabet.2011.10.005

Brazeau, A. S., Rabasa-Lhoret, R., Strychar, I., & Mircescu, H. (2008). Barriers to physical activity among patients with type 1 diabetes. *Diabetes Care, 31*(11), 2108-2109. https://doi.org/10.2337/dc08-0720

Brennan, M., Brown, J., Ntoumanis, N., & Leslie, G. (2020). Barriers and facilitators to physical activity participation in adults living with type 1 diabetes: a scoping review protocol. *JBI Evidence Synthesis, 18*(7), 1587-1593. https://doi.org/10.11124/jbisrir-d-19-00219

Bruce, D., Hunter, M., Peters, K., Davis, T., & Davis, W. (2015). Fear of falling is common in patients with type 2 diabetes and is associated with increased risk of falls. *Age and Ageing, 44*(4), 687-690. https://doi.org/10.1093/ageing/afv024

Cai, Z., Yang, Y., & Zhang, J. (2021). Effects of physical activity on the progression of diabetic nephropathy: a meta-analysis. *Bioscience Reports, 41*(1), BSR20203624. https://doi.org/10.1042/BSR20203624

Carabott Pawley, D. (2020). *Physical activity patterns in Maltese adults living with type 2 diabetes mellitus*. [Master's dissertation, University of Malta]. OAR@UM. https://www.um.edu.mt/library/oar/handle/123456789/65167

Chadchavalpanichaya, N., & Intaratep, N. (2010). Exercise behavior and knowledge among the DM type II patients. *Journal of the Medical Association of Thailand = Chotmaihet Thangphaet, 93*(5), 587-593.

Che, S., Meng, M., Jiang, Y., Ye, X., & Xie, C. (2022). Perceptions of exercise and exercise instruction in patients with type 2 diabetes mellitus and sarcopenia : a qualitative study. *BMC Geriatrics, 22*(1), 892. https://doi.org/10.1186/s12877-022-03519-0

Chudyk, A., & Petrella, R. J. (2011). Effects of exercise on cardiovascular risk factors in type 2 diabetes: a meta-analysis. *Diabetes Care, 34*(5), 1228-1237. https://doi.org/10.2337/dc10-1881

Colberg, S. R., Sigal, R. J., Fernhall, B., Regensteiner, J. G., Blissmer, B. J., Rubin, R. R., Chasan-Taber, L., Albright, A. L., Braun, B., American College of Sports Medicine, & American Diabetes Association. (2010). Exercise and type 2 diabetes: the American College of Sports Medicine and the American Diabetes Association: joint position statement. *Diabetes Care, 33*(12), 147. https://doi.org/10.2337/dc10-9990

Colberg, S. R., Sigal, R. J., Yardley, J. E., Riddell, M. C., Dunstan, D. W., Dempsey, P. C., Horton, E. S., Castorino, K., & Tate, D. F. (2016). Physical Activity/Exercise and Diabetes: A Position Statement of the American Diabetes Association. *Diabetes Care*, *39*(11), 2065-2079. https://doi.org/10.2337/dc16-1728

Cooper, J., Stetson, B., Bonner, J., Spille, S., Krishnasamy, S., & Mokshagundam, S. P. (2015). Self-Reported Physical Activity in Medically Underserved Adults With Type 2 Diabetes in Clinical and Community Settings. *Journal of Physical Activity & Health, 12*(7), 968-975. https://doi.org/10.1123/jpah.2013-0475

Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F., & Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine and Science in Sports and Exercise, 35*(8), 1381-1395. https://doi.org/10.1249/01.MSS.0000078924.61453.FB

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications, Incorporated.

Curran, M., Drayson, M. T., Andrews, R. C., Zoppi, C., Barlow, J. P., Solomon, T. P. J., & Narendran, P. (2020). The benefits of physical exercise for the health of the pancreatic β-cell: a review of the evidence. *Experimental Physiology, 105*(4), 579-589. https://doi.org/10.1113/EP088220

Cuschieri, S. (2020). The diabetes epidemic in Malta. *South Eastern European Journal of Public Health, 13*(1). https://doi.org/10.4119/seejph-3322

Cuschieri, S., Vassallo, J., Calleja, N., Pace, N., Abela, J., Ali, B. A., Abdullah, F., Zahra, E., & Mamo, J. (2016). The diabesity health economic crisis-the size of the crisis in a European island state following a cross-sectional study. *Archives of Public Health = Archives Belges De Sante Publique, 74,* 52. https://doi.org/10.1186/s13690-016-0164-6

Cutajar, J. (2008). An evaluation of type 2 diabetes care in the primary care setting. *Malta Medical Journal : MMJ, 20*(3), 21-28.

Directorate for Health Information and Research. (2023, Sep 14). *Annual Mortality Report 2020*. https://healthservices.gov.mt/en/dhir/Documents/Deaths/Annual%20Mortality%20Report%202020.pdf

Drummond, K., Bennett, R., Gibbs, J., Wei, R., Hu, W., Tardio, V., Gagnon, C., Berger, C., & Morin, S. N. (2022). Perceptions of fracture and fall risk and of the benefits and barriers to exercise in adults with diabetes. *Osteoporosis International : A Journal Established as Result of Cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA, 33*(12), 2563-2573. https://doi.org/10.1007/s00198-022-06524-6

Dubé, M., Valois, P., Prud'homme, D., Weisnagel, S. J., & Lavoie, C. (2006). Physical activity barriers in diabetes: development and validation of a new scale. *Diabetes Research and Clinical Practice, 72*(1), 20-27. https://doi.org/10.1016/j.diabres.2005.08.008

Duclos, M., Dejager, S., Postel-Vinay, N., di Nicola, S., Quéré, S., & Fiquet, B. (2015). Physical activity in patients with type 2 diabetes and hypertension – Insights into motivations and barriers from the MOBILE study. *Vascular Health and Risk Management, 11*, 361-371. https://doi.org/10.2147/VHRM.S84832

Duncan, R. (2016). *Self-care practices of older adults with diabetes mellitus*. [Master's dissertation, University of Malta]. OAR@UM. https://www.um.edu.mt/library/oar//handle/123456789/14044

Dutton, G. R., Johnson, J., Whitehead, D., Bodenlos, J. S., & Brantley, P. J. (2005). Barriers to physical activity among predominantly low-income African-American patients with type 2 diabetes. *Diabetes Care, 28*(5), 1209-1210. https://doi.org/10.2337/diacare.28.5.1209

Dye, C. J., Haley-Zitlin, V., & Willoughby, D. (2003). Insights From Older Adults With Type 2 Diabetes: Making Dietary and Exercise Changes. *The Diabetes Educator, 29*(1), 116-127. https://doi.org/10.1177/014572170302900116

Egan, A. M., Mahmood, W. A. W., Fenton, R., Redziniak, N., Kyaw Tun, T., Sreenan, S., & McDermott, J. H. (2013). Barriers to exercise in obese patients with type 2 diabetes. *QJM : Monthly Journal of the Association of Physicians, 106*(7), 635-638. https://doi.org/10.1093/qjmed/hct075

Eigenmann, C. A., Skinner, T., & Colagiuri, R. (2011). Development and validation of a diabetes knowledge questionnaire. *Practical Diabetes International, 28*(4), 166-170d. https://doi.org/10.1002/pdi.1586

England, K., Buttigieg, D., Calleja, N. (2022). *European Health Interview Survey (EHIS) 2019/2020: Health Status Report*. Malta: Directorate for Health Information and Research. https://deputyprimeminister.gov.mt/en/dhir/Pages/Surveys/European-Health-Interview-Survey2019-(EHIS).aspx

Esteves, M. D. L., Rodrigues, R. J. A. G., Pinheiro, P. G., Brás, R. M. M., Gouveia, A. I. A. D. R., Hara, K. L. S., & Duarte, P. A. O. (2019). Physical activity patterns and perceptions among type 2 diabetic and non-diabetic Portuguese. *Annals of Applied Sport Science*, *7*(4), 36-42. https://doi.org/10.29252/aassjournal.810

European Commission. (2020). *European Health Interview Survey (EHIS wave 3): Methodological manual 2020 edition (re-edition)*. Luxembourg: European Union. https://doi.org/10.2785/135920

European Commission. (2022). *Special Eurobarometer 525 - Sport and Physical Activity*. European Union. https://www.europa.eu/eurobarometer

Felix, H., Li, X., Rowland, B., Long, C. R., Yeary, K. H. K., & McElfish, P. A. (2017). Physical Activity and Diabetes-related Health Beliefs of Marshallese Adults. *American Journal of Health Behavior*, *41*(5), 553-560. https://doi.org/10.5993/AJHB.41.5.4

Fitzgerald, J. T., Davis, W. K., Connell, C. M., Hess, G. E., Funnell, M. M., & Hiss, R. G. (1996). Development and validation of the Diabetes Care Profile. *Evaluation & the Health Professions*, *19*(2), 208-230. https://doi.org/10.1177/016327879601900205

Fonk, F. A. (2021). *Living with Diabetes Mellitus type 2 : a qualitative research study*. [Master's dissertation, University of Malta]. OAR@UM. https://www.um.edu.mt/library/oar/handle/123456789/91595

Ganiyu, A. B., Mabuza, L. H., Malete, N. H., Govender, I., & Ogunbanjo, G. A. (2013). Non-adherence to diet and exercise recommendations amongst patients with type 2 diabetes mellitus attending extension II clinic in Botswana. *African Journal of Primary Health Care and Family Medicine, 5*(1), 457. https://doi.org/10.4102/phcfm.v5i1.457

Gatt, S., & Sammut, R. (2008). An exploratory study of predictors of self-care behaviour in persons with type 2 diabetes. *International Journal of Nursing Studies, 45*(10), 1525-1533. https://doi.org/10.1016/j.ijnurstu.2008.02.006

Gordon, C. D., & Nelson, G. A. (2019). Physical activity correlates among persons with type 2 diabetes in Jamaica. *International Journal of Diabetes in Developing Countries, 39*(1), 108-114. https://doi.org/10.1007/s13410-018-0640-3

Harvey, J. N., & Lawson, V. L. (2009). The importance of health belief models in determining self-care behaviour in diabetes. *Diabetic Medicine, 26*(1), 5-13. https://doi.org/10.1111/j.1464-5491.2008.02628.x

He, W., Zhang, Y., & Zhao, F. (2013). Factors influencing exercises in Chinese people with type 2 diabetes. *International Nursing Review, 60*(4), 494-500. https://doi.org/10.1111/inr.12046

Heiss, V., & Petosa, R. (2014). Correlates of Physical Activity Among Adults With Type 2 Diabetes: A Systematic Literature Review. *American Journal of Health Education, 45*(5), 278-287. https://doi.org/10.1080/19325037.2014.933139

Hsu, H., Chung, D., Lee, L., Lin, I., & Chen, S. (2021). Beliefs, Benefits and Barriers Associated with Physical Activity: Impact of These Factors on Physical Activity in Patients With Type II Diabetes Mellitus. *Clinical Nursing Research, 30*(3), 302-310. https://doi.org/10.1177/1054773820967699

Hui, S. S., Hui, G. P., & Xie, Y. J. (2014). Association between physical activity knowledge and levels of physical activity in Chinese adults with type 2 diabetes. *PLoS ONE, 9*(12), e115098. https://doi.org/10.1371/journal.pone.0115098

International Diabetes Federation. (2021). *IDF Diabetes Atlas, 10th edition*. https://diabetesatlas.org/idfawp/resource-files/2021/07/IDF_Atlas_10th_Edition_2021.pdf

IPAQ. (2022). *IPAQ - International Physical Activity Questionnaire*. Retrieved September 8, 2023 from https://sites.google.com/view/ipaq/home

Janz, N. K., & Becker, M. H. (1984). The Health Belief Model: a decade later. *Health Education Quarterly, 11*(1), 1-47. https://doi.org/10.1177/109019818401100101

Kanaley, J. A., Colberg, S. R., Corcoran, M. H., Malin, S. K., Rodriguez, N. R., Crespo, C. J., Kirwan, J. P., & Zierath, J. R. (2022). Exercise/Physical Activity in Individuals with Type 2 Diabetes: A Consensus Statement from the American College of Sports Medicine. *Medicine and Science in Sports and Exercise, 54*(2), 353-368. https://doi.org/10.1249/MSS.0000000000002800

Kang, H. J., Wang, J. C. K., Burns, S. F., & Leow, M. K. (2021). Is Self-Determined Motivation a Useful Agent to Overcome Perceived Exercise Barriers in Patients With Type 2 Diabetes Mellitus? *Frontiers in Psychology, 12*, 627815. https://doi.org/10.3389/fpsyg.2021.627815

Kennedy, A., Narendran, P., Andrews, R. C., Daley, A., Greenfield, S. M., & EXTOD Group. (2018). Attitudes and barriers to exercise in adults with a recent diagnosis of type 1 diabetes: a qualitative study of participants in the Exercise for Type 1 Diabetes (EXTOD) study. *BMJ Open, 8*(1), e017813. https://doi.org/10.1136/bmjopen-2017-017813

Kennerly, A., & Kirk, A. (2018). Physical activity and sedentary behaviour of adults with type 2 diabetes: A systematic review. *Practical Diabetes, 35*(3), 86-89g. https://doi.org/10.1002/pdi.2169

Khan, M. A. B., Hashim, M. J., King, J. K., Govender, R. D., Mustafa, H., & Al Kaabi, J. (2020). Epidemiology of Type 2 Diabetes - Global Burden of Disease and Forecasted Trends. *Journal of Epidemiology and Global Health, 10*(1), 107-111. https://doi.org/10.2991/jegh.k.191028.001

Kime, N. H., Pringle, A., Rivett, M. J., & Robinson, P. M. (2018). Physical activity and exercise in adults with type 1 diabetes: understanding their needs using a person-centered approach. *Health Education Research, 33*(5), 375-388. https://doi.org/10.1093/her/cyy028

Lanhers, C., Duclos, M., Guttmann, A., Coudeyre, E., Pereira, B., & Ouchchane, L. (2015). General Practitioners' Barriers to Prescribe Physical Activity: The Dark Side of the Cluster Effects on the Physical Activity of Their Type 2 Diabetes Patients. *PloS One, 10*(10), e0140429. https://doi.org/10.1371/journal.pone.0140429

Lascar, N., Kennedy, A., Hancock, B., Jenkins, D., Andrews, R. C., Greenfield, S., & Narendran, P. (2014). Attitudes and barriers to exercise in adults with type 1 diabetes (T1DM) and how best to address them: a qualitative study. *PloS One, 9*(9), e108019. https://doi.org/10.1371/journal.pone.0108019

Lawton, J., Ahmad, N., Hanna, L., Douglas, M., & Hallowell, N. (2006). 'I can't do any serious exercise': barriers to physical activity amongst people of Pakistani and Indian origin with Type 2 diabetes. *Health Education Research, 21*(1), 43-54. https://doi.org/10.1093/her/cyh042

Lee, O., Lee, D., Lee, S., & Kim, Y. S. (2016). Associations between Physical Activity and Obesity Defined by Waist-To-Height Ratio and Body Mass Index in the Korean Population. *PloS One*, *11*(7), e0158245. https://doi.org/10.1371/journal.pone.0158245

Leitner, D. R., Frühbeck, G., Yumuk, V., Schindler, K., Micic, D., Woodward, E., & Toplak, H. (2017). Obesity and Type 2 Diabetes: Two Diseases with a Need for Combined Treatment Strategies - EASO Can Lead the Way. *Obesity Facts*, *10*(5), 483-492. https://doi.org/10.1159/000480525

Li, D., Yang, Y., Gao, Z., Zhao, L., Yang, X., Xu, F., Yu, C., Zhang, X., Wang, X., Wang, L., & Su, J. (2022). Sedentary lifestyle and body composition in type 2 diabetes. *Diabetology & Metabolic Syndrome*, *14*(1), 8-6. https://doi.org/10.1186/s13098-021-00778-6

Lidegaard, L. P., Schwennesen, N., Willaing, I., & Færch, K. (2016). Barriers to and motivators for physical activity among people with Type 2 diabetes: patients' perspectives. *Diabetic Medicine*, *33*(12), 1677-1685. https://doi.org/10.1111/dme.13167

Magalhães, J. P., Melo, X., Correia, I. R., Ribeiro, R. T., Raposo, J., Dores, H., Bicho, M., & Sardinha, L. B. (2019). Effects of combined training with different intensities on vascular health in patients with type 2 diabetes: a 1-year randomized controlled trial. *Cardiovascular Diabetology*, *18*(1), 34-2. https://doi.org/10.1186/s12933-019-0840-2

Mannucci, E., Bonifazi, A., & Monami, M. (2021). Comparison between different types of exercise training in patients with type 2 diabetes mellitus: A systematic review and network metanalysis of randomized controlled trials. *Nutrition*,

Metabolism, and Cardiovascular Diseases : NMCD, 31(7), 1985-1992. https://doi.org/10.1016/j.numecd.2021.02.030

Martin, C. G., Pomares, M. L., Muratore, C. M., Avila, P. J., Apoloni, S. B., Rodríguez, M., & Gonzalez, C. D. (2021). Level of physical activity and barriers to exercise in adults with type 2 diabetes. *AIMS Public Health, 8*(2), 229-239. https://doi.org/10.3934/publichealth.2021018

Martinez-Harvell, G., Goluboff, F., Rodriguez, P., Castro, G., & Barengo, N. C. (2020). Predictors of adherence to physical activity guidelines in patients with diabetes mellitus in the US in 2017: An exploratory analysis. *Primary Care Diabetes, 14*(6), 645-653. https://doi.org/10.1016/j.pcd.2020.05.001

Martín-Timón, I., Sevillano-Collantes, C., Segura-Galindo, A., & Del Cañizo-Gómez, F. J. (2014). Type 2 diabetes and cardiovascular disease: Have all risk factors the same strength? *World Journal of Diabetes*, *5*(4), 444-470. https://doi.org/10.4239/wjd.v5.i4.444

Matos, M., Mendes, R., Silva, A. B., & Sousa, N. (2018). Physical activity and exercise on diabetic foot related outcomes: A systematic review. *Diabetes Research and Clinical Practice, 139*, 81-90. https://doi.org/10.1016/j.diabres.2018.02.020

Mier, N., Medina, A. A., & Ory, M. G. (2007). Mexican Americans with type 2 diabetes: perspectives on definitions, motivators, and programs of physical activity. *Preventing Chronic Disease, 4*(2), A24.

Miller, S. T., & Marolen, K. (2012). Physical activity-related experiences, counseling expectations, personal responsibility, and altruism among urban African American women with type 2 diabetes. *The Diabetes Educator, 38*(2), 229-235. https://doi.org/10.1177/0145721712437558

Nakanishi, S., Hirukawa, H., Shimoda, M., Tatsumi, F., Kohara, K., Obata, A., Okauchi, S., Katakura, Y., Sanada, J., Fushimi, Y., Nishioka, M., Kan, Y., Tomita-Mizoguchi, A., Isobe, H., Iwamoto, H., Takahashi, K., Mune, T., Kaku, K., & Kaneto, H. (2020). Impact of physical activity and sedentary time on glycated hemoglobin levels and body composition: Cross-sectional study using outpatient clinical data of Japanese patients with type 2 diabetes. *Journal of Diabetes Investigation, 11*(3), 633-639. https://doi.org/10.1111/jdi.13185

National Institute for Health and Care Excellence (NICE). (2023, July 26). *Obesity: identification, assessment and management (CG189).* Retrieved August 25, 2023 from https://www.nice.org.uk/guidance/cg189

National Statistics Office. (2014). *Metadata: Districts (Local Administrative Unit)*. Retrieved August 14, 2023 from https://metadata.nso.gov.mt/classificationdetails.aspx?id=Districts%20(Local%20Administrative%20Unit)

National Statistics Office. (2023). *Census of Population and Housing 2021: Final Report: Population, migration and other social characteristics Volume 1*. Valletta: National Statistics Office. https://nso.gov.mt/events/census-of-population-and-housing-2021-final-report-population-migration-and-other-social-characteristics/

Nor Shazwani, M. N., Suzana, S., Hanis Mastura, Y., Lim, C. J., Teh, S. C., Mohd Fauzee, M. Z., Lim, H. C., Dahlia, S., & Norliza, M. (2010). Assessment of physical activity level among individuals with type 2 diabetes mellitus at Cheras health clinic, Kuala Lumpur. *Malaysian Journal of Nutrition, 16*(1), 101-112. https://www.scopus.com/inward/record.uri?eid=2-s2.0-77954286735&partnerID=40&md5=1d888d5223f05395bbc721d6226b1117

Okonta, H. I., Ikombele, J. B., & Ogunbanjo, G. A. (2014). Knowledge, attitude and practice regarding lifestyle modification in type 2 diabetic patients. *African Journal of Primary Health Care & Family Medicine, 6*(1), E1-6. https://doi.org/10.4102/phcfm.v6i1.655

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ (Clinical Research Ed.), 372*, n71. https://doi.org/10.1136/bmj.n71

Paing, A. C., McMillan, K. A., Kirk, A. F., Collier, A., Hewitt, A., & Chastin, S. F. M. (2018). The associations of sedentary time and breaks in sedentary time with 24-hour glycaemic control in type 2 diabetes. *Preventive Medicine Reports, 12*, 94-100. https://doi.org/10.1016/j.pmedr.2018.09.002

Pati, S., Lobo, E., Pati, S., Desaraju, S., & Mahapatra, P. (2019). Type 2 diabetes and physical activity: barriers and enablers to diabetes control in Eastern India. *Primary Health Care Research & Development, 20*, e44. https://doi.org/10.1017/S146342361800097X

Peel, E., Douglas, M., Parry, O., & Lawton, J. (2010). Type 2 diabetes and dog walking: Patients' longitudinal perspectives about implementing and sustaining physical activity. *British Journal of General Practice, 60*(577), 570-577. https://doi.org/10.3399/bjgp10X515061

Peter, P. I., Steinberg, W. J., van Rooyen, C., & Botes, J. (2022). Type 2 diabetes mellitus patients' knowledge, attitude and practice of lifestyle

modifications. *Health SA = SA Gesondheid, 27*, 1921. https://doi.org/10.4102/hsag.v27i0.1921

Piirtola, M., Jelenkovic, A., Latvala, A., Sund, R., Honda, C., Inui, F., Watanabe, M., Tomizawa, R., Iwatani, Y., Ordoñana, J. R., Sánchez-Romera, J. F., Colodro-Conde, L., Tarnoki, A. D., Tarnoki, D. L., Martin, N. G., Montgomery, G. W., Medland, S. E., Rasmussen, F., Tynelius, P., . . . Silventoinen, K. (2018). Association of current and former smoking with body mass index: A study of smoking discordant twin pairs from 21 twin cohorts. *PloS One, 13*(7), e0200140. https://doi.org/10.1371/journal.pone.0200140

Qian, X., Su, C., Zhang, B., Qin, G., Wang, H., & Wu, Z. (2019). Changes in distributions of waist circumference, waist-to-hip ratio and waist-to-height ratio over an 18-year period among Chinese adults: a longitudinal study using quantile regression. *BMC Public Health, 19*(1), 700-6. https://doi.org/10.1186/s12889-019-6927-6

Qiu, S., Cai, X., Yin, H., Sun, Z., Zügel, M., Steinacker, J. M., & Schumann, U. (2018). Exercise training and endothelial function in patients with type 2 diabetes: a meta-analysis. *Cardiovascular Diabetology*, *17*(1), 64-2. https://doi.org/10.1186/s12933-018-0711-2

Reiff, S. (2015). *Self-efficacy, self-care and outcomes in persons with diabetes.* [Master's dissertation, University of Malta]. OAR@UM. https://www.um.edu.mt/library/oar//handle/123456789/41108

Ren, C., Liu, W., Li, J., Cao, Y., Xu, J., & Lu, P. (2019). Physical activity and risk of diabetic retinopathy: a systematic review and meta-analysis. *Acta Diabetologica*, *56*(8), 823-837. https://doi.org/10.1007/s00592-019-01319-4

Röhling, M., Herder, C., Roden, M., Stemper, T., & Müssig, K. (2016). Effects of Long-Term Exercise Interventions on Glycaemic Control in Type 1 and Type 2 Diabetes: a Systematic Review. *Experimental and Clinical Endocrinology & Diabetes : Official Journal, German Society of Endocrinology [and] German Diabetes Association, 124*(8), 487-494. https://doi.org/10.1055/s-0042-106293

Rosenstock, I. M., Strecher, V. J., & Becker, M. H. (1988). Social learning theory and the Health Belief Model. *Health Education Quarterly, 15*(2), 175-183. https://doi.org/10.1177/109019818801500203

Royal Australian College of General Practitioners. (2020). *Management of type 2 diabetes: A handbook for general practice*. East Melbourne, Victoria.

Scavarda, A., Costa, G., & Beccaria, F. (2023). Using Photovoice to understand physical and social living environment influence on adherence to diabetes. *Health (London, England : 1997), 27*(2), 279–300. https://doi.org/10.1177/13634593211020066

Schmitt, A., Gahr, A., Hermanns, N., Kulzer, B., Huber, J., & Haak, T. (2013). The Diabetes Self-Management Questionnaire (DSMQ): development and evaluation of an instrument to assess diabetes self-care activities associated with glycaemic control. *Health and Quality of Life Outcomes, 11*, 138-138. https://doi.org/10.1186/1477-7525-11-138

Sechrist, K. R., Walker, S. N., & Pender, N. J. (1987). Development and psychometric evaluation of the exercise benefits/barriers scale. *Research in Nursing & Health, 10*(6), 357-365. https://doi.org/10.1002/nur.4770100603

Sember, V., Meh, K., Sorić, M., Starc, G., Rocha, P., & Jurak, G. (2020). Validity and Reliability of International Physical Activity Questionnaires for Adults across EU Countries: Systematic Review and Meta Analysis. *International Journal of*

Environmental Research and Public Health, 17(19), 7161. https://doi.org/10.3390/ijerph17197161

Shah, S. Z. A., Karam, J. A., Zeb, A., Ullah, R., Shah, A., Haq, I. U., Ali, I., Darain, H., & Chen, H. (2021). Movement is Improvement: The Therapeutic Effects of Exercise and General Physical Activity on Glycemic Control in Patients with Type 2 Diabetes Mellitus: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Diabetes Therapy : Research, Treatment and Education of Diabetes and Related Disorders, 12*(3), 707-732. https://doi.org/10.1007/s13300-021-01005-1

Tenenbaum, A., Fisman, E. Z., & Motro, M. (2003). Metabolic syndrome and type 2 diabetes mellitus: Focus on peroxisome proliferator activated receptors (PPAR). *Cardiovascular Diabetology, 2*(1), 4. https://doi.org/10.1186/1475-2840-2-4

The World Bank. (n.d.). *World Bank Country and Lending Groups*. Retrieved May 7, 2023 from https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

Thomas, N., Alder, E., & Leese, G. P. (2004). Barriers to physical activity in patients with diabetes. *Postgraduate Medical Journal, 80*(943), 287-291. https://doi.org/10.1136/pgmj.2003.010553

Trott, M., Driscoll, R., & Pardhan, S. (2022). Associations between diabetic retinopathy and modifiable risk factors: An umbrella review of meta-analyses. *Diabetic Medicine : A Journal of the British Diabetic Association, 39*(6), e14796. https://doi.org/10.1111/dme.14796

Vanden Bosch, M., Wesley, E., & Strouse, S. (2021). Perceptions of Physical Activity in Middle-aged Women with Type 2 Diabetes. *Western Journal of Nursing Research, 43*(7), 640-648. https://doi.org/10.1177/0193945920973151

Vilafranca Cartagena, M., Arreciado Marañón, A., Artigues-Barbera, E., & Tort-Nasarre, G. (2022). Successful Practices in Performing and Maintaining Physical Activity in Adults with Type 2 Diabetes Mellitus: A Qualitative Study. *International Journal of Environmental Research and Public Health, 19*(21), 14041. https://doi.org/10.3390/ijerph192114041

Vilafranca Cartagena, M., Tort-Nasarre, G., & Rubinat Arnaldo, E. (2021). Barriers and Facilitators for Physical Activity in Adults with Type 2 Diabetes Mellitus: A Scoping Review. *International Journal of Environmental Research and Public Health, 18*(10), 5359. https://doi.org/10.3390/ijerph18105359

Wang, H. H., Lee, D. K., Liu, M., Portincasa, P., & Wang, D. Q. (2020). Novel Insights into the Pathogenesis and Management of the Metabolic Syndrome. *Pediatric Gastroenterology, Hepatology & Nutrition, 23*(3), 189-230. https://doi.org/10.5223/pghn.2020.23.3.189

Wanko, N. S., Brazier, C. W., Young-Rogers, D., Dunbar, V. G., Boyd, B., George, C. D., Rhee, M. K., El-Kebbi, I., & Cook, C. B. (2004). Exercise Preferences and Barriers in Urban African Americans With Type 2 Diabetes. *The Diabetes Educator, 30*(3), 502-513. https://doi.org/10.1177/014572170403000322

Way, K. L., Hackett, D. A., Baker, M. K., & Johnson, N. A. (2016). The Effect of Regular Exercise on Insulin Sensitivity in Type 2 Diabetes Mellitus: A Systematic Review and Meta-Analysis. *Diabetes & Metabolism Journal, 40*(4), 253-271. https://doi.org/10.4093/dmj.2016.40.4.253

Whipple, M. O., Pinto, A. J., Abushamat, L. A., Bergouignan, A., Chapman, K., Huebschmann, A. G., Masters, K. S., Nadeau, K. J., Scalzo, R. L., Schauer, I. E., Rafferty, D., Reusch, J. E. B., & Regensteiner, J. G. (2022). Sex Differences in Physical Activity Among Individuals With Type 2 Diabetes Across the Life Span: A Systematic Review and Meta-analysis. *Diabetes Care, 45*(9), 2163-2177. https://doi.org/10.2337/dc22-0576

Whipple, M. O., Schorr, E. N., Talley, K. M. C., Lindquist, R., Bronas, U. G., & Treat-Jacobson, D. (2019). A mixed methods study of perceived barriers to physical activity, geriatric syndromes, and physical activity levels among older adults with peripheral artery disease and diabetes. *Journal of Vascular Nursing : Official Publication of the Society for Peripheral Vascular Nursing, 37*(2), 91-105. https://doi.org/10.1016/j.jvn.2019.02.001

Williams, J. E., Helsel, B. C., Nelson, B. A., & Eke, R. (2018). Exercise considerations for Type 1 and Type 2 Diabetes. *ACSM's Health & Fitness Journal, 22*(1), 10-16. https://doi.org/10.1249/FIT.0000000000000359

World Health Organization. (2010, Jan 1). *Global recommendations on physical activity for health.* Geneva: World Health Organization. https://www.who.int/publications/i/item/9789241599979

World Health Organization. (2011, May 16). *Waist circumference and waist-hip ratio: report of a WHO expert consultation, Geneva, 8-11 December 2008.* Geneva: World Health Organization. https://www.who.int/publications/i/item/9789241501491

World Health Organization. (2020, Nov 25). *WHO guidelines on physical activity and sedentary behaviour*. Geneva: World Health Organization. https://www.who.int/publications/i/item/9789240015128

World Health Organization. (2021, Nov 13). *Global physical activity questionnaire (GPAQ)*. Geneva: World Health Organization. https://www.who.int/publications/m/item/global-physical-activity-questionnaire

World Health Organization. (2023, April 5). *Diabetes*. Retrieved July 17, 2023 from https://www.who.int/news-room/fact-sheets/detail/diabetes

Yan, X., Han, X., Wu, C., Shang, X., Zhang, L., & He, M. (2021). Effect of physical activity on reducing the risk of diabetic retinopathy progression: 10-year prospective findings from the 45 and Up Study. *PloS One, 16*(1), e0239214. https://doi.org/10.1371/journal.pone.0239214

Yoo, E. (2016). Waist-to-height ratio as a screening tool for obesity and cardiometabolic risk. *Korean Journal of Pediatrics, 59*(11), 425-431. https://doi.org/10.3345/kjp.2016.59.11.425

Zavala, G. A., Ainscough, T. S., & Jimenez-Moreno, A.,C. (2022). Barriers to a healthy diet and physical activity in Mexican adults: results from the Mexican Health and Nutrition Survey. *Nutrition Bulletin, 47*(3), 298-306. http://ejournals.um.edu.mt/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=158791403&site=ehost-live

Zhao, X., He, Q., Zeng, Y., & Cheng, L. (2021). Effectiveness of combined exercise in people with type 2 diabetes and concurrent overweight/obesity: a systematic review and meta-analysis. *BMJ Open, 11*(10), e046252-046252. https://doi.org/10.1136/bmjopen-2020-046252

Zhu, P., Lao, G., Li, H., Tan, R., Gu, J., & Ran, J. (2023). Replacing of sedentary behavior with physical activity and the risk of mortality in people with prediabetes and diabetes: a prospective cohort study. *The International Journal*

of Behavioral Nutrition and Physical Activity, 20(1),

81. https://doi.org/10.1186/s12966-023-01488-0

Appendices

Appendix A: Example of search strategy used for the systematic literature review

Search strategy used in PubMed:

i. Type 2 diabetes mellitus

Subject heading: Diabetes Mellitus, Type 2

Keywords searched in Title/Abstract: "diabetes mellitus type 2" OR "diabetes mellitus type II" OR "diabetes type 2" OR "diabetes type II" OR "type 2 diabet*" OR "type II diabet*" OR "type 2 DM" OR "type II DM" OR T2DM OR T2D OR TIIDM OR TIID OR "non insulin dependent diabet*" OR "non insulin dependent DM" OR "noninsulin dependent diabet*" OR "noninsulin dependent DM" OR NIDDM OR "adult onset diabet*" OR "adult onset DM"

ii. Physical activity

Subject heading: Exercise

Keywords searched in Title/Abstract: "PA" OR "physical activit*" OR exercis*

iii. Knowledge, barriers, and enablers

Subject heading: Attitude to Health [NoExp] OR Motivation [NoExp]

Keywords searched in Title/Abstract: barrier* OR enabl* OR motiv* OR facilitat* OR knowledge OR awareness OR attitude* OR perception* OR view OR views OR fear* OR "perceived benefit*" OR opinion* OR difficult* OR obstacle* OR belief*

Search strings (i), (ii), and (iii) were then combined. Limits applied: English language; year 2010 onwards

Appendix B: Summary of studies included in the systematic literature review

Authors & year of study	Study title	Country	Study Sample	Study design	Main findings
Scavarda et al., 2023	Using Photovoice to understand physical and social living environment influence on adherence to diabetes	Italy	10 adults with T2DM aged 60-70 years and living in a deprived neighbourhood of an Italian city	Qualitative study using interviews which were digitally recorded and transcribed, applying the photovoice method, a photo elicitation method based on the active production of images by participants. Prior to the interviews, participants were requested to produce a series of photographs (6-10) that portrayed their living environment. The interview was driven by the photographs.	The findings revealed that the possibility to engage in diet, exercise and blood sugar monitoring seemed to be more affected by the physical and social elements of the participants' environment than by their beliefs and attitudes. Both environmental barriers and social isolation emerged as barriers to lifestyle changes and self-care activities, including exercise. The predominance of bonding social capital, the scant level of trust, and the negative perception of local health services resulted in a low level of social cohesion, a limited circulation of health information on diabetes management and, consequently, in poor health outcomes.
Blicher-Hansen et al., 2022	Experiences of successful physical activity maintenance among adults with type 2 diabetes: a theory-based qualitative study	Participants recruited from UK, USA, Australia and Canada	18 adults with T2DM aged 41-76 years who had successfully adopted the recommended physical activity levels	Qualitative study using one-to-one semi-structured interviews which were held via an online video call and audio-recorded and transcribed. Following the interview, participants completed a brief demographic questionnaire. Analysis was theory-informed but driven by the data.	Seven themes emerged. Two themes, namely negative affect engendered by the diagnosis of T2DM and inspiration and guidance from others with T2DM, were identified as influential in the decision to initiate physical activity. Two themes, namely setting achievable, behaviour-centric goals, and experiencing biopsychosocial gains, were identified as key to behaviour adoption. Three themes were identified related to physical activity maintenance, namely expectations of positive affect, habit, and a new sense of identity, connection and belonging.

Che et al., 2022	Perceptions of exercise and exercise instruction in patients with type 2 diabetes mellitus and sarcopenia : a qualitative study	China	16 patients with T2DM and sarcopenia aged 18 years and over	Qualitative study using a descriptive phenomenological approach involving semi-structured face-to-face in-depth interviews.	Four themes were identified regarding the experiences of patients with T2DM and sarcopenia: knowledge-attitudes-practices regarding exercise (participants knew the benefits of exercise for diabetes and had a positive attitude, although not all engaged in exercise); motivators for exercise (desire for health, positive feelings regarding exercise, and social support); barriers to exercise (physical discomfort, psychological factors, and poor exercise conditions such as weather, exercise area, assistive devices, and time); and attitudes towards professional exercise instruction (the urgent need for guidance from healthcare professionals, fear of intensity of the instructed exercise, and financial constraints).
Drummond et al., 2022	Perceptions of fracture and fall risk and of the benefits and barriers to exercise in adults with diabetes	Canada	446 participants aged 50 years and over with a self-reported diagnosis of diabetes; 59% (n=261) had T2DM	Cross-sectional study design using a self-administered online survey.	Perceived barriers preventing from participation in physical activity in the previous 12 months among T2DM individuals, in descending order, were lack of motivation, health condition/limitations, lack of energy, lack of company to exercise with, cost, lack of available activities in the area, lack of time, and illness/injury. Other barriers included location being too far/not accessible/transportation problems, lack of skills or knowledge, fear of injury, and fear of hypoglycaemia. The latter was more prominent among T1DM than T2DM individuals. A minority of participants recognised that living with diabetes increased their risk of fractures or falls, while around 90% of participants reported not having been informed about diabetes-related fracture risk by their physicians. Just over half reported having been informed about the benefits of exercise on bone health. These results did not differ between participants with T1DM and T2DM.
Peter et al., 2022	Type 2 diabetes mellitus patients' knowledge, attitude and practice of lifestyle modifications	South Africa	149 patients with T2DM	Cross-sectional study design using a self-administered structured questionnaire.	50.3% of participants knew that regular exercise could improve blood sugar levels. 61.2% stated that patients with diabetes should exercise for at least 30 minutes per day. Participants displayed a positive attitude towards exercise, in that almost all (94.6%) agreed that exercise is important and that controlling one's weight is vital (94.5%). 89.9% stated that they engaged in some form of exercise. Perceived barriers to exercise included a busy schedule and bad weather. A small percentage noted age and poor health as barriers. Other reasons included a lack of exercise partner and exercise facilities, poor vision, and work-related issues.

Vilafranca Cartagena et al., 2022	Successful Practices in Performing and Maintaining Physical Activity in Adults with Type 2 Diabetes Mellitus: A Qualitative Study	Spain	10 patients with T2DM aged 58-79 years and who practised regular physical activity (participants were participating in another ongoing study on diabetes and physical activity)	Qualitative descriptive study consisting of semi-structured face-to-face interviews. Data was analysed using thematic analysis.	Two themes were identified related to how patients change habits and maintain physical activity: integrating physical activity as a lifestyle, and finding support for change. With respect to the first theme, participants' level of knowledge regarding T2DM varied but all had to learn to live with their disease and acquire new knowledge. The meaning that patients gave to physical activity was important and all agreed that it is a key element for their diabetes. The change of habit of physical activity was closely linked to the participants seeing that they had a better control over their T2DM. Participants did not perceive that they made major changes to start or increase physical activity and this contributed to their adherence. All participants were aware of the psychological and physiological benefits of activity, although knowledge about sedentarism was low. With respect to the second theme, participants identified having company and external support as very important when engaging in physical activity. However, the participants also recognised the importance of personal motivating strategies, whereby each participant found their own motivations to continue performing physical activity.
Zavala et al., 2022	Barriers to a healthy diet and physical activity in Mexican adults: results from the Mexican Health and Nutrition Survey	Mexico	6406 adults aged 20-65 years; 6.2% (n=400) had a T2DM diagnosis	Cross-sectional, secondary analysis of publicly available data from the Mexican National Health and Nutrition Survey 2016.	Among the diabetic population, perceived barriers to physical activity were lack of time (46.3%), health-related issues (44.1%), lack of motivation (41.5%), lack of safe and adequate spaces for performing physical activity (34.6%), physical activity not considered a priority in the family (32.2%), prefer sedentary activities (27.6%), and do not like to perform physical activity (24.6%), with 84.5% reporting at least one of these barriers. Health-related issues for performing physical activity were found to be a specific barrier for people with a reported diagnosis of T2DM.
Albuquerque et al., 2021	Adherence to Physical Activity in People with Type 2 Diabetes	Portugal	102 participants with insulin-treated T2DM aged 40-85 years	Quantitative cross-sectional, descriptive, and correlational study using a questionnaire and collection of HbA1c.	The majority (78.4%) of participants perceived medication as the most important component in the treatment of diabetes and 53.9% did not recognise physical exercise as part of diabetic treatment. In addition, physical activity was identified as the self-care activity which patients attached little importance to: participants claimed that they engaged in physical activity on only 1 day per week on average. The study also reported that the greater the involvement of patients in activities related to physical activity, the lower the HbA1c value.

AlKhudidi et al., 2021	Awareness of Type 2 Diabetic Patients about the Importance of Exercise and Diet on Diabetes Type 2 in the Western Region of Saudi Arabia	Saudi Arabia	568 patients with T2DM and older than 18 years of age	Cross-sectional study design using a self-administered questionnaire.	57% of participants reported engaging in exercise. 36.3% were engaging in exercise for less than five days per week and 12.3% for less than thirty minutes per day. 90% of participants thought that exercise and diet positively impact the blood glucose level. A non-significant association was found between gender and practice of exercise, although educated and married participants were more likely to be practising exercise and to agree that exercise and diet have a positive impact on blood glucose level ($p =< 0.05$). Participants who did not exercise had a significantly longer mean diabetes duration.
Fonk, 2021	Living with Diabetes Mellitus Type 2	Malta	9 participants with T2DM aged between 47-78 years, and 2 experts in the field	Qualitative study using in-depth semi-structured interviews, some of which (6) were held virtually	The main sub-themes which emerged related to committing to performing physical activity were self-efficacy, the environment, social support, and the Covid factor. Some participants admitted that they lacked the motivation to exercise as it did not form part of their life and hence find it difficult to adjust to regular exercise. Other barriers included medical co-morbidities and inadequate spaces for exercise. Some participants mentioned how teaming up with a family member, friend, or joining a class is encouraging and motivating.
Hsu et al., 2021	Beliefs, Benefits and Barriers Associated with Physical Activity: Impact of These Factors on Physical Activity in Patients With Type II Diabetes Mellitus	Taiwan (Republic of China)	149 patients with T2DM aged 20 years and over	Cross-sectional study design using a structured questionnaire by self-report. Body mass index and waist circumference were measured and information on medical history was obtained from medical records.	17.4% of participants had strenuous physical activity, 22.2% had moderate physical activity, and 60.4% had mild physical activity. The highest rated benefits of physical activity were: “exercise improves my flexibility” ($M=3.31$, $SD=0.53$), “exercising helps me sleep better at night” ($M=3.30$, $SD=0.58$), “I will live longer if I exercise” ($M=3.29$, $SD=0.58$), “my physical endurance is improved by exercising” ($M=3.28$, $SD=0.52$), and “my muscle tone is improved with exercise” ($M=3.26$, $SD=0.52$). Highest rated barriers toward physical activity were: “exercise facilities do not have convenient schedules for me” ($M=2.20$, $SD=0.85$), “exercising takes too much of my time” ($M=2.19$, $SD=0.78$), “exercise takes too much time from my family responsibilities” ($M=2.16$, $SD=0.73$), “exercise takes too much time from family relationships” ($M=2.16$, $SD=0.76$), and “I am fatigued by exercise” ($M=2.08$, $SD=0.75$). More physical activity was associated with stronger physical activity beliefs.

Kang et al., 2021	Is Self-Determined Motivation a Useful Agent to Overcome Perceived Exercise Barriers in Patients With Type 2 Diabetes Mellitus?	Singapore	16 patients with T2DM aged 21 years and over. Patients were grouped into either a higher self-motivation (HSM) or lower self-motivation (LSM) group (n=8 for each group)	This study used an integrated approach combining qualitative and quantitative analysis. The protocol consisted of a questionnaire and a semi-structured interview. Thematic and deductive analyses were used to identify attitudes based on ten pre-conceived barrier themes (apathy, dislike, no priority, lack of support, health problems, lack of knowledge, unfavourable environment, tiredness, lack of time, and financial constraints). Quantitative analysis was done to assess for statistical differences in the volume of physical activity/exercise across the two groups. A mixed-methods analysis combining interviews and results from questionnaire was employed to highlight unique cases.	Patients in the HSM group expressed positive attitudes towards barriers to physical activity/exercise, while patients in the LSM group expressed a greater degree of hindrance, whereby they considered physical activity/exercise a lesser priority, displaying negative attitudes such as apathy and dislike. Conversely, patients with HSM placed greater emphasis on the benefits of physical activity/exercise. The barriers within the ten themes were mentioned more frequently in the LSM group than the HSM group ($p=0.002$). However, some barriers like health problems and lack of time were found to be common to all patients with T2DM, irrespective of the motivation level. The volume of physical activity/exercise corresponded to motivation levels.

Martin et al., 2021	Level of physical activity and barriers to exercise in adults with type 2 diabetes	Argentina (USA)	495 adults with T2DM aged 18-65 years	Multicentre, observational, cross-sectional study using a self-administered questionnaire. Demographic, clinical and biochemical information was obtained from medical records.	52.3% of participants had a low level of physical activity and 30.5% had a moderate level of activity. A low physical activity level was associated with age (Odds ratio (OR): 1.05 per year of age; $p < 0.001$), HbA1c (OR: 1.16 per 1%; $p < 0.05$), BMI (OR: 1.06 per kg/m2; $p < 0.001$), gender (OR: 1.69 for women; $p < 0.01$), diabetic foot (OR: 2.77; $p = 0.0511$), and lack of social support (OR: 2.42). The most frequent barriers to physical activity were a lack of willpower (59.6%), lack of energy (37.2%), and lack of time (31.5%), followed by social influences (23.2%), lack of resources (21.4%), lack of skills (21.2%), fear of injury (15.8%), and diabetes itself being a limitation (15.2%).
Vanden Bosch et al., 2021	Perceptions of Physical Activity in Middle-aged Women with Type 2 Diabetes	USA	14 women with T2DM aged 45-61 years and who were capable of participating in physical activity or exercise.	Qualitative study using a phenomenological design with focus group interviews. The focus group discussions were voice-recorded and transcribed verbatim in order to analyse the themes.	Eight themes were identified representing the perceptions of physical activity: types of physical activity; benefits; barriers and limitations; stage of life; motivators; regret; living with diabetes; and strategies. Participants perceived walking as an activity accessible to most women. Participants were able to state the benefits of physical activity and perceived that participation in physical activity was affected by barriers and limitations based on their current health status and stage of life. Some participants regretted their lack of healthy behaviours. Participants were able to identify strategies to motivate and facilitate physical activity participation.
Akinci et al., 2019	Physical Activity Indicators, Metabolic Biomarkers, and Comorbidity in Type 2 Diabetes	Turkey	61 patients with T2DM aged 35-65 years with HbA1c levels between 7-11%. Patients were divided into two groups: patients using oral hypoglycaemic agents (OHA) only (n=36) and patients using combined OHA	Self-administered questionnaires completed under supervision, objective assessment of physical activity level using a pedometer, determination of functional exercise capacity using the 6-minute walking test, metabolic biomarkers derived from medical records, and measurement of anthropometric parameters.	51.4% of participants in the OHA group and 61.5% in the OHAiN group were insufficiently active (IPAQ). 68.6% of participants in the OHA group and 88.5% in the OHAiN group thought that their activity level was insufficient for good glycaemic control. The most common barrier to physical activity was lack of spare time (OHA=34.3%; OHAiN=42.3%). Other barriers in the OHA group were the lack of local areas for physical activity and experiencing pain/stiffness/fatigue/dyspnoea with physical activity (both 31.4%), followed by financial constraints and having no reason for being physically inactive (both 11.4%), and lastly experiencing hypoglycaemia with physical activity (2.9%). Barriers in the OHAiN group were experiencing pain/stiffness/fatigue/dyspnoea with physical activity and experiencing hypoglycaemia (both 30.8%),

			and insulin (OHAiN) (n=25).		followed by having no local areas for activity (23.1%), having no reason for being inactive (15.4%), and financial constraints (3.8%).
Alzahrani et al., 2019	Physical activity level and its barriers among patients with type 2 diabetes mellitus attending primary healthcare centers in Saudi Arabia	Saudi Arabia	250 patients with T2DM aged 25-75 years and able to walk	Cross-sectional study using a face-to-face interviewer-administered questionnaire.	The overall prevalence of physical inactivity was found to be 38.4%. The identified barriers to physical activity included lack of resources, lack of willpower, lack of energy, lack of skills, lack of time, lack of social support, and the fear of injury. Lack of skills, lack of energy, fear of injury, and lack of social support were significantly associated with the physical activity level.
Esteves et al., 2019	Physical Activity Patterns and Perceptions among Type 2 Diabetic and Non-diabetic Portuguese	Portugal	485 participants aged 41-90 years; 85 were diabetic (defined as diabetic if they were undergoing medical treatment with hypoglycaemic agents or insulin injections) and 400 were not diabetic	Qualitative study using questionnaires.	32% of diabetic individuals were found to be physically inactive, compared with 29% of non-diabetics, although no statistically significant differences were found between the two groups. Attitudes towards physical activity were not much different between groups. However, distance and lack of transportation, the perception of few benefits related to exercise, and the perception that exercise is not suitable for their health and can in fact be dangerous were considered as more important barriers among diabetic individuals. In contrast, lack of time and the importance of exercising with friends were identified as more important for non-diabetics. Regarding information seeking behaviour about physical activity, diabetics rely more on doctors as the leading source of information and rely less on online information.

Gordon & Nelson, 2019	Physical activity correlates among persons with type 2 diabetes in Jamaica	Jamaica	194 participants with T2DM aged 18 years and over	Cross-sectional study design using an interviewer-administered questionnaire.	38.7% of participants were low active, 33.5% moderately active, and 26.1% highly active. The mean knowledge score was 64.5% and the mean score on the Exercise barriers scale was 26.9. The five main barriers to exercise participation were "exercise is tiring" (50%), "exercise is hard work" (28.9%), "exercise is fatiguing" (26.3%), "exercise takes too much time" (19.6%), and "my spouse does not encourage exercising" (18.6%). The knowledge and perceived barriers scores were not significantly related to physical activity level. A greater percentage of those who were low active perceived exercise as tiring and exercise facilities as being too far away ($p < 0.05$). Younger and employed persons were more active than their counterparts (both $p < 0.01$).
Whipple et al., 2019	A mixed methods study of perceived barriers to physical activity, geriatric syndromes, and physical activity levels among older adults with peripheral artery disease and diabetes	USA	10 adults aged 65 years and over with T2DM and lifestyle-limiting claudication with activity due to peripheral artery disease	Mixed methods design, involving semi-structured interviews about experiences with physical activity; self-reported questionnaires assessing perceived benefits and barriers to exercise, geriatric syndromes, quality of life and fear of falling; measures of balance, strength and physical function; measure of physical activity with accelerometry; and ankle brachial index from medical records. Inductive content analysis was used to identify themes, and integrated analysis was performed to evaluate patterns among qualitative and quantitative variables.	Participants spent 10% of their time in moderate or vigorous physical activity and 67% of their time in sedentary behaviour. Barriers to physical activity included lack of accessibility, lack of enjoyment of activity, lack of motivation, and pain and physical health. Facilitators to physical activity were social support, accessibility and convenience, and enjoyment of the activity. Three themes were identified with respect to benefits of exercise, namely energy, mobility and physical health, and sense of accomplishment. Participants with more sedentary time and less physical activity tended to report greater fear of falling and more barriers to physical activity and achieved lower distances in 6-minute walk tests.

Alghafri et al., 2017	Perceived barriers to leisure time physical activity in adults with type 2 diabetes attending primary healthcare in Oman: a cross-sectional survey	Oman	305 patients with T2DM and older than 18 years of age	Cross-sectional study using an interviewer-administered questionnaire. Physiological data was obtained from the medical records. This was part of a larger study that examined correlates of physical activity and sitting time in adults with T2DM and barriers to leisure activity in the same population.	Only 17% of participants considered themselves as actively participating in regular, moderate or vigorous physical activity. Of the remainder, the majority reported being 'not ready' (37%), 'getting ready' (31%) or in 'preparation' (15%). 97.7% reported at least one barrier to performing leisure time physical activity. The most commonly reported barriers were lack of willpower, lack of resources, and low social support, followed by fear of injury, lack of skills, lack of time, lack of energy, and environmental and religious barriers. Lack of time was frequently highly scored by males, younger adults and those who were married, employed or educated. Lack of social support was highly scored by females. Lack of energy was highly scored by employed or educated adults. Lack of willpower was highly scored by individuals with lower income or at inactive stages of physical activity. Fear of injury was highly scored by older adults, unemployed, uneducated or individuals reporting inactive stages of activity. Lack of skills was highly scored by females, younger adults and unemployed or uneducated. Lack of resources was frequently highly scored by married adults or those with lower income.
Felix et al., 2017	Physical Activity and Diabetes-related Health Beliefs of Marshallese Adults	Marshall Islands	376 adults with and without T2DM: 20.2% (n=76) reported a diagnosis of T2DM	Cross-sectional study using a questionnaire and the collection of HbA1c, blood pressure, height, and weight.	A high proportion of participants (over 90%) indicated that they believed physical activity is good for them, and there was no difference between the diagnosis groups. A high proportion of participants also indicated that they had time to exercise and that they had a comfortable place to exercise, with no difference detected between the two groups. However, 41.2% of participants indicated that they experienced pain when walking for more than 5 minutes and there was a statistically significant difference between the diagnosis groups: 56.6% of those with T2DM reported experiencing pain versus 37.3% of those without T2DM (p=0.01). Both groups perceived the health risks associated with having diabetes.

Duncan, 2016	Self-care practices of older adults with Diabetes Mellitus	Malta	12 older adults with T2DM aged between 69-79 years, recruited from a local hospital. Half of participants had good glycaemic control, with an HbA1c of 7.0-7.9%.	Qualitative study using an Interpretive social science (ISS) approach. Data was collected through in-depth, semi-structured, face-to-face interviews and analysed using a Hermeneutic approach.	This study revealed important differences in attitudes towards self-care between participants with good and poor glycaemic control. None of the respondents with poor glycaemic control carried out any physical exercise. Participants often declined to exercise because of limitations imposed by their medical co-morbidities. There was also a general feeling of apathy and disinterest in the role of physical exercise in diabetes self-care. Other limitations included the environment and weather conditions. Most of those with good glycaemic control incorporated a daily walk into their routine and described the psychological benefits. Family support was shown to have an important role in physical exercise.
Lidegaard et al., 2016	Barriers to and motivators for physical activity among people with Type 2 diabetes: patients' perspectives	Denmark	28 individuals with T2DM aged 39-71 years	Qualitative study using four focus groups which were recorded on video and dictaphone and transcribed verbatim. Each focus group consisted of six to nine participants.	Two overarching themes were identified as barriers to participating in physical activity: the body as a barrier because of functional limitations and a lack of knowledge about how to exercise or be active, thus requiring professional guidance; and logistic challenges including lack of time and awareness of where to exercise in the local area. Other barriers which were identified included broken exercise routine and other priorities and interests. Two main themes were identified as motivators: being physically active with others, providing a sense of mutual commitment and enjoyment; and goal-setting and self-tracking, which were seen as an opportunity to track physical improvement over time. Other motivators included body-related factors such as to maintain or improve health, and gaining energy and reducing stress.
Bruce et al., 2015	Fear of falling is common in patients with type 2 diabetes and is associated with increased risk of falls	Australia	186 participants with T2DM, age and sex matched with 186 normoglycaemic individuals	Cross-sectional, matched case-cohort study. Participants recruited from a community-based survey consisting of a questionnaire, clinical examination, and fasting blood and urine samples. This study was based on cross-sectional baseline data collected in 2009.	Fear of falling and fear-associated activity restriction were significantly more common in participants with T2DM, with indoor activity restriction being reported at almost three times the rate seen in the normoglycaemic participants. Despite this and the finding that those with T2DM had worse mobility as assessed by the timed Up and Go (TUG) test, there was no difference in the rate of falls or recurrent falls between the groups.

Cooper et al., 2015	Self-Reported Physical Activity in Medically Underserved Adults With Type 2 Diabetes in Clinical and Community Settings	USA	253 adults with T2DM (low-income, medically underserved population)	Quantitative study using questionnaires which were completed on-site or by mail.	Physical activity levels among participants were low. The mean number of perceived barriers to physical activity was 2.20 (1.13). Women reported barriers more frequently ($p < 0.001$). The top barrier was pain (61% of sample), followed by variable schedules (54.8%). 36.9% of those endorsing pain reported experiencing it once or twice per week. For insulin and non-insulin prescribed participants, respectively, the third ranked barriers were stress (43.9%) and being too busy (44.3%). Lack of support was the least endorsed barrier to physical activity (22.2%).
Duclos et al., 2015	Physical activity in patients with type 2 diabetes and hypertension – insights into motivations and barriers from the MOBILE study	France	1,766 adults aged 18 years and over, diagnosed with T2DM and pharmacologically treated hypertension, for whom a recent HbA1c was available. Participants were split into two cohorts: active (n=628) and inactive (n=1,138). Participants were recruited through their physicians.	Cross-sectional, observational study using a self-administered questionnaire.	The active cohort had a mean barriers score of 2.4 +/- 0.8 and a mean motivation score of 3.2 +/- 0.6, while the inactive cohort had a higher mean barriers score of 2.8 +/- 0.7 and a lower mean motivation score of 2.6 +/- 0.8 (both $p < 0.001$). In the inactive cohort, fitness and a negative self-image was the highest ranked barrier, followed by lack of support and encouragement including lack of company to exercise with, medical concerns and fear of injury, and environmental factors. In the active cohort, the main motivators were a lack of health concerns, medical support, and encouragement from a non-physician, followed by self-image, and environmental factors. The physician's role emerged in the motivations, namely reassurance on health issues, training on hypoglycaemia risk, and prescription and/or monitoring of physical activity, although more so among active patients.

Lanhers et al., 2015	General Practitioners' Barriers to Prescribe Physical Activity: The Dark Side of the Cluster Effects on the Physical Activity of Their Type 2 Diabetes Patients	France	General practitioners (n=48) and their T2DM patients (n=369)	Cross-sectional study design using a self-administered questionnaire.	48% of participants claimed that they had regular physical activity, defined as at least 30 minutes on each occasion. However, only 45.8% declared practising physical activity at least three times per week and among them, only 26.8% had daily physical activity. Regarding duration and frequency, 36.9% fulfilled the definition of regular physical activity. Patients gave the greatest priority to medication to manage their diabetes, followed by physical activity. The most perceived barriers among T2DM patients were a low fitness level, weather conditions, fear of being tired, and physical health status. The main barriers held in common between patients (barriers to physical activity participation) and their practitioners (barriers preventing them from prescribing regular physical activity) were the fear of suffering a heart attack, physical health status, and a low fitness level. The higher the patient's barriers (BAPAD) score, the higher the risk of declaring practising no physical activity ($p < 0.001$), low frequency and low duration of activity ($p < 0.001$). A high barriers score was also associated with a higher risk of having an elevated HbA1c ($p = 0.001$). An important cluster effect was also demonstrated between GPs and their patients: the higher the GP's BAPAD score, the higher their patients' scores.
Hui et al., 2014	Association between Physical Activity Knowledge and Levels of Physical Activity in Chinese Adults with Type 2 Diabetes	China	258 adults with T2DM	Cross-sectional study design using an interviewer-administered questionnaire.	The mean physical activity knowledge score was 12.85 +/- 3.46 out of a possible 20, which indicated that participants could correctly answer more than half of the questions. However, participants demonstrated limited knowledge on the best time of day to exercise and on the effects of resistance exercise on diabetes management, while 37.6% incorrectly believed that preparing meals was an activity that could provide health benefits. Participants with a higher education level had higher physical activity knowledge scores ($P < 0.05$). 70% of participants reported engaging in moderate and high physical activity levels. Younger, female, and obese participants were more likely to have lower levels of physical activity (all $p < 0.05$). After adjusting for age, gender, education, and body mass index, physical activity knowledge was found to be positively associated with level of activity ($p < 0.01$), and this association was strongest in participants with at least a tertiary level of education.

Okonta et al., 2014	Knowledge, attitude and practice regarding lifestyle modification in type 2 diabetic patients	South Africa	217 patients with T2DM aged 30 years and over	Cross-sectional study design using a structured interviewer-administered questionnaire. Anthropometric measurements were also taken.	92.1% of participants had poor knowledge regarding the benefits of exercise and weight loss. 91.7% of the participants reported that they did not exercise regularly; of the 8.3% that exercised regularly, the majority (94.4%) exercised for less than 30 minutes per day or less than 150 minutes per week. Despite poor knowledge and practice, the majority of participants (84.3%) had a positive attitude towards lifestyle modifications.
Egan et al., 2013	Barriers to exercise in obese patients with type 2 diabetes	Ireland	145 obese patients (BMI >30 kg/m2) with T2DM	Cross-sectional study using a self-administered questionnaire. Anthropometric details were obtained from the patient's medical chart.	47.6% of participants exercised for less than 150 minutes per week and these patients had a higher BMI than those meeting targets (p=0.02). The most commonly reported major barriers to exercise were: physical discomfort (23.4%), finding exercise boring (20.7%), lack of time (20%), tiredness (15.9%), weather conditions (11.7%), dislike of the gym (9.7%), depression (5.5%), cost (4.8%), negative past experiences of exercise and embarrassment about physical appearance (both 4.1%), lack of company (3.4%), dangerous roads (2.8%), transport issues (1.4%), and lack of support from family/friends (0.7%). Among patients reporting exercising for less than 150 minutes per week, those reporting physical discomfort as a barrier were older (p=0.032) and had a higher BMI (p=0.021). Patients reporting time as a barrier were younger (p=0.001). Unmarried patients were more likely to report embarrassment about their appearance as a major barrier (p=0.021), and there was also a trend towards greater reporting of this as a major barrier in females (p=0.089). Males were more likely to report lack of time as a major barrier (p=0.034).
Ganiyu et al., 2013	Non-adherence to diet and exercise recommendations amongst patients with type 2 diabetes mellitus attending Extension II Clinic in Botswana	Botswana	104 participants with T2DM aged 30 years and over	Cross-sectional study design using a structured questionnaire.	67.3% of participants claimed that they understood that exercise helped to control diabetes, although 52% of participants did not adhere to exercise recommendations. The main reasons for non-adherence to exercise were a lack of information about the benefits of exercise and how it should be undertaken (65.7%), the notion that exercise exacerbated their diabetes (57.6%), lack of an exercise partner (24%), locations away from home (18%), and extreme weather conditions (15.4%). The least mentioned reason for not adhering to exercise was criticism by others (friends and family members) (1.9%).

He et al., 2013	Factors influencing exercises in Chinese people with type 2 diabetes	China	17 participants with T2DM aged 20 years and over and on a treatment plan that recommends exercise	Qualitative study using in-depth semi-structured one-to-one interviews which were audio-recorded and transcribed, following which participants were asked to review transcripts for accuracy and completeness. Thematic analysis was used to analyse the data and identify themes.	The core themes used by the participants to describe their perceptions on the factors influencing exercise were characterised by: their beliefs about the disease, communication between themselves and their health professionals, feasibility of the exercise regimen, skills to engage in exercise, environmental factors including the natural environment and social support, and perceived benefits in terms of a better physical sensation and the improvement of clinical indicators with exercise.
Baldacchino, 2012	Knowledge and behaviour amongst clients with Type 2 Diabetes regarding their condition and its management	Malta	20 individuals with T2DM recruited from primary health care	Descriptive research design using quantitative and some qualitative data gathered through the use of face-to-face structured interviews.	The overall diabetes knowledge mean score was 13.6 (61.8%) out of a maximum score of 22. The majority of participants recognised the role of exercise in the management of diabetes (50%; n=10) and believed that regular exercise will not increase the need for insulin or other diabetic medications (95%; n=19). 60% of participants (n=12) were found to engage in some type of physical activity, with the majority (50%; n=10) reporting exercising every day, with exercise sessions lasting 20 to 60 minutes (60%; n=12). Most participants considered their family members as a form of support in the management of their condition.
Miller & Marolen, 2012	Physical Activity-Related Experiences, Counseling Expectations, Personal Responsibility, and Altruism among Urban African American Women with Type 2 Diabetes	USA	African American women aged 41-50 years with a clinical diagnosis of T2DM and classified as physically underactive	Qualitative study consisting of focus groups which were conducted in a video- and audio-equipped focus group room. A content-based, stepped analytic approach was used to analyse data and identify themes.	Themes related to physical activity/exercise perceptions were: the words “physical activity” were viewed as synonymous to the word “exercise"; the word “exercise” elicited thoughts about specific exercises (i.e. walking); both “physical activity” and “exercise” were viewed as weight loss strategies. Themes related to barriers to physical activity were: competing priorities (i.e. caregiver roles) and lack of motivation. Themes related to enablers to physical activity included: social support. Themes related to physical activity counselling expectations or desires versus experience included that participants expect and desire praise or acknowledgement of efforts but often get advice only. Other themes identified were: participants’ acknowledgement and acceptance of the need to make changes themselves, regardless of the nature of physician input and strong altruistic intentions towards others.

Beverly & Wray, 2010	The role of collective efficacy in exercise adherence: a qualitative study of spousal support and Type 2 diabetes management	USA	30 couples (n=60) consisting of couples who were married or cohabitating, were aged 50 years and older, and having at least one member of the couple with a physician diagnosis of T2DM for at least one year	Qualitative study using 12 focus groups which were audio-recorded and transcribed verbatim. The groups were segmented into persons with diabetes (PWD) and spouses of persons with diabetes (SPWD).	The core themes used by the couples to describe their beliefs were characterised by: 'Collective support', 'Collective motivation', and 'Collective responsibility'. With respect to the first theme, spousal support appeared to be a critical element when encouraging PWDs to adopt and maintain an exercise programme. Both PWDs and SPWDs echoed the importance of support when someone was diagnosed with diabetes. With respect to the second theme, couples described a process of finding motivation through the identification of shared goals, although not all couples shared a collective motivation to exercise. In fact, lack of motivation was the most commonly stated barrier for couples striving to incorporate exercise into their daily management. With respect to the third theme, participants recognised that diabetes management, particularly exercise, was not the sole responsibility of the PWD but rather the responsibility of the couple. Despite this, not all spousal involvement was welcomed by PWDs, and not all SPWDs played an active role in their spouses' exercise management.
Chadcha valpanic haya & Intaratep, 2010	Exercise Behavior and Knowledge among the DM Type II Patients	Thailand	196 patients with T2DM and older than 18 years of age	Cross-sectional study design using an interviewer-administered questionnaire.	The majority of participants recognised the benefits of exercise, the least recognised being an increase in endorphin release. Only half of participants were aware of the proper frequency of aerobic exercise and around 60% were aware of the correct intensity and duration. The majority were aware of the importance of wearing proper shoes and terminating exercise if they experience abnormal symptoms such as chest discomfort, loss of balance, dizziness, nausea & vomiting, dyspnoea, and severe leg pain, although the latter was the least recognised symptom for terminating exercise (70.4%). Most participants were aware of hypoglycaemia symptoms, except dizziness (only recognised by 16.3%). Healthcare providers were the main source of knowledge about exercise (58.2%). 65.8% of participants exercised regularly at least three times a week, with the most common form of activity being walking (67.3%). The practice of exercise was related to co-morbid diseases, acquisition of knowledge, and preference of exercise. 13.3% did not engage in exercise. The main reasons for not exercising were feeling unhealthy (46.2%), lack of time (38.5%), followed by lack of motivation and enjoyment, and lack of companionship.

Nor Shazwani et al., 2010	Assessment of Physical Activity Level among Individuals with Type 2 Diabetes Mellitus at Cheras Health Clinic, Kuala Lumpur	Malaysia	132 patients with T2DM and other co-morbidities and co-existing diabetes complications aged 30 years and over	Cross-sectional study design using an interview-based questionnaire, anthropometric and body fat measurements, and glycaemic status (HbA1c, fasting blood sugar, and 2 hours post-prandial) obtained from medical records.	Physical activity levels of the participants were unsatisfactory (33.3% having low physical activity levels, 47.0% moderate, and only 20.0% having high activity levels) and associated with poor glycaemic control, especially in the elderly. Among participants with a low physical activity level, the most commonly reported barriers to physical activity were lack of time (54.5%) and lack of energy (21.2%), followed by fear of being injured or health problems (12.1%), lack of facilities or lack of interest (9.0%), and laziness (3.0%). Among participants with moderate and high physical activity levels, 68.1% reported that willingness to be healthy had motivated them to exercise. This was followed by 17.0% who exercised because they realised its importance. Other factors that influenced physical activity among these participants were the desire to exercise (8.5%) and to exercise as a routine affair (6.4%).
Peel et al., 2010	Type 2 diabetes and dog walking: patients' longitudinal perspectives about implementing and sustaining physical activity	Scotland, UK	40 patients with recently diagnosed T2DM; after a 4-year follow-up period, 20 patients remained	Longitudinal, qualitative study using repeat in-depth interviews with 20 patients over four years following clinical diagnosis. Interviews were conducted in participants' homes, tape-recorded, and transcribed verbatim. Field notes were also written immediately after each interview to capture initial impressions and additional contextual information. Analysis adopted a critical realist epistemological position.	Few participants acknowledged that physical activity was fundamental to their diabetes self-care. Participants claimed to have only received vague and non-specific guidance about physical activity from health professionals and emphasised a perceived lack of interest and encouragement over time. Most participants found regular physical activity challenging to maintain, although walking, especially with a dog, was found to be an achievable and sustainable form of exercise for people with T2DM as it offers regular, routine activity and companionship. Other forms of physical activity had not been maintained by the fourth year after diagnosis.

Al-Kaabi et al., 2009	Physical Activity and Reported Barriers to Activity Among Type 2 Diabetic Patients in the United Arab Emirates	United Arab Emirates	390 patients with T2DM	Cross-sectional study design using an interviewer-administered questionnaire. Blood pressure, body mass index, body fat, abdominal circumference, glycaemic control (HbA1c), and fasting lipid profile were measured.	Only 3% of participants met the recommended guidelines for physical activity. 95% of participants recognised the importance of physical activity. The major barriers to physical activity were disease (e.g. arthritis), lack of time, cultural issues, lack of interest, and family responsibilities. Physicians were reported to be the best source of advice regarding physical activity by the majority of patients (95%), while diabetic educators were rarely reported as the main source of advice. The total number of barriers reported was positively correlated with BMI ($p < 0.01$) and systolic blood pressure ($p < 0.01$).
Cutajar, 2008	An evaluation of type 2 diabetes care in the primary care setting	Malta	110 patients with T2DM recruited from primary health care	Quantitative study using a questionnaire. Fasting blood glucose, HbA1c, lipid profile, serum creatinine, blood pressure, body mass index and waist circumference were measured during a clinical examination.	Patients showed limited knowledge on diabetes, its complications and exercise, whereby 54% of participants did not know the amount of physical activity they should be undertaking. Despite this, over 75% of participants were found to engage in physical exercise of adequate frequency and duration.
Mier et al., 2007	Mexican Americans With Type 2 Diabetes: Perspectives on Definitions, Motivators, and Programs of Physical Activity	USA	39 Mexican Americans with T2DM aged 30-55 years and living in the Texas-Mexico border region (minority group)	Qualitative research design using six focus groups which were audio-taped and transcribed. At the end of the group discussions, participants also completed a written questionnaire on their demographic characteristics.	Motivators to physical activity included the sense of physical and mental well-being derived from physical activity, and family support and wanting to be as healthy as possible to take care of family. Barriers to physical activity included individual and environmental factors, such as lack of time due to work and family obligations, physical pain, depression, being overweight, lack of motivation, unsafe neighbourhoods, lack of facilities and transportation, and the weather. Participants suggested that the ideal intervention would be low in cost, family-based, close to home, and led by bilingual instructors.

Lawton et al., 2006	'I can't do any serious exercise': barriers to physical activity amongst people of Pakistani and Indian origin with Type 2 diabetes	Scotland (UK)	Indian (n=9) and Pakistani (n=23) patients with T2DM aged 18 years and over (ethnic minority group)	Qualitative study using single in-depth interviews in respondents' homes, which were tape-recorded and transcribed. A concurrent process of data collection and analysis was adopted and emerging themes were explored with respondents in later interviews.	Virtually all participants reported an awareness that they should be undertaking regular physical activity as part of their diabetes care; however, few had put this lifestyle advice into practice. A plethora of interweaving factors and considerations operated as barriers to participants increasing and/or maintaining their physical activity. The main themes identified were lack of time and obligations to others particularly their family, fear and shame, lack of culturally sensitive facilities especially for women, climatic conditions, co-morbidities and health limitations, and the perception that diabetes triggers an irreversible decline beyond their control. Among those who exercised, short-term goals, efforts to avoid moving on to insulin particularly due to the fear of injections and the stigma, and improved glucose readings were motivating factors.
Dutton et al., 2005	Barriers to Physical Activity Among Predominantly Low-Income African American Patients With Type 2 Diabetes	USA	105 adult patients with T2DM, predominantly low income, African American	Cross-sectional study design using a questionnaire. Medical charts were reviewed for HbA1c, weight, height, and blood pressure.	75% of participants reported that exercise is extremely important for controlling diabetes, 18% and 5% reported that it is important or moderately important, and 2% reported that it is slightly or not at all important. 60% reported that it is very likely that exercise will prevent future diabetes-related complications, 17% and 10% reported that it is likely or moderately likely, and 8% and 5% reported that it is unlikely or very unlikely. Common barriers included health problems, lack of company, lack of time and equipment. Other less commonly reported barriers included social obligations (e.g. caring for children), lack of access to exercise places, and others such as bad weather, special occasions, and lack of physician advice. Barriers were unrelated to medical outcome variables. However, participants' perceived importance of exercise was negatively associated with the number of barriers endorsed ($p < 0.01$).

Wanko et al., 2004	Exercise Preferences and Barriers in Urban African Americans With Type 2 Diabetes.	USA	605 patients with diabetes (95% had T2DM) recruited from a diabetes clinic which provides care to a predominately indigent, minority patient population	Cross-sectional study using a self-administered questionnaire.	52% of participants reported that they had a barrier to exercising. 53% of these patients indicated having only one obstacle, 29% reported having two obstacles, and 18% reported having three or more obstacles. Among the top reasons for having difficulty exercising, pain was the most commonly reported reason (41%), followed by no willpower (27%), health not good enough (21%), don't know what kind to do (17%), and no one to exercise with (15%). Other responses, such as no convenient or close place to exercise (11%) or nowhere safe to exercise (5%) were less common. Among patients younger than 35 years of age, issues pertaining to time, willpower, and exercising alone were the top reasons for not exercising, while for patients aged 65 years and older, pain and health issues were the primary barriers. Only 1% of respondents indicated that they felt exercise was not important.
Dye et al., 2003	Insights from older adults with Type 2 Diabetes: Making dietary and exercise changes	USA	31 participants with T2DM over the age of 55 years	Qualitative study using four focus groups which were audio-taped and transcribed verbatim. Content analysis was applied to identify themes.	Factors seen as influencing exercise behaviour included: personal factors such as willpower, physical limitations due to arthritis and foot problems, and low energy; environmental factors such as having an exercise leader or supervisor, social support, and physician advice; and behaviours considered important for incorporating exercise into participants' lives, particularly walking and participating in exercise classes.

Appendix C: Authors' permissions to use the research tools

Permission to use the Exercise Benefits/Barriers Scale (EBBS)

Health Promotion Model Instrumentation Group

Nola J. Pender, PhD, RN, FAAN • Susan Noble Walker, EdD, RN, FAAN • Karen R. Sechrist, PhD, RN, FAAN

Dear Colleague:

Thank you for your interest in the Exercise Benefits/Barriers Scale (EBBS). The EBBS was developed in response to a need for an instrument designed to determine perceptions of individuals concerning the benefits of and barriers to participating in exercise. Items for the scale were obtained inductively from interviews and from the literature.

The EBBS is a 43-item summated rating scale consisting of two subscales, Benefits and Barriers. Ratings are obtained using a four-point response system. The EBBS has been tested for internal consistency, validity of its constructs, and test-retest reliability. A sample of 650 individuals over 18 years of age, primarily from northern Illinois, participated in the initial testing of the EBBS. Calculation of Cronbach's alpha for the 43-item instrument yielded a standardized alpha of .954. The 29-item Benefits Scale has a standardized alpha of .954 and the 14-item Barriers Scale has a standardized alpha of .866. Factor analysis yielded a nine-factor solution initially with an explained variance of 65.2%. Second order factor analysis yielded a two-factor solution, one a benefits factor and the other a barriers factor. Test-retest reliability was accomplished with a sample of 66 healthy adults at a two-week interval. Test-retest reliability was found to be .89 on the total instrument, .89 on the Benefits Scale and .77 on the Barriers Scale. Additional information on the development and initial testing of the EBBS can be found at in the following article:

> Sechrist, KR, Walker, SN, and Pender, NJ. (1987). Development and psychometric evaluation of the Exercise Benefits/Barriers Scale. *Research in Nursing & Health, 10*, 357-365.

You have our permission to download and use the EBBS for non-commercial data collection purposes such as research or evaluation projects as long as the following conditions are met:

- The EBBS will be used without any modifications other than translation into a language other than English (see information on translation, if required);
- The copyright statement will appear on the bottom of all copies of the EBBS; and
- All study participants will be over 18 years of age since the EBBS was not validated in younger populations.

Copyright of the EBBS and all translations is held by Karen R. Sechrist, PhD, RN, FAAN, Susan Noble Walker, EdD, RN, FAAN, and Nola J. Pender, PhD, RN. FAAN. Individuals translating the EBBS into another language may place their name as translator following the copyright statement.

The EBBS may be reproduced in the appendix of a dissertation, thesis, or research grant proposal. Reproduction for any other purpose, including publication of study findings, is prohibited.

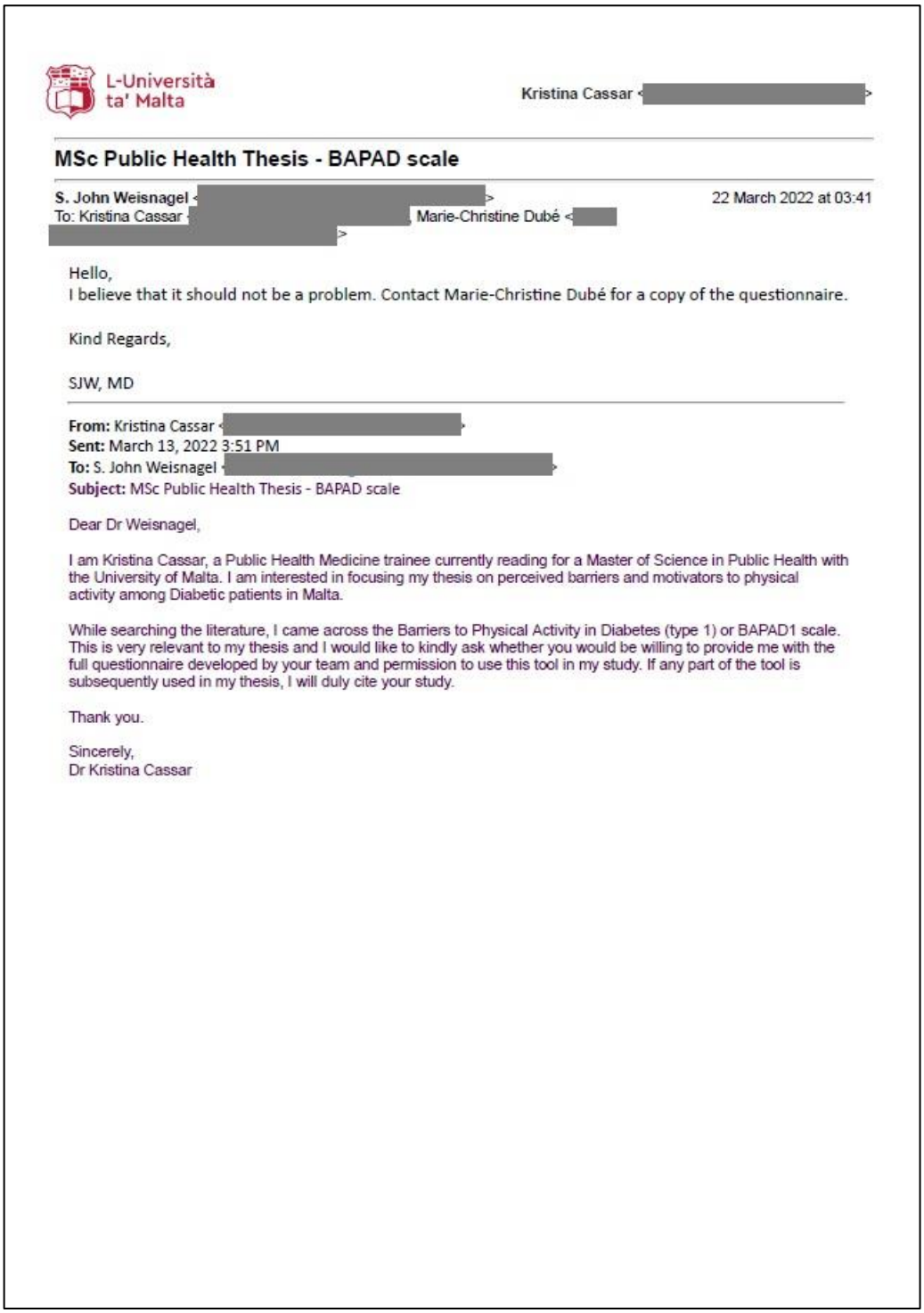
A copy of the EBBS with scoring information is available for download. A Spanish translation of the EBBS is also available. If you need additional information, you may contact Dr. Karen Sechrist by e-mail ([redacted]).

Best wishes with your research,

Karen R. Sechrist

Karen R. Sechrist, PhD, RN, FAAN
for Pender/Walker/Sechrist

Permission to use the Barriers to Physical Activity in Diabetes (BAPAD) scale



L-Università ta' Malta

Kristina Cassar <[redacted]>

MSc Public Health Thesis - BAPAD scale

S. John Weisnagel <[redacted]> 22 March 2022 at 03:41
To: Kristina Cassar <[redacted]>, Marie-Christine Dubé <[redacted]>

Hello,
I believe that it should not be a problem. Contact Marie-Christine Dubé for a copy of the questionnaire.

Kind Regards,

SJW, MD

From: Kristina Cassar <[redacted]>
Sent: March 13, 2022 3:51 PM
To: S. John Weisnagel <[redacted]>
Subject: MSc Public Health Thesis - BAPAD scale

Dear Dr Weisnagel,

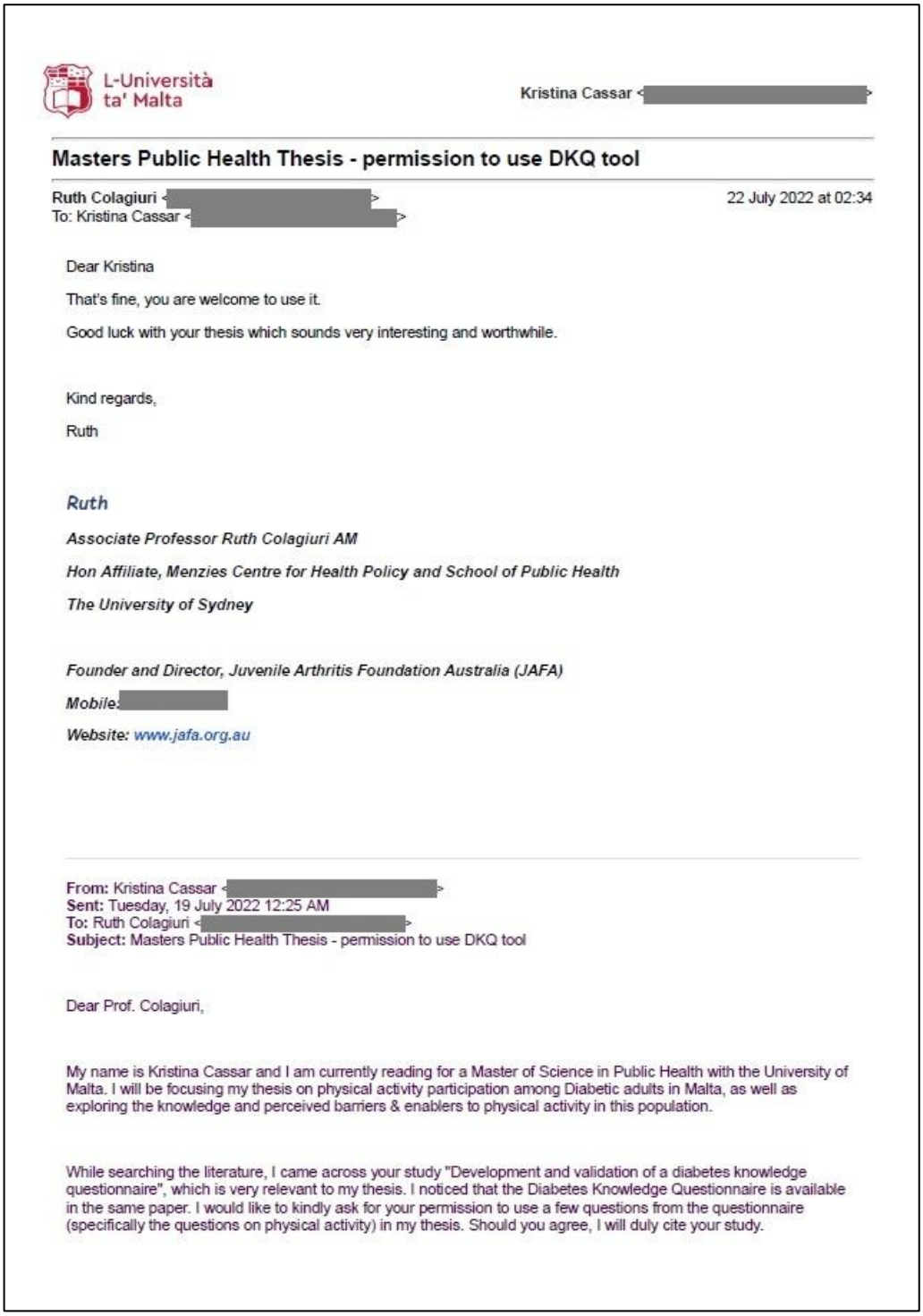
I am Kristina Cassar, a Public Health Medicine trainee currently reading for a Master of Science in Public Health with the University of Malta. I am interested in focusing my thesis on perceived barriers and motivators to physical activity among Diabetic patients in Malta.

While searching the literature, I came across the Barriers to Physical Activity in Diabetes (type 1) or BAPAD1 scale. This is very relevant to my thesis and I would like to kindly ask whether you would be willing to provide me with the full questionnaire developed by your team and permission to use this tool in my study. If any part of the tool is subsequently used in my thesis, I will duly cite your study.

Thank you.

Sincerely,
Dr Kristina Cassar

Permission to use questions from the Diabetes Knowledge Questionnaire (DKQ)



L-Università ta' Malta

Kristina Cassar <[redacted]>

Masters Public Health Thesis - permission to use DKQ tool

Ruth Colagiuri <[redacted]> 22 July 2022 at 02:34
To: Kristina Cassar <[redacted]>

Dear Kristina

That's fine, you are welcome to use it.

Good luck with your thesis which sounds very interesting and worthwhile.

Kind regards,

Ruth

Ruth

Associate Professor Ruth Colagiuri AM

Hon Affiliate, Menzies Centre for Health Policy and School of Public Health

The University of Sydney

Founder and Director, Juvenile Arthritis Foundation Australia (JAFA)

Mobile: [redacted]

Website: www.jafa.org.au

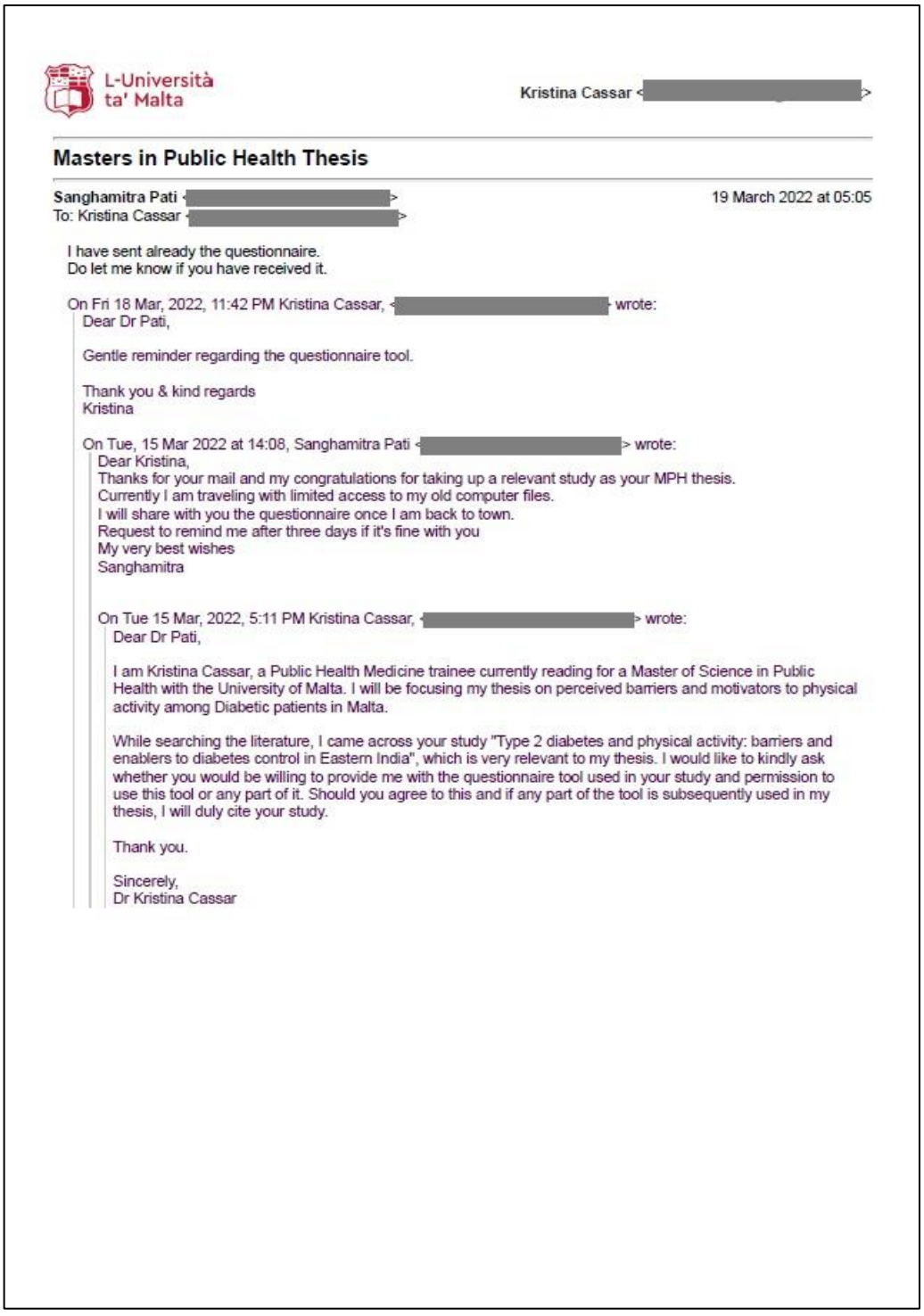
From: Kristina Cassar <[redacted]>
Sent: Tuesday, 19 July 2022 12:25 AM
To: Ruth Colagiuri <[redacted]>
Subject: Masters Public Health Thesis - permission to use DKQ tool

Dear Prof. Colagiuri,

My name is Kristina Cassar and I am currently reading for a Master of Science in Public Health with the University of Malta. I will be focusing my thesis on physical activity participation among Diabetic adults in Malta, as well as exploring the knowledge and perceived barriers & enablers to physical activity in this population.

While searching the literature, I came across your study "Development and validation of a diabetes knowledge questionnaire", which is very relevant to my thesis. I noticed that the Diabetes Knowledge Questionnaire is available in the same paper. I would like to kindly ask for your permission to use a few questions from the questionnaire (specifically the questions on physical activity) in my thesis. Should you agree, I will duly cite your study.

Permission to use questions from the study "Type 2 diabetes and physical activity: barriers and enablers to diabetes control in Eastern India"



L-Università ta' Malta

Kristina Cassar <[redacted]>

Masters in Public Health Thesis

Sanghamitra Pati <[redacted]> 19 March 2022 at 05:05
To: Kristina Cassar <[redacted]>

I have sent already the questionnaire.
Do let me know if you have received it.

On Fri 18 Mar, 2022, 11:42 PM Kristina Cassar, <[redacted]> wrote:
Dear Dr Pati,

Gentle reminder regarding the questionnaire tool.

Thank you & kind regards
Kristina

On Tue, 15 Mar 2022 at 14:08, Sanghamitra Pati <[redacted]> wrote:
Dear Kristina,
Thanks for your mail and my congratulations for taking up a relevant study as your MPH thesis.
Currently I am traveling with limited access to my old computer files.
I will share with you the questionnaire once I am back to town.
Request to remind me after three days if it's fine with you
My very best wishes
Sanghamitra

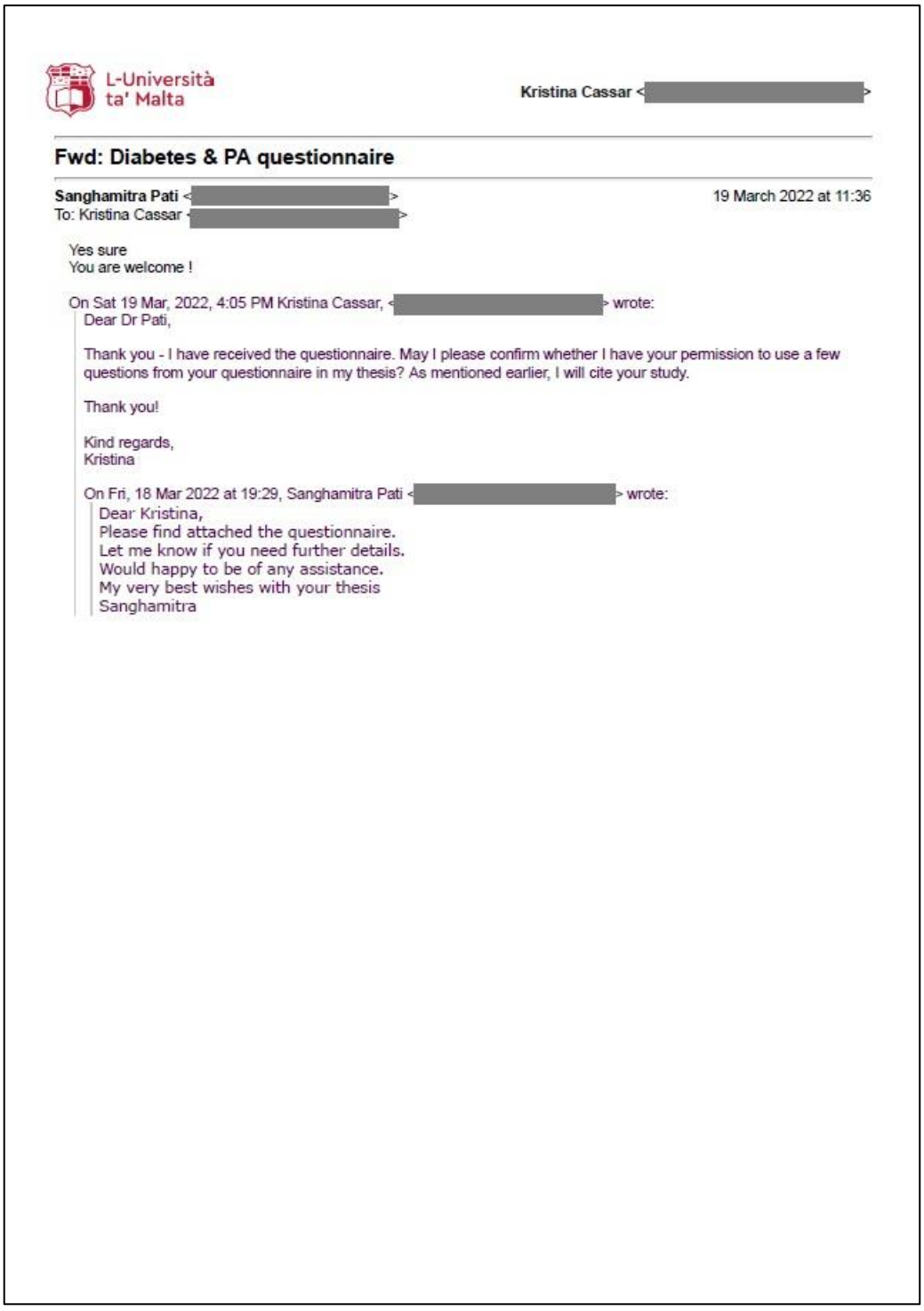
On Tue 15 Mar, 2022, 5:11 PM Kristina Cassar, <[redacted]> wrote:
Dear Dr Pati,

I am Kristina Cassar, a Public Health Medicine trainee currently reading for a Master of Science in Public Health with the University of Malta. I will be focusing my thesis on perceived barriers and motivators to physical activity among Diabetic patients in Malta.

While searching the literature, I came across your study "Type 2 diabetes and physical activity: barriers and enablers to diabetes control in Eastern India", which is very relevant to my thesis. I would like to kindly ask whether you would be willing to provide me with the questionnaire tool used in your study and permission to use this tool or any part of it. Should you agree to this and if any part of the tool is subsequently used in my thesis, I will duly cite your study.

Thank you.

Sincerely,
Dr Kristina Cassar



L-Università ta' Malta

Kristina Cassar <[redacted]>

Fwd: Diabetes & PA questionnaire

Sanghamitra Pati <[redacted]> 19 March 2022 at 11:36
To: Kristina Cassar <[redacted]>

Yes sure
You are welcome !

On Sat 19 Mar, 2022, 4:05 PM Kristina Cassar, <[redacted]> wrote:

> Dear Dr Pati,
>
> Thank you - I have received the questionnaire. May I please confirm whether I have your permission to use a few questions from your questionnaire in my thesis? As mentioned earlier, I will cite your study.
>
> Thank you!
>
> Kind regards,
> Kristina
>
> On Fri, 18 Mar 2022 at 19:29, Sanghamitra Pati <[redacted]> wrote:
>
> > Dear Kristina,
> > Please find attached the questionnaire.
> > Let me know if you need further details.
> > Would happy to be of any assistance.
> > My very best wishes with your thesis
> > Sanghamitra

Appendix D: Research tool (English and Maltese versions)

Research tool – English version

Study code	

L-Università ta' Malta
Faculty of Medicine & Surgery

Improving Diabetes Outcomes: The Role of Physical Activity

Dear participant,

I thank you for agreeing to participate in this study. The aim of this study is to assess physical activity participation among persons with diabetes and explore any barriers and motivating factors towards physical activity participation.

In this first part, I am asking for your name and ID number. These will only be used to obtain your most recent HbA1c blood result from the hospital. The blood result will be linked to your questionnaire answers and your personal details will then be discarded and not used anymore in the study.

Name and Surname of participant: _____

ID number: _____

Date of completion of questionnaire: _____

Study code	

General Information

Age: _____ (years)

Gender:

Male	
Female	
Other	

Locality of residence: _____

What is the highest level of education that you have successfully completed? Tick one box ONLY.

No formal education	
Primary school	
Secondary school	
Post-secondary (6^{th} form/MCAST)	
Tertiary (University)	
Other (please specify) _____	

Medical history

The following questions relate to your medical history, including your diabetes.

How long have you had diabetes for? _____ (years)

What type of diabetes do you have? Tick one box ONLY.

Type 1	
Type 2	
Don't know	

Study code	

What treatment are you currently taking for your diabetes? Tick one box ONLY.

Diet control only	
Tablets/pills	
Insulin injections only or with tablets/pills	

Do you suffer from any of the following medical conditions or diseases? Tick ALL that apply.

Asthma	
Chronic bronchitis, chronic obstructive pulmonary disease (COPD), emphysema	
Heart disease, including heart attack	
High blood pressure (hypertension)	
High cholesterol	
Stroke or chronic consequences of stroke	
Osteoarthritis (joint degeneration)	
Lower back disorder or chronic back pain	
Cancer (malignant tumour, also including leukaemia and lymphoma)	
Chronic anxiety/depression	
Other conditions you suffer from which are not mentioned above (please specify) (i) _____ (ii) _____ (iii)_____	
I do not suffer from any medical conditions other than diabetes	

Do you suffer from any of the following diabetes-related complications? Tick ALL that apply.

Foot problems/amputation of toe/s, foot, leg	
Kidney disease	
Eye problems due to diabetes	

Study code	

Kindly indicate your smoking status. Tick one box ONLY.

Current smoker	
Ex-smoker	
Non-smoker	

Kindly provide your weight and height and circle where appropriate:

Weight: _____ kg / pounds / stones Waist: _____ cm / inches

Height: _____ cm / feet / inches

Physical activity participation

The following questions relate to your awareness of physical activity recommendations and your level of physical activity participation.

How important do you think exercise is for controlling diabetes? Tick one box ONLY.

Very	
Somewhat	
Not at all	

How often should people with diabetes exercise or be physically active? Tick one box ONLY.

Most days of the week for at least 30 minutes	
Once a week for at least 30 minutes	
Once a month for one hour	
At least every fortnight for two hours	
Unsure/don't know	

Study code	

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions below will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and garden work, to get from place to place, and in your spare time for recreation, exercise or sport.

Vigorous physical activity

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, heavy construction, climbing up stairs, aerobics, running, fast bicycling or fast swimming?

   _____ **days per week**

   ☐ No vigorous physical activities → *Skip to question 3*

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **minutes per day** ☐ Don't know/Not sure

Moderate physical activity

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, sweeping, washing windows, scrubbing floors, bicycling or swimming at a regular pace, or doubles tennis? Do not include walking.

   _____ **days per week**

Study code	

☐ No moderate physical activities → *Skip to question 5*

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **minutes per day** ☐ Don't know/Not sure

Walking activities

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → *Skip to question 7*

6. How much time did you usually spend **walking** on one of those days?

_____ **minutes per day** ☐ Don't know/Not sure

Time spent sitting

This question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **HOURS per day** ☐ Don't know/Not sure

Study code	

Barriers and enablers towards physical activity participation

Below are statements that relate to ideas about exercise. Please indicate the degree to which you agree or disagree with the statements by circling SA for strongly agree, A for agree, D for disagree, or SD for strongly disagree.

	Strongly agree	Agree	Disagree	Strongly disagree
I enjoy exercise.	SA	A	D	SD
Exercise decreases feelings of stress and tension for me.	SA	A	D	SD
Exercise improves my mental health.	SA	A	D	SD
Exercising takes too much of my time.	SA	A	D	SD
I will prevent heart attacks by exercising.	SA	A	D	SD
Exercise tires me.	SA	A	D	SD
Exercise increases my muscle strength.	SA	A	D	SD
Exercise gives me a sense of personal accomplishment.	SA	A	D	SD
Places for me to exercise are too far away.	SA	A	D	SD
Exercising makes me feel relaxed.	SA	A	D	SD
Exercising lets me have contact with friends and persons I enjoy.	SA	A	D	SD
I am too embarrassed to exercise.	SA	A	D	SD
Exercising will keep me from having high blood pressure.	SA	A	D	SD
It costs too much to exercise.	SA	A	D	SD
Exercising increases my level of physical fitness.	SA	A	D	SD
Exercise facilities do not have convenient schedules for me.	SA	A	D	SD
My muscle tone is improved with exercise.	SA	A	D	SD
Exercising improves functioning of my cardiovascular system.	SA	A	D	SD
I am fatigued by exercise.	SA	A	D	SD

Study code	

	Strongly agree	Agree	Disagree	Strongly disagree
I have improved feelings of well-being from exercise.	SA	A	D	SD
My spouse (or significant other) does not encourage exercising.	SA	A	D	SD
Exercise increases my stamina.	SA	A	D	SD
Exercise improves my flexibility.	SA	A	D	SD
Exercise takes too much time from family relationships.	SA	A	D	SD
My disposition (mood) is improved with exercise.	SA	A	D	SD
Exercising helps me sleep better at night.	SA	A	D	SD
I will live longer if I exercise.	SA	A	D	SD
I think people in exercise clothes look funny.	SA	A	D	SD
Exercise helps me decrease fatigue.	SA	A	D	SD
Exercising is a good way for me to meet new people.	SA	A	D	SD
My physical endurance is improved by exercising.	SA	A	D	SD
Exercising improves my self-concept (how I perceive myself).	SA	A	D	SD
My family members do not encourage me to exercise.	SA	A	D	SD
Exercising increases my mental alertness.	SA	A	D	SD
Exercise allows me to carry out normal activities without becoming tired.	SA	A	D	SD
Exercise improves the quality of my work.	SA	A	D	SD
Exercise takes too much time from my family responsibilities.	SA	A	D	SD
Exercise is good entertainment for me.	SA	A	D	SD
Exercising increases my acceptance by others.	SA	A	D	SD
Exercise is hard work for me.	SA	A	D	SD
Exercise improves overall body functioning for me.	SA	A	D	SD
There are too few places for me to exercise.	SA	A	D	SD
Exercise improves the way my body looks.	SA	A	D	SD

Study code	

Indicate the probability that each of the factors listed below would keep you from practicing regular physical activity during the next 6 months.
(1 = very unlikely, 2 = unlikely, 3 = rather unlikely, 4 = uncertain, 5 = rather likely, 6 = likely, 7 = very likely)

	Very unlikely						**Very likely**
The loss of control over your diabetes	1	2	3	4	5	6	7
The risk of hypoglycaemia (low blood glucose)	1	2	3	4	5	6	7
The fear of being tired	1	2	3	4	5	6	7
The fear of hurting yourself	1	2	3	4	5	6	7
The fear of suffering a heart attack	1	2	3	4	5	6	7
A low fitness level	1	2	3	4	5	6	7
The fact that you have diabetes	1	2	3	4	5	6	7
The risk of hyperglycaemia (high blood glucose)	1	2	3	4	5	6	7
Your actual physical health status excluding your diabetes	1	2	3	4	5	6	7
Weather conditions	1	2	3	4	5	6	7
Your work schedule	1	2	3	4	5	6	7

Are there any other factors which keep you from practising regular physical activity?

1. _____
2. _____
3. _____

What would encourage you to perform more physical activity? Kindly mention the most important factors you feel would enable you to exercise more.

1. _____
2. _____
3. _____

Thank you for your participation!

Research tool – Maltese version

Study code	

L-Università ta' Malta
Faculty of Medicine & Surgery

Improving Diabetes Outcomes: The Role of Physical Activity

Għażiż/a parteċipant/a,

Nirringrazzjak talli aċċettajt li tipparteċipa f'dan l-istudju. L-għan ta' dan l-istudju huwa li nevalwaw il-parteċipazzjoni fl-attività fiżika fost persuni bid-dijabete u nesploraw ostakli u fatturi motivanti lejn il-parteċipazzjoni fl-attività fiżika.

F'din l-ewwel parti, qed nitolbok ismek u n-numru tal-karta tal-identità tiegħek. Dawn ser jintużaw biss biex jinkiseb l-aħħar riżultat tad-demm tiegħek tal-HbA1c mill-isptar. Ir-riżultat tad-demm ser jiġi marbut mat-tweġibiet tal-kwestjonarju tiegħek u d-dettalji personali tiegħek imbagħad ser jitħassru u ma jibqgħux jintużaw fl-istudju.

Isem u Kunjom tal-parteċipant/a: _____

Numru tal-ID: _____

Data tat-tlestija tal-kwestjonarju _____

Study code	

Informazzjoni ġenerali

Età: _____ (snin)

Sess:

Raġel	
Mara	
Oħrajn	

Lokalità fejn tgħix: _____

X'inhu l-ogħla livell ta' edukazzjoni li lestejt b'suċċess? Immarka kaxxa waħda BISS.

M'attendejtx skola	
Skola Primarja	
Skola Sekondarja	
Post-Sekondarja (6th form/MCAST)	
Terzjarja (Università)	
Oħrajn (jekk jogħġbok speċifika) _____	

Storja medika

Il-mistoqsijiet li ġejjin huma relatati ma' kwalunkwe problemi tas-saħħa tiegħek, inkluż id-dijabete.

Kemm ilek li sirt taf li għandek id-dijabete? _____ (snin)

Liema tip ta' dijabete għandek? Immarka kaxxa waħda BISS.

Type 1	
Type 2	
Ma nafx	

Study code	

Xi trattament qiegħed/qiegħda tieħu bħalissa għad-dijabete? Immarka kaxxa waħda BISS.

Nikkontrolla bid-dieta biss	
Pilloli	
Insulina biss jew insulina u pilloli	

Tbati minn xi kundizzjonijiet mediċi jew mard minn dawk imsemmija hawn taħt? Immarka kull fejn japplika.

Ażma	
Bronkite kronika, *chronic obstructive pulmonary disease* (COPD), emfiżema	
Mard tal-qalb, inkluż attakk tal-qalb	
Pressjoni għolja	
Kolesterol għoli	
Puplesija jew konsegwenzi kroniċi ta' puplesija	
Artrite (artroż, ġogi mittiekla)	
Uġigħ kroniku jew problemi oħra fid-dahar	
Kanċer (tumur, inkluż *leukaemia* jew *lymphoma*)	
Ansjetà/dipressjoni kronika/fit-tul	
Kundizzjonijiet oħra li tbati minnhom li mhumiex imsemmija hawn fuq (jekk jogħġbok speċifika) (i) _____ (ii) _____ (iii)_____	
Ma nbati minn ebda kundizzjoni medika ħlief id-dijabete	

Tbati minn xi kumplikazzjonijiet relatati mad-dijabete minn dawk imsemmija hawn taħt? Immarka kull fejn japplika.

Problemi tas-saqajn/amputazzjoni ta' saba'/swaba/sieq/riġel	
Mard tal-kliewi	
Problemi fl-għajnejn minħabba d-dijabete	

Study code	

Jekk jogħġbok indika l-istat tat-tipjip tiegħek. Immarka kaxxa waħda BISS.

Inpejjep	
Kont inpejjep	
Ma npejjipx	

Jekk jogħġbok ipprovdi l-piż u t-tul tiegħek u agħmel ċirku fejn japplika:

Piż: _____ kg / *pounds* / *stones* Qadd (*waist*): _____ cm / *inches*

Tul: _____ cm / *feet* / *inches*

Parteċipazzjoni fl-attività fiżika

Il-mistoqsijiet li ġejjin huma relatati mal-għarfien tiegħek tar-rakkomandazzjonijiet tal-attività fiżika u l-livell ta' parteċipazzjoni tiegħek fl-attività fiżika.

Kemm taħseb li huwa importanti l-eżerċizzju għall-kontroll tad-dijabete? Immarka kaxxa waħda BISS.

Ħafna	
Xi ftit	
Xejn	

Kemm-il darba għandhom jagħmlu eżerċizzju jew ikunu fiżikament attivi nies bid-dijabete? Immarka kaxxa waħda BISS.

Il-maġġoranza tal-ġranet tal-ġimgħa għal mill-inqas 30 minuta	
Darba fil-ġimgħa għal mill-inqas 30 minuta	
Darba fix-xahar għal siegħa	
Mill-inqas kull ħmistax għal sagħtejn	
Ma nafx / m'inix ċert/ċerta	

Study code	

Aħna interessati nsiru nafu dwar it-tip ta' attivitajiet fiżiċi li n-nies jagħmlu bħala parti mill-ħajja tagħhom ta' kuljum. Il-mistoqsijiet t'hawn taħt ser isaqsuk dwar kemm qattajt ħin tkun fiżikament attiv/a matul dawn **l-aħħar 7 t'ijiem**. Jekk jogħġbok wieġeb kull mistoqsija anke jekk ma tqisx lilek innifsek bħala persuna attiva. Jekk jogħġbok aħseb dwar l-attivitajiet li tagħmel fuq ix-xogħol, bħala parti mix-xogħol tad-dar u fil-ġnien jew bitħa, biex tmur minn post għall-ieħor, u attività fiżika fil-ħin liberu tiegħek bħala rikreazzjoni, eżerċizzju jew sport.

Attività fiżika vigoruża

Aħseb dwar l-attivitajiet **iebsin/vigoruż** kollha li għamilt **fl-aħħar 7 t'ijiem**. Attivitajiet fiżiċi **iebsin/vigoruż** jirreferu għall-attivitajiet li jirrikjedu sforz fiżiku kbir u li jġiegħluk tieħu n-nifs ħafna aktar qawwi min-normal. Aħseb *biss* f'dawk l-attivitajiet fiżiċi li domt tagħmilhom għal mill-inqas 10 minuti bla waqfien.

1. Matul **l-aħħar 7 t'ijiem**, kemm-il darba għamilt xi attivitjiet fiżiċi **iebsin/vigoruż**, bħal terfa' xi ħaġa tqila, xogħol ta' kostruzzjoni, titla' t-taraġ, *aerobics*, ġiri, issuq ir-rota tgħaġġel jew tgħum tgħaġġel?

   _____ **ijiem fil-ġimgħa**

   ☐ L-ebda attività fiżika vigoruża → ***Aqbeż għal mistoqsija nru. 3***

2. Kemm qattajt ħin tagħmel attivitajiet fiżiċi **iebsin/vigoruż** f'waħda minn dawk il-ġranet?

   _____ **minuti kull jum** ☐ Ma nafx/M'inix ċert/a

Attività fiżika moderata

Aħseb dwar l-attivitajiet **moderati** kollha li għamilt **fl-aħħar 7 t'ijiem**. Attivitajiet **moderati** jirreferu għall-attivitajiet li jirrikjedu sforz fiżiku moderat u li jġiegħluk tieħu n-nifs ftit aktar qawwi min-normal. Aħseb *biss* f'dawk l-attivitajiet fiżiċi li domt tagħmilhom għal mill-inqas 10 minuti bla waqfien.

3. Matul **l-aħħar 7 t'ijiem**, kemm-il darba għamilt xi attivitajiet fiżiċi **moderati**, bħal iġġorr xi ħaġa ħafifa, tiknes, taħsel il-ħġieġ, togħrok l-art, issuq ir-rota jew tgħum b'ritmu regolari, jew tilgħab it-tennis tnejn kontra tnejn (*doubles*)? Tinkludix il-mixi.

Study code	

_____ **ijiem fil-ġimgħa**

☐ L-ebda attività fiżika moderata → *Aqbeż għal mistoqsija nru. 5*

4. Kemm qattajt ħin tagħmel attivitajiet fiżiċi **moderati** f'waħda minn dawk il-ġranet?

_____ **minuti kull jum** ☐ Ma nafx/M'inix ċert/a

Mixi

Aħseb dwar il-ħin li qattajt **timxi fl-aħħar 7 t'ijiem**. Dan jinkludi mixi fuq ix-xogħol u d-dar, mixi biex tmur minn post għall-ieħor, u kwalunkwe mixi ieħor li għamilt sempliċiment bħala rikreazzjoni, sport, eżerċizzju, jew għall-gost.

5. Matul **l-aħħar 7 t'ijiem**, kemm-il darba **mxejt** għal mill-inqas 10 minuti kontinwi?

_____ **ijiem fil-ġimgħa**

☐ L-ebda mixi → *Aqbeż għal mistoqsija nru. 7*

6. Kemm qattajt ħin **timxi** f'waħda minn dawk il-ġranet?

_____ **minuti kull jum** ☐ Ma nafx/M'inix ċert/a

Ħin bilqiegħda

Din il-mistoqsija hija dwar il-ħin li qattajt **bilqiegħda** fost il-gimgħa **fl-aħħar 7 t'ijiem**. Inkludi l-ħin li qattajt bilqiegħda fuq ix-xogħol, id-dar, waqt li kont qed tagħmel xi xogħol ta' kors u waqt il-ħin liberu. Dan jista' jinkludi ħin bilqiegħda ma' skrivanija, iżżur il-ħbieb, taqra, jew bilqiegħda jew mimdud/a biex tara t-televixin.

7. Matul **l-aħħar 7 t'ijiem**, kemm qattajt ħin **bilqiegħda f'jum wieħed fost il-ġimgħa** (weekday)?

_____ **SIGĦAT kull jum** ☐ Ma nafx/M'inix ċert/a

Study code	

Ostakli u faċilitaturi lejn il-parteċipazzjoni fl-attività fiżika

Hawn taħt ser issib dikjarazzjonijiet relatati ma' opinjonijiet dwar l-eżerċizzju. Jekk jogħġbok indika kemm taqbel jew ma taqbilx mad-dikjarazzjonijiet billi tagħmel ċirku madwar NĦ għal naqbel ħafna, N għal naqbel, MN għal ma naqbilx, jew MNĦ għal ma naqbilx ħafna.

	Naqbel ħafna	Naqbel	Ma naqbilx	Ma naqbilx ħafna
Nieħu gost nagħmel l-eżerċizzju.	NĦ	N	MN	MNĦ
L-eżerċizzju jnaqqasli s-sentimenti ta' stress u tensjoni.	NĦ	N	MN	MNĦ
L-eżerċizzju jtejjeb is-saħħa mentali tiegħi.	NĦ	N	MN	MNĦ
L-eżerċizzju jeħodli wisq mill-ħin tiegħi.	NĦ	N	MN	MNĦ
Billi nagħmel l-eżerċizzju ser nipprevjeni attakki tal-qalb.	NĦ	N	MN	MNĦ
L-eżerċizzju jgħajjini.	NĦ	N	MN	MNĦ
L-eżerċizzju jżidli s-saħħa fil-muskoli.	NĦ	N	MN	MNĦ
L-eżerċizzju jagħtini sens ta' sodisfazzjon personali.	NĦ	N	MN	MNĦ
Postijiet biex nagħmel l-eżerċizzju qegħdin 'l bogħod wisq.	NĦ	N	MN	MNĦ
L-eżerċizzju nħossu jirrilassani.	NĦ	N	MN	MNĦ
L-eżerċizzju jippermettili li jkolli kuntatt ma' ħbieb u persuni li nieħu gost magħhom.	NĦ	N	MN	MNĦ
Inħossni wisq imbarazzat/a biex nagħmel l-eżerċizzju.	NĦ	N	MN	MNĦ
L-eżerċizzju ser jipprevjeni milli jkolli pressjoni għolja.	NĦ	N	MN	MNĦ
L-eżerċizzju jqum ħafna flus.	NĦ	N	MN	MNĦ
L-eżerċizzju jżidli l-livell ta' saħħa fiżika.	NĦ	N	MN	MNĦ
Faċilitajiet fejn isir l-eżerċizzju m'għandhomx ħinijiet konvenjenti għalija.	NĦ	N	MN	MNĦ
L-eżerċizzju jtejjeb it-ton tal-muskoli tiegħi.	NĦ	N	MN	MNĦ
L-eżerċizzju jtejjeb il-funzjoni tas-sistema kardjovaskulari tiegħi.	NĦ	N	MN	MNĦ
Inħossni għajjien/a wara l-eżerċizzju.	NĦ	N	MN	MNĦ

Study code	

	Naqbel ħafna	Naqbel	Ma naqbilx	Ma naqbilx ħafna
L-eżerċizzju jtejjeb il-mod ta' kif inħossni (*well-being*).	NĦ	N	MN	MNĦ
Żewġi/marti/l-partner tiegħi ma jinkoraġġix/tinkoraġġix l-eżerċizzju.	NĦ	N	MN	MNĦ
L-eżerċizzju jżidli l-istamina.	NĦ	N	MN	MNĦ
L-eżerċizzju jtejjibli l-flessibbiltà.	NĦ	N	MN	MNĦ
L-eżerċizzju jieħu wisq ħin mir-relazzjonijiet tal-familja.	NĦ	N	MN	MNĦ
Il-burdata tiegħi titjieb bl-eżerċizzju.	NĦ	N	MN	MNĦ
L-eżerċizzju jgħinni norqod aħjar bil-lejl.	NĦ	N	MN	MNĦ
Jekk nagħmel l-eżerċizzju ngħix iżjed fit-tul.	NĦ	N	MN	MNĦ
Naħseb li nies liebsin ħwejjeġ tal-eżerċizzju jidħru taċ-ċajt.	NĦ	N	MN	MNĦ
L-eżerċizzju jgħini nnaqqas l-għejja.	NĦ	N	MN	MNĦ
L-eżerċizzju huwa mod tajjeb biex niltaqa' ma' nies ġodda.	NĦ	N	MN	MNĦ
L-eżerċizzju jgħin biex il-ġisem tiegħi jiflaħ iżjed (*endurance*).	NĦ	N	MN	MNĦ
L-eżerċizzju jtejjibli l-mod ta' kif naħseb fuqi nnifsi (*self-concept*).	NĦ	N	MN	MNĦ
Il-membri tal-familja tiegħi ma jinkoraġġunix biex nagħmel l-eżerċizzju.	NĦ	N	MN	MNĦ
L-eżerċizzju jgħinni nkun attent (*alert*) mentalment.	NĦ	N	MN	MNĦ
L-eżerċizzju jippermettili nagħmel l-attivitajiet normali tiegħi mingħajr ma nħossni għajjien/a.	NĦ	N	MN	MNĦ
L-eżerċizzju jtejjeb il-kwalità tax-xogħol tiegħi.	NĦ	N	MN	MNĦ
L-eżerċizzju jeħodli wisq ħin mir-responsabbilitajiet tiegħi tal-familja.	NĦ	N	MN	MNĦ
Għalija l-eżerċizzju huwa ta' divertiment.	NĦ	N	MN	MNĦ
L-eżerċizzju jżid iċ-ċans li ħaddiehor jaċċettani.	NĦ	N	MN	MNĦ
Għalija l-eżerċizzju huwa xogħol iebes.	NĦ	N	MN	MNĦ
L-eżerċizzju jtejjeb il-funzjoni ġenerali ta' ġismi.	NĦ	N	MN	MNĦ
Hemm wisq ftit postijiet fejn nista' mmur nagħmel l-eżerċizzju.	NĦ	N	MN	MNĦ
L-eżerċizzju jtejjeb il-mod ta' kif jidher ġismi.	NĦ	N	MN	MNĦ

Study code	

Indika l-probabbilità li kull wieħed minn dawn li ġejjin iżommok milli tagħmel attività fiżika regolari fis-6 xhur li ġejjin.

(1 = improbabbli ħafna, 2 = improbabbli, 3 = pjuttost improbabbli, 4 = inċert, 5 = pjuttost probabbli, 6 = probabbli, 7 = probabbli ħafna)

	Improbabbli ħafna						**Probabbli ħafna**
Titlef il-kontroll tad-dijabete tiegħek	1	2	3	4	5	6	7
Ir-riskju li jinżel iz-zokkor (*hypoglycaemia*)	1	2	3	4	5	6	7
Il-biża' li tkun għajjien	1	2	3	4	5	6	7
Il-biża' li tweġġa' lilek innifsek	1	2	3	4	5	6	7
Il-biża' li ssofri minn attakk tal-qalb	1	2	3	4	5	6	7
Livell baxx ta' *fitness*	1	2	3	4	5	6	7
Il-fatt li għandek id-dijabete	1	2	3	4	5	6	7
Ir-riskju li jiżdied iz-zokkor (*hyperglycaemia*)	1	2	3	4	5	6	7
L-istat tas-saħħa fiżika tiegħek esklużd-dijabete	1	2	3	4	5	6	7
Kundizzjonijiet tat-temp	1	2	3	4	5	6	7
L-iskeda tax-xogħol tiegħek	1	2	3	4	5	6	7

Hemm xi fatturi oħra li jżommuk milli tagħmel attività fiżika regolari?

1. _____
2. _____
3. _____

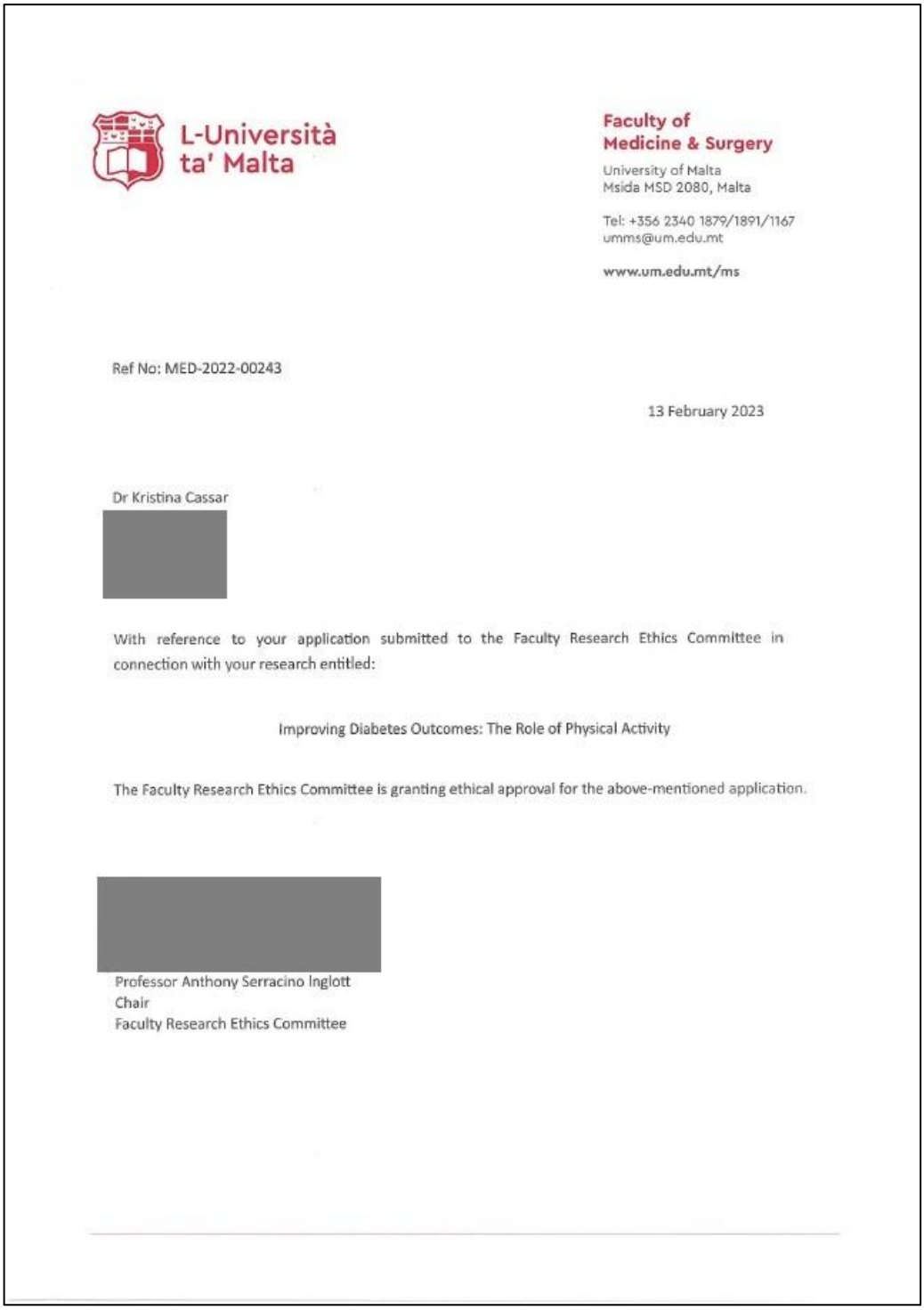
X'jinkoraġġik biex tagħmel aktar attività fiżika? Jekk jogħġbok semmi l-fatturi l-aktar importanti li tħoss li kieku jippermettulek tagħmel iżjed eżerċizzju.

1. _____
2. _____
3. _____

Grazzi tal-parteċipazzjoni tiegħek!

Appendix E: Ethics approvals

Approval from the University of Malta Faculty Research Ethics Committee



L-Università ta' Malta

Faculty of Medicine & Surgery
University of Malta
Msida MSD 2080, Malta

Tel: +356 2340 1879/1891/1167
umms@um.edu.mt

www.um.edu.mt/ms

Ref No: MED-2022-00243

13 February 2023

Dr Kristina Cassar
[redacted]

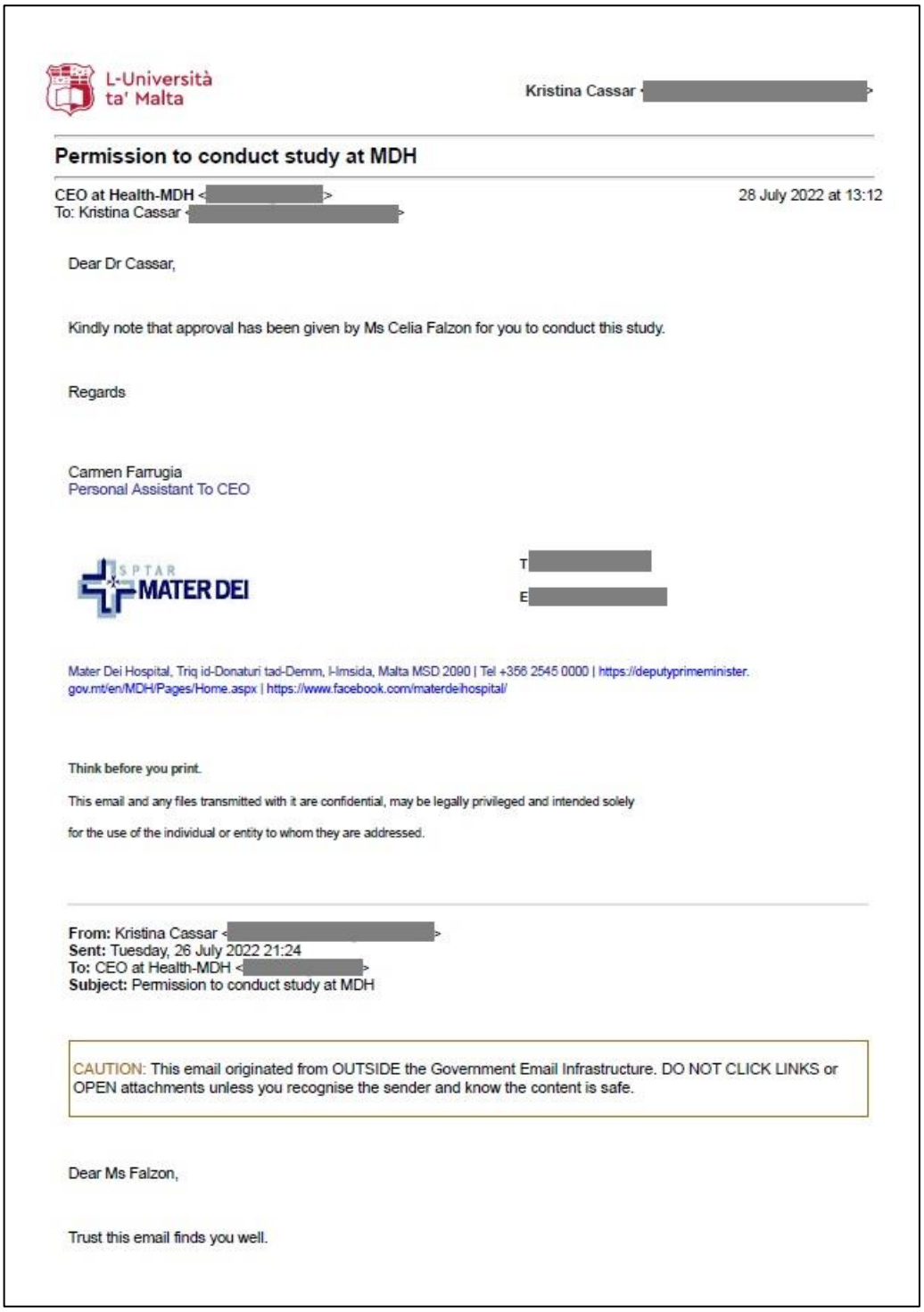
With reference to your application submitted to the Faculty Research Ethics Committee in connection with your research entitled:

Improving Diabetes Outcomes: The Role of Physical Activity

The Faculty Research Ethics Committee is granting ethical approval for the above-mentioned application.

[redacted]
Professor Anthony Serracino Inglott
Chair
Faculty Research Ethics Committee

Approval from the Chief Executive Officer of Mater Dei Hospital



L-Università ta' Malta

Kristina Cassar <[redacted]>

Permission to conduct study at MDH

CEO at Health-MDH <[redacted]>
To: Kristina Cassar <[redacted]>

28 July 2022 at 13:12

Dear Dr Cassar,

Kindly note that approval has been given by Ms Celia Falzon for you to conduct this study.

Regards

Carmen Farrugia
Personal Assistant To CEO

SPTAR MATER DEI

T [redacted]
E [redacted]

Mater Dei Hospital, Triq id-Donaturi tad-Demm, l-Imsida, Malta MSD 2090 | Tel +356 2545 0000 | https://deputyprimeminister.gov.mt/en/MDH/Pages/Home.aspx | https://www.facebook.com/materdeihospital/

Think before you print.

This email and any files transmitted with it are confidential, may be legally privileged and intended solely

for the use of the individual or entity to whom they are addressed.

From: Kristina Cassar <[redacted]>
Sent: Tuesday, 26 July 2022 21:24
To: CEO at Health-MDH <[redacted]>
Subject: Permission to conduct study at MDH

CAUTION: This email originated from OUTSIDE the Government Email Infrastructure. DO NOT CLICK LINKS or OPEN attachments unless you recognise the sender and know the content is safe.

Dear Ms Falzon,

Trust this email finds you well.

I am Dr Kristina Cassar, a Basic Specialist Trainee in Public Health Medicine, currently reading for a Master of Science in Public Health with the University of Malta. I am contacting you for permission to conduct a survey among patients attending Diabetes outpatients at MDH as part of my thesis entitled "Improving Diabetes Outcomes: The Role of Physical Activity".

The aim of my research project is to examine the knowledge and adherence to physical activity recommendations and explore perceived benefits and barriers to physical activity among Diabetic adults in Malta and Gozo. I will be distributing a paper-based questionnaire to type 2 diabetic adults aged 18-69 years attending Diabetes outpatients at Mater Dei Hospital, Diabetes clinics at three health centres, and outpatients at Gozo General Hospital. The questionnaire will contain instruments which will assess their knowledge on physical activity recommendations, measure levels of physical activity carried out, and identify perceived barriers and enablers to physical activity. Apart from this, patients will be asked to provide information regarding their demographics, type and duration of diabetes, treatment regimen, and presence of any co-morbidities or complications (a copy of the questionnaire is being attached to this email). Individuals would initially be asked to participate in the study by a member of staff (nurse), who would distribute the information letter and consent form. Those who agree to participate would then be approached by the researcher (myself).

Apart from the above, glycaemic control will be assessed by the most recent HbA1c obtained via an intermediary ( ) from iSoft Clinical Manager, and BMI (self-reported weight and height) and/or waist circumference will be assessed. Participants will be asked to provide their name and ID number on the front page of the questionnaire; these details will be discarded once the questionnaire has been linked to their HbA1c blood result and data will be analysed blindly.

Kindly find attached:

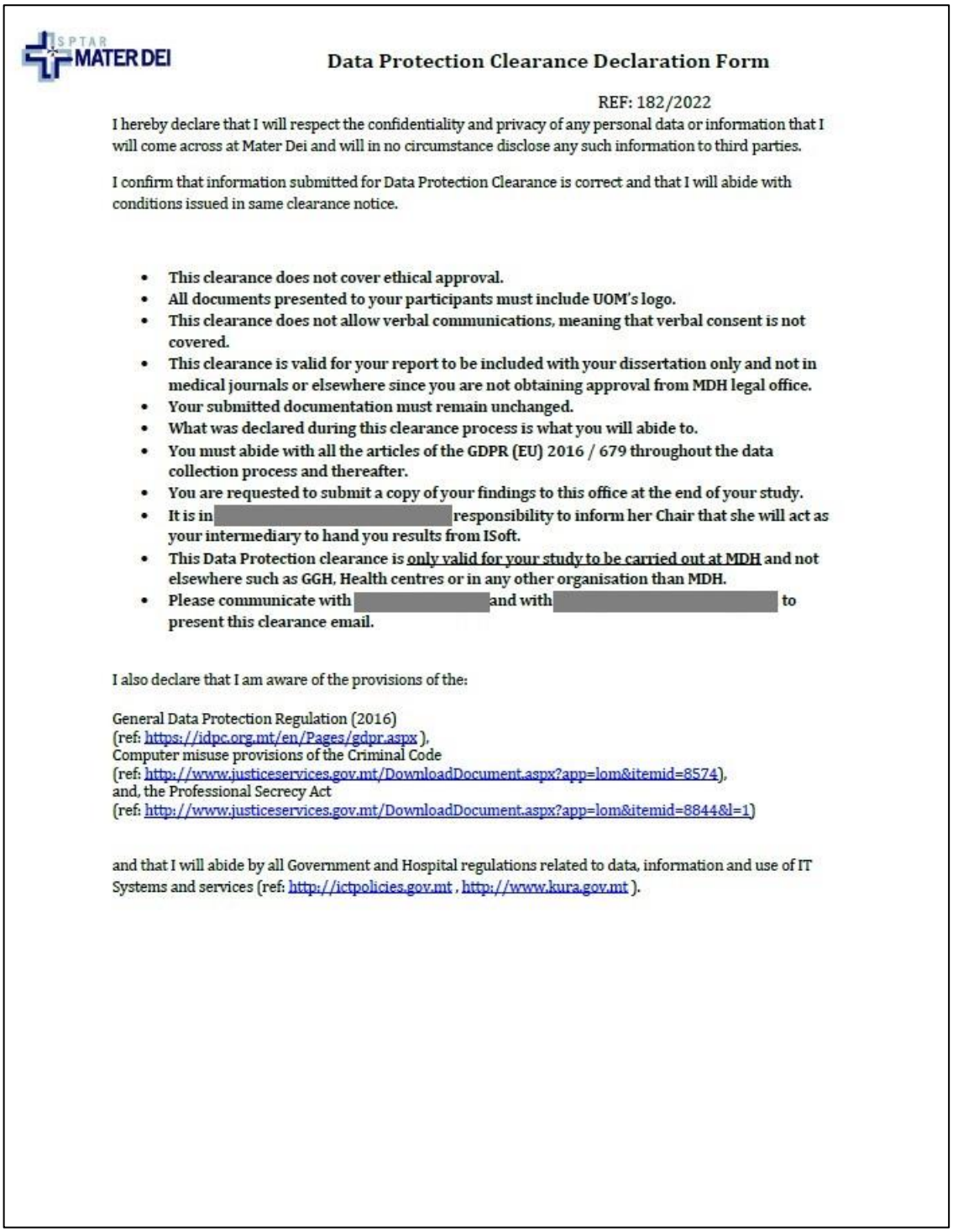
- Approval from Data Protection Officer, MDH
- Approval from Prof Stephen Fava
- Questionnaire tool to be used in my study
- Information Letter and Consent form to be distributed to the participants
- Declaration from intermediary who will recruit patients on my behalf ( )
- Declaration from intermediary who will obtain the HbA1c results from iSoft Clinical Manager ( )

Kindly let me know should you require any additional information to grant permission. While thanking you for your time, I look forward to hearing from you at your earliest convenience.

Kind regards

Dr Kristina Cassar

Data Protection Clearance Form for Mater Dei Hospital



SPTAR MATER DEI

Data Protection Clearance Declaration Form

REF: 182/2022

I hereby declare that I will respect the confidentiality and privacy of any personal data or information that I will come across at Mater Dei and will in no circumstance disclose any such information to third parties.

I confirm that information submitted for Data Protection Clearance is correct and that I will abide with conditions issued in same clearance notice.

- **This clearance does not cover ethical approval.**
- **All documents presented to your participants must include UOM's logo.**
- **This clearance does not allow verbal communications, meaning that verbal consent is not covered.**
- **This clearance is valid for your report to be included with your dissertation only and not in medical journals or elsewhere since you are not obtaining approval from MDH legal office.**
- **Your submitted documentation must remain unchanged.**
- **What was declared during this clearance process is what you will abide to.**
- **You must abide with all the articles of the GDPR (EU) 2016 / 679 throughout the data collection process and thereafter.**
- **You are requested to submit a copy of your findings to this office at the end of your study.**
- **It is in [redacted] responsibility to inform her Chair that she will act as your intermediary to hand you results from ISoft.**
- **This Data Protection clearance is only valid for your study to be carried out at MDH and not elsewhere such as GGH, Health centres or in any other organisation than MDH.**
- **Please communicate with [redacted] and with [redacted] to present this clearance email.**

I also declare that I am aware of the provisions of the:

General Data Protection Regulation (2016)
(ref: https://idpc.org.mt/en/Pages/gdpr.aspx),
Computer misuse provisions of the Criminal Code
(ref: http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=8574),
and, the Professional Secrecy Act
(ref: http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=8844&l=1)

and that I will abide by all Government and Hospital regulations related to data, information and use of IT Systems and services (ref: http://ictpolicies.gov.mt , http://www.kura.gov.mt).

SPTAR MATER DEI

Data Protection Clearance Declaration Form

REF: 182/2022

Full Name: Kristina Cassar

ID/ Passport: [redacted]

Approval Date from DPO: 25th July 2022

Approval Date from CEO: 28th July 2022

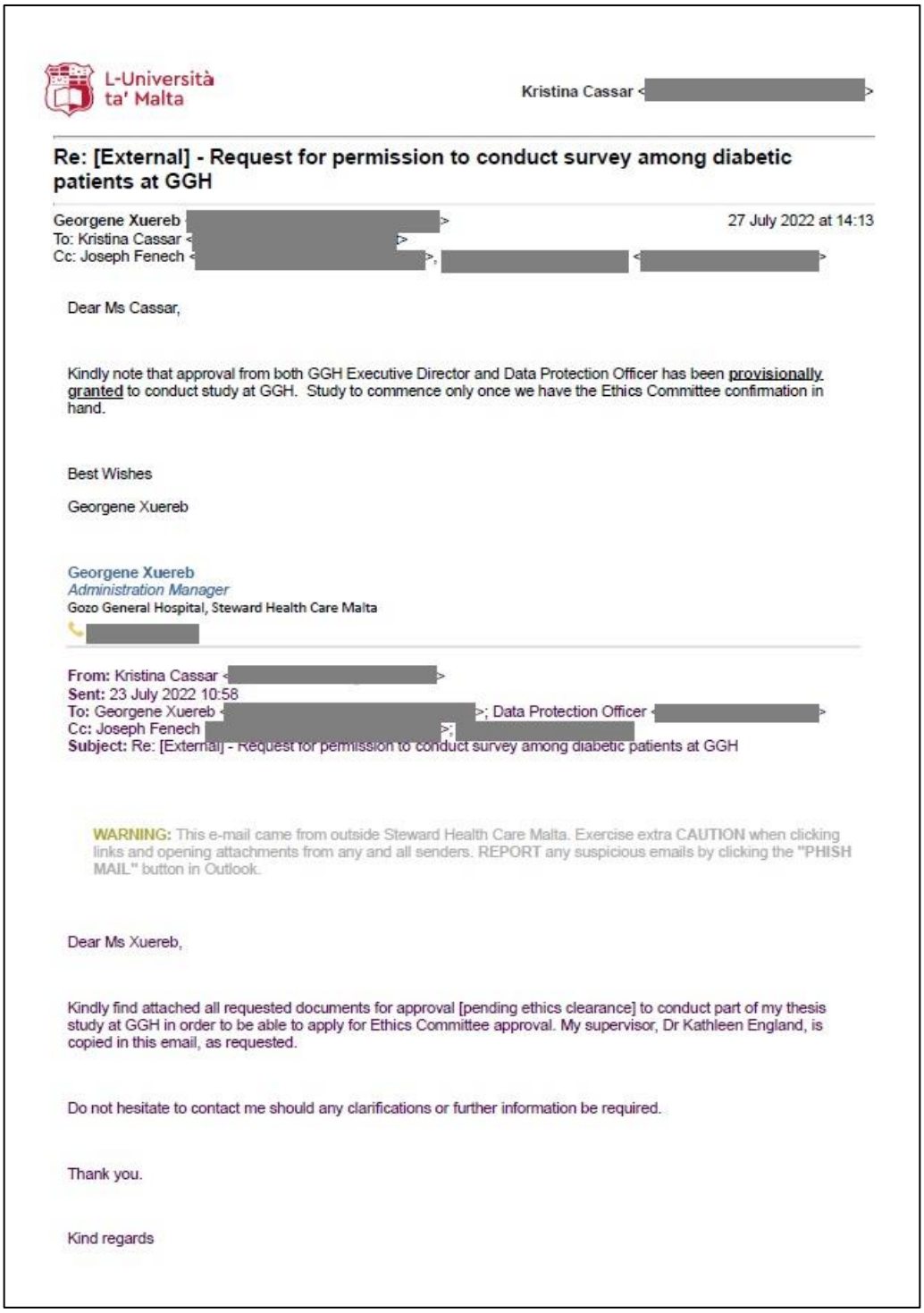
Data Collection Period (From – To): September 2022 – August 2023

MDH Official Approval Names: Prof S Fava

Name of Study / Audit: Improving Diabetes Outcomes: The Role of Physical Activity

Applicant's Signature: [redacted]

Approval from the Data Protection Officer and Executive Director of Gozo General Hospital



L-Università ta' Malta

Kristina Cassar <[redacted]>

Re: [External] - Request for permission to conduct survey among diabetic patients at GGH

Georgene Xuereb <[redacted]> 27 July 2022 at 14:13
To: Kristina Cassar <[redacted]>
Cc: Joseph Fenech <[redacted]>, [redacted] <[redacted]>

Dear Ms Cassar,

Kindly note that approval from both GGH Executive Director and Data Protection Officer has been provisionally granted to conduct study at GGH. Study to commence only once we have the Ethics Committee confirmation in hand.

Best Wishes

Georgene Xuereb

Georgene Xuereb
Administration Manager
Gozo General Hospital, Steward Health Care Malta
[redacted]

From: Kristina Cassar <[redacted]>
Sent: 23 July 2022 10:58
To: Georgene Xuereb <[redacted]>; Data Protection Officer <[redacted]>
Cc: Joseph Fenech [redacted]
Subject: Re: [External] - Request for permission to conduct survey among diabetic patients at GGH

WARNING: This e-mail came from outside Steward Health Care Malta. Exercise extra CAUTION when clicking links and opening attachments from any and all senders. REPORT any suspicious emails by clicking the "PHISH MAIL" button in Outlook.

Dear Ms Xuereb,

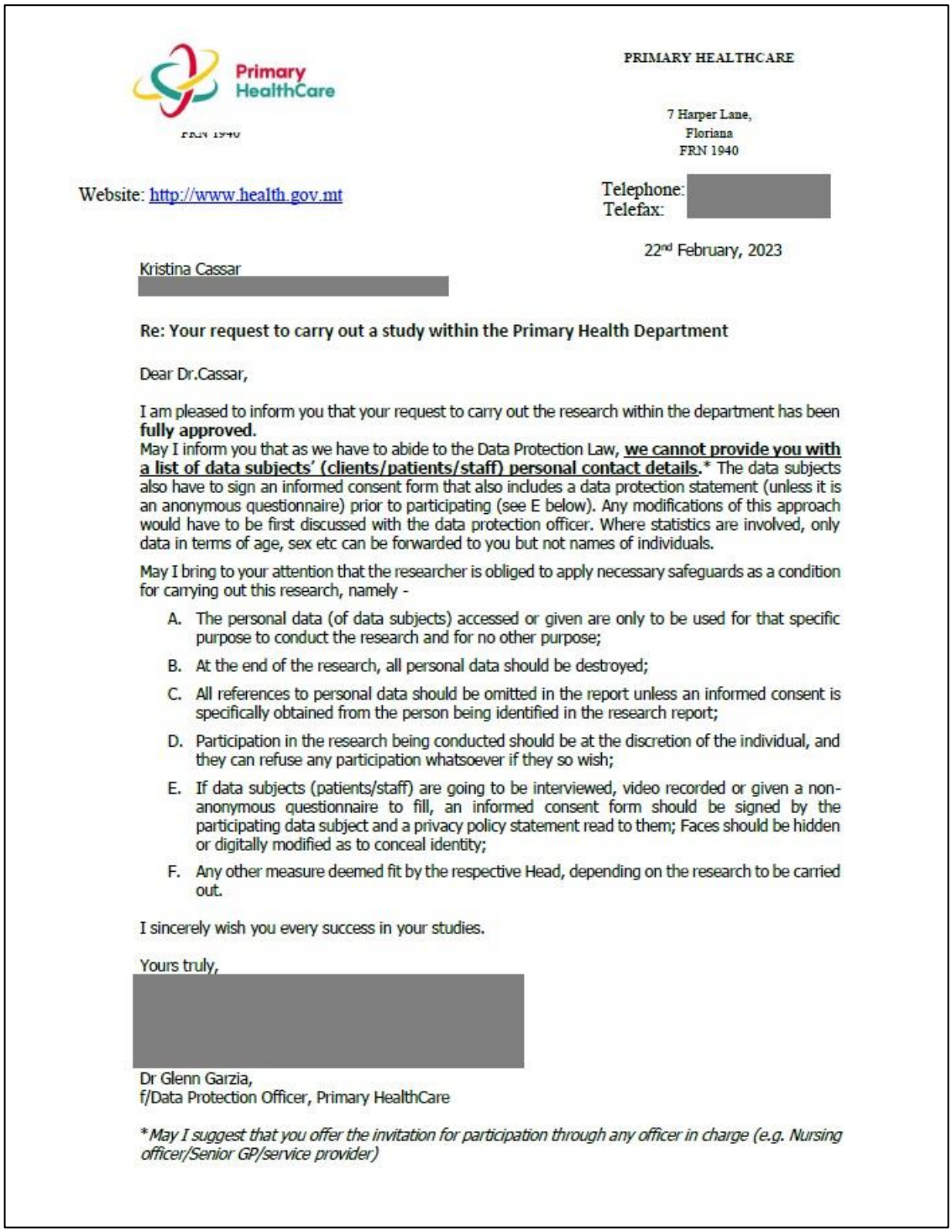
Kindly find attached all requested documents for approval [pending ethics clearance] to conduct part of my thesis study at GGH in order to be able to apply for Ethics Committee approval. My supervisor, Dr Kathleen England, is copied in this email, as requested.

Do not hesitate to contact me should any clarifications or further information be required.

Thank you.

Kind regards

Approval from the Data Protection Officer of Primary HealthCare



Primary HealthCare

FRN 1940

PRIMARY HEALTHCARE

7 Harper Lane,
Floriana
FRN 1940

Website: http://www.health.gov.mt

Telephone: [redacted]
Telefax:

22nd February, 2023

Kristina Cassar
[redacted]

Re: Your request to carry out a study within the Primary Health Department

Dear Dr.Cassar,

I am pleased to inform you that your request to carry out the research within the department has been **fully approved**.
May I inform you that as we have to abide to the Data Protection Law, **we cannot provide you with a list of data subjects' (clients/patients/staff) personal contact details.*** The data subjects also have to sign an informed consent form that also includes a data protection statement (unless it is an anonymous questionnaire) prior to participating (see E below). Any modifications of this approach would have to be first discussed with the data protection officer. Where statistics are involved, only data in terms of age, sex etc can be forwarded to you but not names of individuals.

May I bring to your attention that the researcher is obliged to apply necessary safeguards as a condition for carrying out this research, namely -

A. The personal data (of data subjects) accessed or given are only to be used for that specific purpose to conduct the research and for no other purpose;
B. At the end of the research, all personal data should be destroyed;
C. All references to personal data should be omitted in the report unless an informed consent is specifically obtained from the person being identified in the research report;
D. Participation in the research being conducted should be at the discretion of the individual, and they can refuse any participation whatsoever if they so wish;
E. If data subjects (patients/staff) are going to be interviewed, video recorded or given a non-anonymous questionnaire to fill, an informed consent form should be signed by the participating data subject and a privacy policy statement read to them; Faces should be hidden or digitally modified as to conceal identity;
F. Any other measure deemed fit by the respective Head, depending on the research to be carried out.

I sincerely wish you every success in your studies.

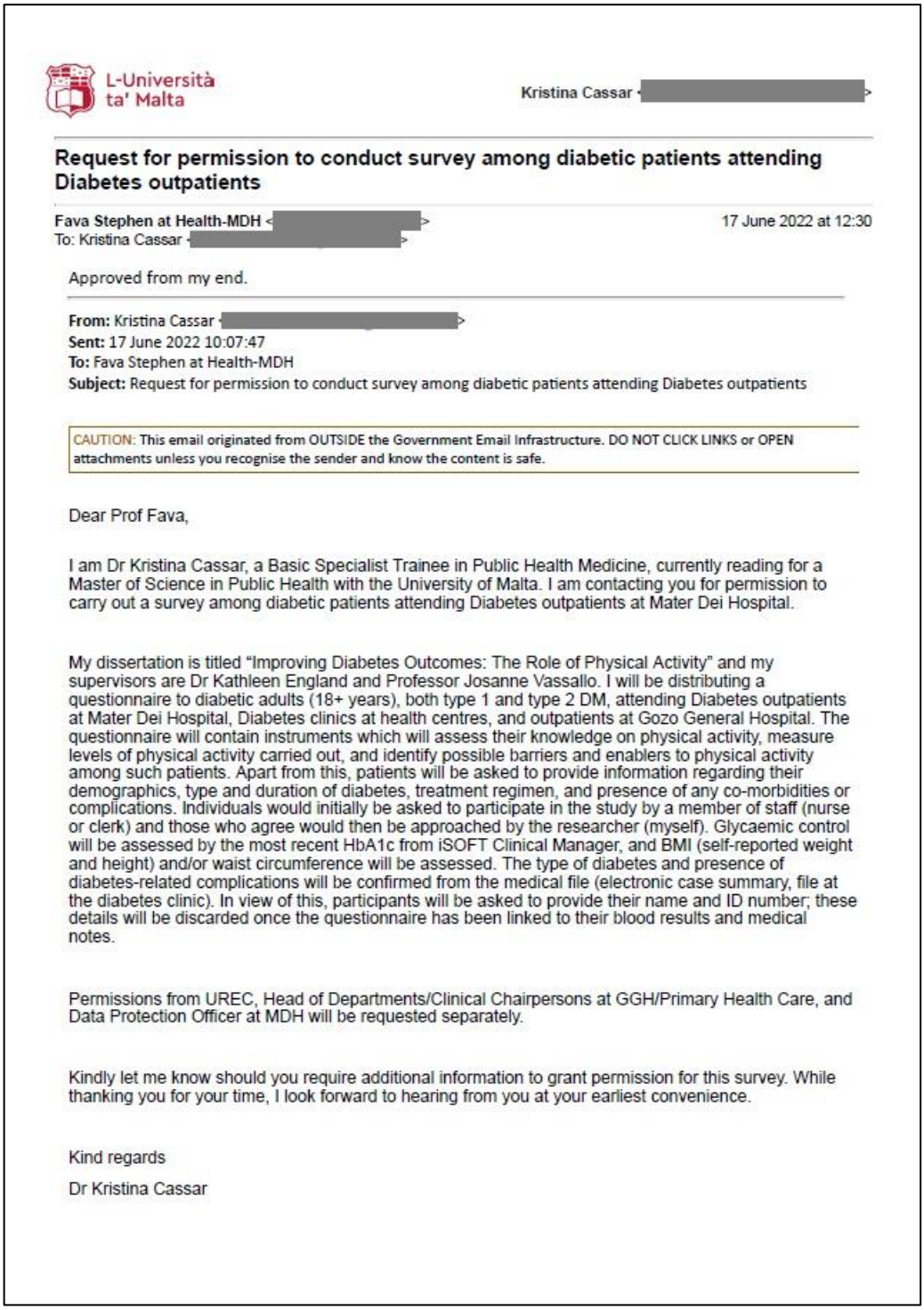
Yours truly,

[redacted]

Dr Glenn Garzia,
f/Data Protection Officer, Primary HealthCare

**May I suggest that you offer the invitation for participation through any officer in charge (e.g. Nursing officer/Senior GP/service provider)*

Approval from the Chairperson of the Department of Medicine at Mater Dei Hospital



L-Università ta' Malta

Kristina Cassar <[redacted]>

Request for permission to conduct survey among diabetic patients attending Diabetes outpatients

Fava Stephen at Health-MDH <[redacted]> 17 June 2022 at 12:30
To: Kristina Cassar <[redacted]>

Approved from my end.

From: Kristina Cassar <[redacted]>
Sent: 17 June 2022 10:07:47
To: Fava Stephen at Health-MDH
Subject: Request for permission to conduct survey among diabetic patients attending Diabetes outpatients

CAUTION: This email originated from OUTSIDE the Government Email Infrastructure. DO NOT CLICK LINKS or OPEN attachments unless you recognise the sender and know the content is safe.

Dear Prof Fava,

I am Dr Kristina Cassar, a Basic Specialist Trainee in Public Health Medicine, currently reading for a Master of Science in Public Health with the University of Malta. I am contacting you for permission to carry out a survey among diabetic patients attending Diabetes outpatients at Mater Dei Hospital.

My dissertation is titled "Improving Diabetes Outcomes: The Role of Physical Activity" and my supervisors are Dr Kathleen England and Professor Josanne Vassallo. I will be distributing a questionnaire to diabetic adults (18+ years), both type 1 and type 2 DM, attending Diabetes outpatients at Mater Dei Hospital, Diabetes clinics at health centres, and outpatients at Gozo General Hospital. The questionnaire will contain instruments which will assess their knowledge on physical activity, measure levels of physical activity carried out, and identify possible barriers and enablers to physical activity among such patients. Apart from this, patients will be asked to provide information regarding their demographics, type and duration of diabetes, treatment regimen, and presence of any co-morbidities or complications. Individuals would initially be asked to participate in the study by a member of staff (nurse or clerk) and those who agree would then be approached by the researcher (myself). Glycaemic control will be assessed by the most recent HbA1c from iSOFT Clinical Manager, and BMI (self-reported weight and height) and/or waist circumference will be assessed. The type of diabetes and presence of diabetes-related complications will be confirmed from the medical file (electronic case summary, file at the diabetes clinic). In view of this, participants will be asked to provide their name and ID number; these details will be discarded once the questionnaire has been linked to their blood results and medical notes.

Permissions from UREC, Head of Departments/Clinical Chairpersons at GGH/Primary Health Care, and Data Protection Officer at MDH will be requested separately.

Kindly let me know should you require additional information to grant permission for this survey. While thanking you for your time, I look forward to hearing from you at your earliest convenience.

Kind regards

Dr Kristina Cassar

Approval from Consultant in Diabetes at Gozo General Hospital

L-Università ta' Malta

Kristina Cassar <[redacted]>

Request for permission to conduct survey among diabetic patients under your care attending GGH outpatients

Bigeni Josephine at GGH-Health [redacted] 2 August 2022 at 21:39
To: Kristina Cassar <[redacted]>

Dear Kristina,

This is a very interesting project. You have my permission to conduct the survey on my patients. My DOP is on a Tuesday. Should you need further help from my end kindly let me know.

Kindly send me a copy of the publications you will be able to publish from your Master.

Kind regards

Josephine Bigeni

Get Outlook for iOS

From: Kristina Cassar <[redacted]>
Sent: Tuesday, August 2, 2022 12:36:20 PM
To: [redacted]
Subject: Request for permission to conduct survey among diabetic patients under your care attending GGH outpatients

CAUTION: This email originated from OUTSIDE the Government Email Infrastructure. DO NOT CLICK LINKS or OPEN attachments unless you recognise the sender and know the content is safe.

Dear Dr Bigeni,

I am Dr Kristina Cassar, a Basic Specialist Trainee in Public Health Medicine currently reading for a Master of Science in Public Health with the University of Malta. I am contacting you for permission to conduct a survey among diabetic patients under your care attending outpatients at Gozo General Hospital.

My dissertation is entitled "Improving Diabetes Outcomes: The Role of Physical Activity" and my supervisors are Dr Kathleen England and Professor Josanne Vassallo. The aim of my research project is to examine the knowledge and adherence to physical activity recommendations and explore perceived benefits and barriers to physical activity among Diabetic adults in Malta and Gozo.

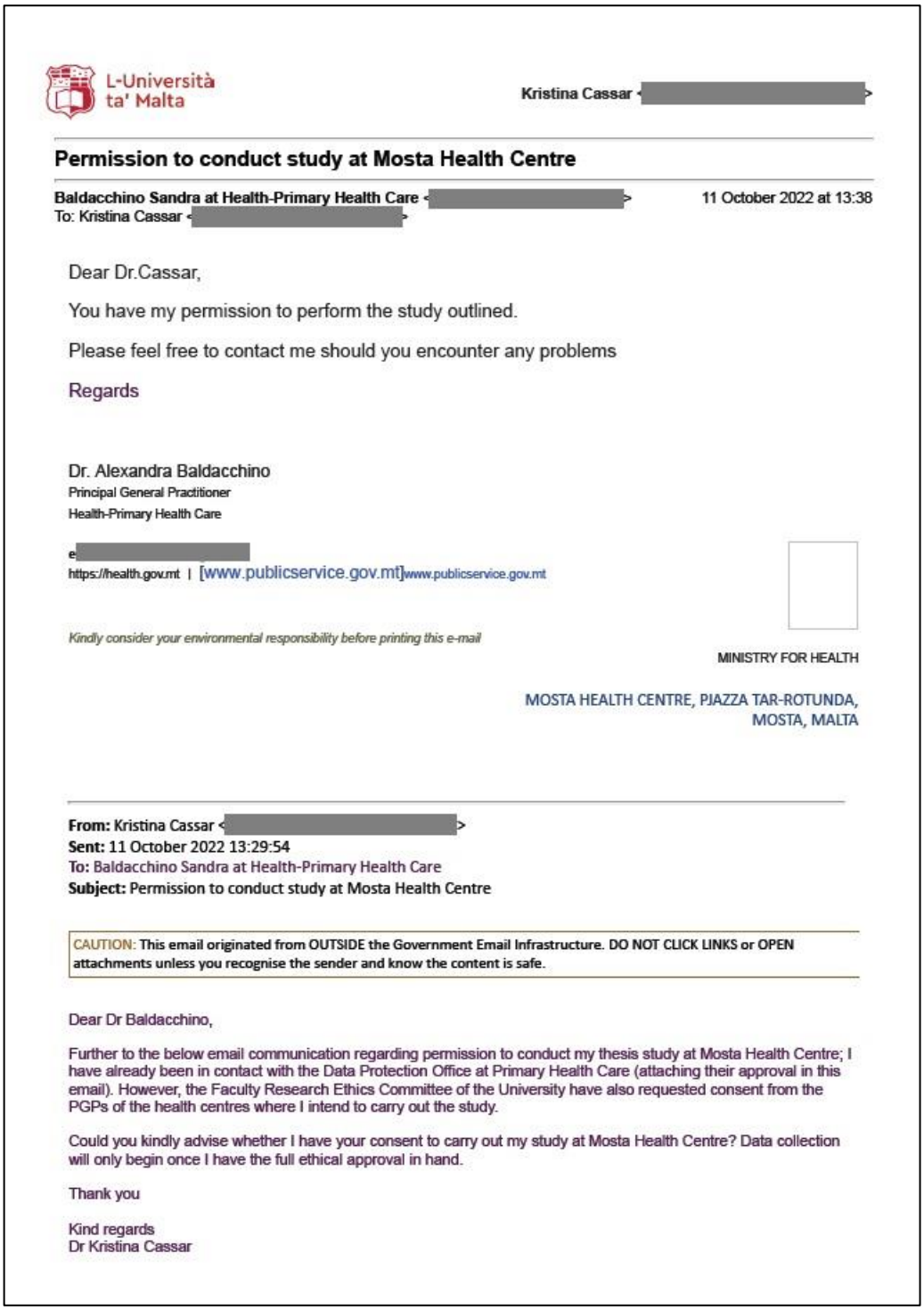
Participants will be recruited from Diabetes outpatients at Mater Dei Hospital, Gozo General Hospital, and Diabetes clinics within Primary Health Care when they visit for their follow-up appointment. Partici pants must be aged 18-69 years and diagnosed with Type 2 Diabetes Mellitus. Individuals would initially be asked to participate in the study by a member of staff (nurse), who would distribute the information letter and consent form. Those who agree to participate will be asked to fill in a paper-based questionnaire provided to them on the day and have their waist circumference measured. The questionnaire will contain instruments which will assess their knowledge on physical activity recommendations, measure levels of physical activity carried out, and identify possible barriers and enablers to physical activity among such patients. Apart from this, patients will be asked to provide information regarding their demographics, type and duration of diabetes, treatment regimen, and presence of any co-morbidities or complications. Glycaemic control will be assessed by the most recent HbA1c from iSOFT Clinical Manager - participants will be asked to provide their name and ID number on the front page of the questionnaire; these details will be discarded once the questionnaire has been linked to their HbA1c blood result and data will be analysed anonymously.

Provisional approval (pending Ethics Committee approval) to conduct the study at GGH from the Data Protection Office of GGH (Ms Georgene Xuereb) and Executive Director has already been obtained, and ethics clearance will be obtained prior to starting data collection.

Kindly let me know should you require any additional information. While thanking you for your time, I look forward to hearing from you at your earliest convenience.

Kind regards,
Dr Kristina Cassar

Approval from the Principal General Practitioner of Mosta Health Centre



L-Università ta' Malta

Kristina Cassar [redacted]

Permission to conduct study at Mosta Health Centre

Baldacchino Sandra at Health-Primary Health Care [redacted] 11 October 2022 at 13:38
To: Kristina Cassar [redacted]

Dear Dr.Cassar,

You have my permission to perform the study outlined.

Please feel free to contact me should you encounter any problems

Regards

Dr. Alexandra Baldacchino
Principal General Practitioner
Health-Primary Health Care

e[redacted]
https://health.gov.mt | [www.publicservice.gov.mt]www.publicservice.gov.mt

Kindly consider your environmental responsibility before printing this e-mail

MINISTRY FOR HEALTH

MOSTA HEALTH CENTRE, PJAZZA TAR-ROTUNDA,
MOSTA, MALTA

From: Kristina Cassar [redacted]
Sent: 11 October 2022 13:29:54
To: Baldacchino Sandra at Health-Primary Health Care
Subject: Permission to conduct study at Mosta Health Centre

CAUTION: **This email originated from OUTSIDE the Government Email Infrastructure. DO NOT CLICK LINKS or OPEN attachments unless you recognise the sender and know the content is safe.**

Dear Dr Baldacchino,

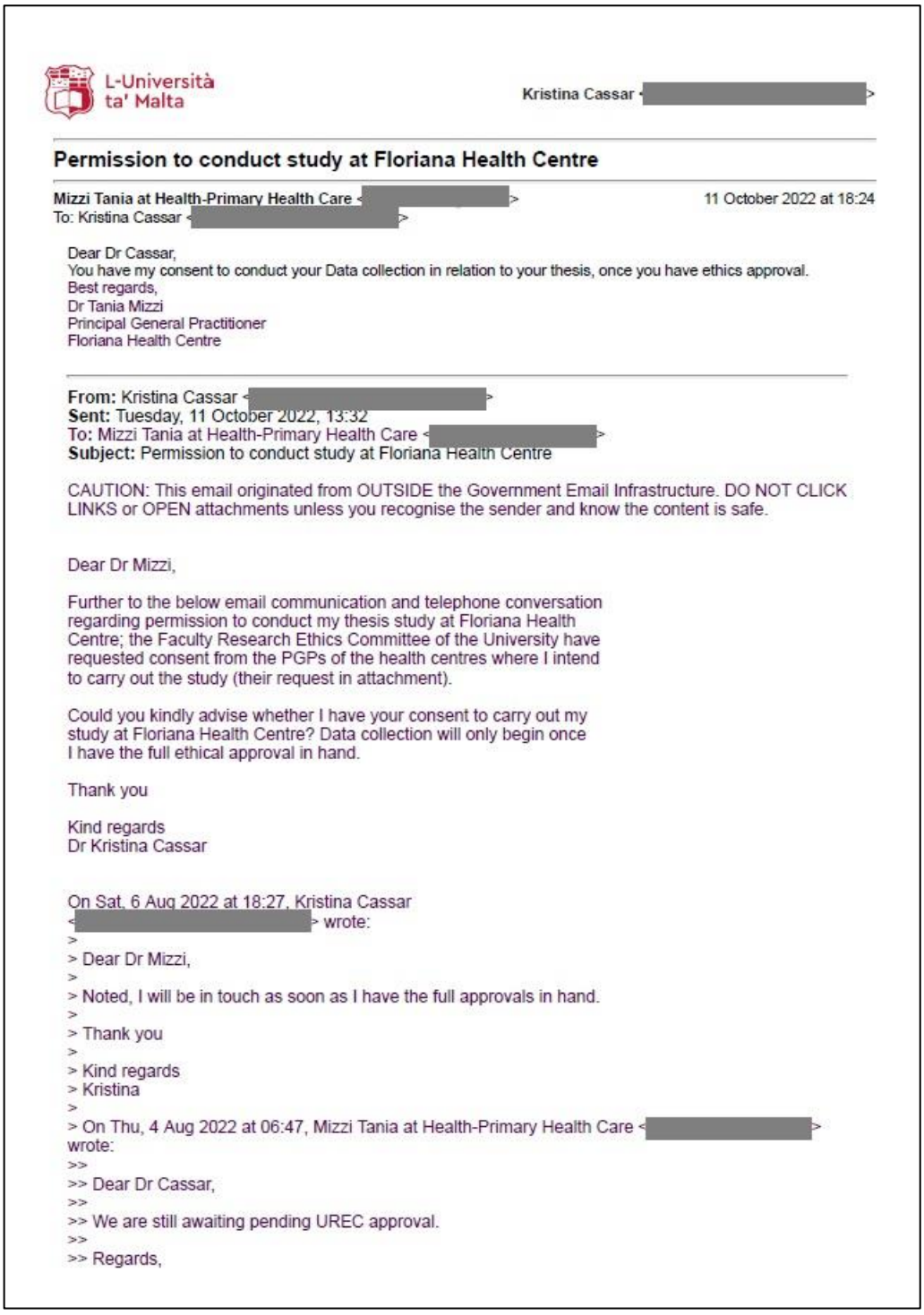
Further to the below email communication regarding permission to conduct my thesis study at Mosta Health Centre; I have already been in contact with the Data Protection Office at Primary Health Care (attaching their approval in this email). However, the Faculty Research Ethics Committee of the University have also requested consent from the PGPs of the health centres where I intend to carry out the study.

Could you kindly advise whether I have your consent to carry out my study at Mosta Health Centre? Data collection will only begin once I have the full ethical approval in hand.

Thank you

Kind regards
Dr Kristina Cassar

Approval from the Principal General Practitioner of Floriana Health Centre



L-Università ta' Malta

Kristina Cassar <[redacted]>

Permission to conduct study at Floriana Health Centre

Mizzi Tania at Health-Primary Health Care <[redacted]> 11 October 2022 at 18:24
To: Kristina Cassar <[redacted]>

Dear Dr Cassar,
You have my consent to conduct your Data collection in relation to your thesis, once you have ethics approval.
Best regards,
Dr Tania Mizzi
Principal General Practitioner
Floriana Health Centre

From: Kristina Cassar <[redacted]>
Sent: Tuesday, 11 October 2022, 13:32
To: Mizzi Tania at Health-Primary Health Care <[redacted]>
Subject: Permission to conduct study at Floriana Health Centre

CAUTION: This email originated from OUTSIDE the Government Email Infrastructure. DO NOT CLICK LINKS or OPEN attachments unless you recognise the sender and know the content is safe.

Dear Dr Mizzi,

Further to the below email communication and telephone conversation regarding permission to conduct my thesis study at Floriana Health Centre; the Faculty Research Ethics Committee of the University have requested consent from the PGPs of the health centres where I intend to carry out the study (their request in attachment).

Could you kindly advise whether I have your consent to carry out my study at Floriana Health Centre? Data collection will only begin once I have the full ethical approval in hand.

Thank you

Kind regards
Dr Kristina Cassar

On Sat, 6 Aug 2022 at 18:27, Kristina Cassar <[redacted]> wrote:
>
> Dear Dr Mizzi,
>
> Noted, I will be in touch as soon as I have the full approvals in hand.
>
> Thank you
>
> Kind regards
> Kristina
>
> On Thu, 4 Aug 2022 at 06:47, Mizzi Tania at Health-Primary Health Care <[redacted]> wrote:
>>
>> Dear Dr Cassar,
>>
>> We are still awaiting pending UREC approval.
>>
>> Regards,

Approval from the Principal General Practitioner of Paola Health Centre

L-Università ta' Malta

Kristina Cassar <[redacted]>

Permission to conduct study at Paola Health Centre

Balzan Michael J at Health-Primary Health Care <[redacted]> 3 August 2022 at 08:53
To: Kristina Cassar <[redacted]>

From my side approved.

Dr.Balzan

From: Kristina Cassar <[redacted]>
Sent: Friday, 29 July 2022 07:51
To: Balzan Michael J at Health-Primary Health Care <[redacted]>
Subject: Permission to conduct study at Paola Health Centre

CAUTION: This email originated from OUTSIDE the Government Email Infrastructure. DO NOT CLICK LINKS or OPEN attachments unless you recognise the sender and know the content is safe.

Dear Dr Balzan,

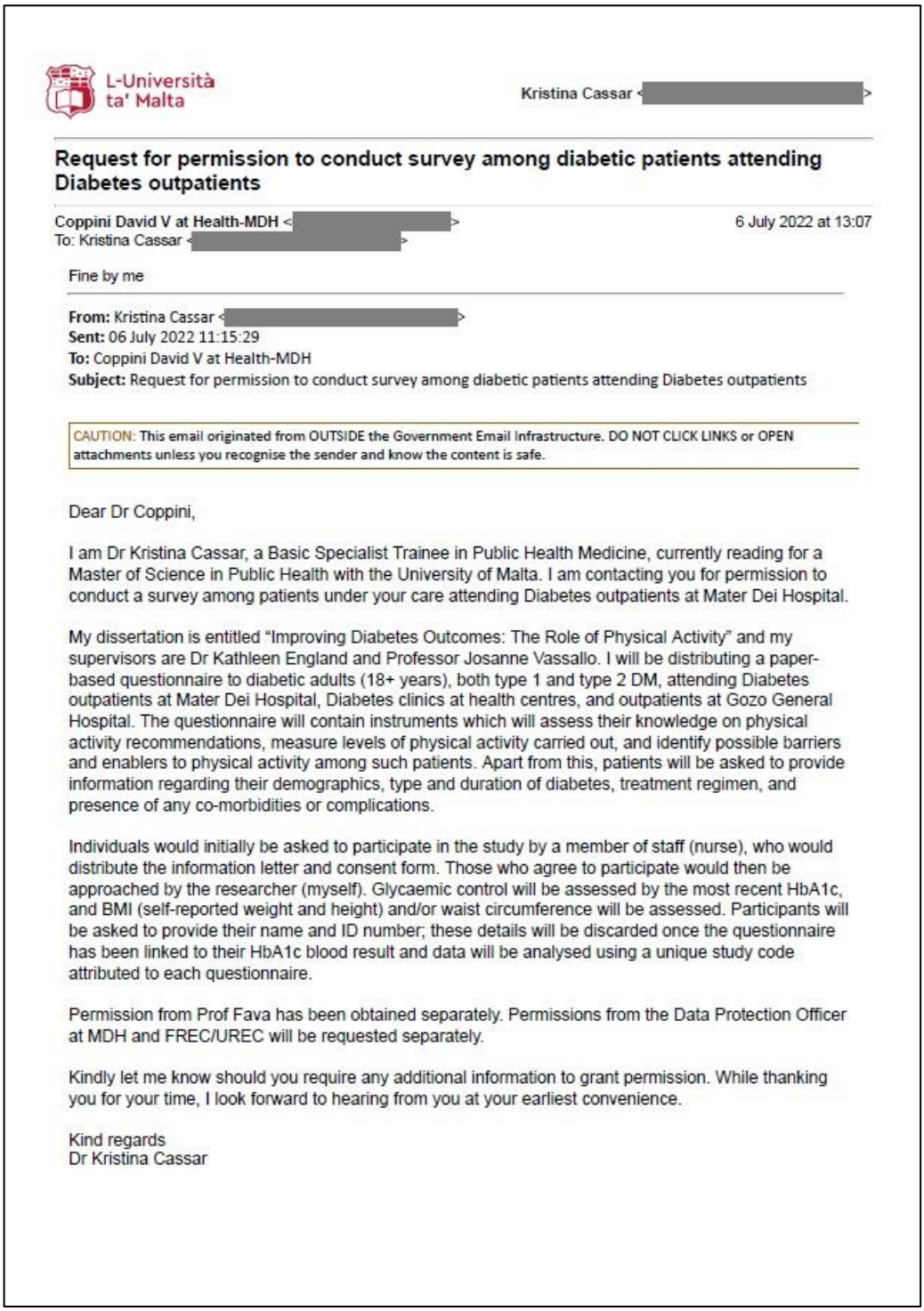
I am Dr Kristina Cassar, a Basic Specialist Trainee in Public Health Medicine, currently reading for a Master of Science in Public Health with the University of Malta. I am contacting you for permission to conduct a survey among patients attending Diabetes clinics at the health centre.

My dissertation is entitled "Improving Diabetes Outcomes: The Role of Physical Activity" and my supervisors are Dr Kathleen England and Professor Josanne Vassallo. Study participants will be recruited from Diabetes outpatients at Mater Dei Hospital and Gozo General Hospital, and from Diabetes clinics at three health centres (Mosta, Floriana, Paola) when they visit for their follow-up appointment. Participants must be aged 18-69 years and diagnosed with type 2 Diabetes Mellitus. Individuals would initially be asked to participate in the study by a member of staff (nurse), who would distribute the information letter and consent form. Those who agree to participate would then be approached by the researcher (myself).

Those who agree to participate will be asked to fill in a paper-based questionnaire provided to them on the day and have their waist circumference measured. The questionnaire will contain instruments which will assess their knowledge on physical activity recommendations, measure levels of physical activity carried out, and identify possible barriers and enablers to physical activity among such patients. Apart from this, patients will be asked to provide information regarding their demographics, type and duration of diabetes, treatment regimen, and presence of any co-morbidities or complications. Glycaemic control will be assessed by the most recent HbA1c from iSOFT Clinical Manager (provided by an intermediary). Participants will be asked to provide their name and ID number; these details will be discarded once the questionnaire has been linked to their HbA1c blood result and data will be analysed anonymously.

Temporary approval (pending Ethics Committee approval) to conduct the study has been obtained from the Data Protection Office of Primary Health Care. Permission from FREC/UREC will be requested separately.

Approvals from the individual consultants at Mater Dei Hospital



L-Università ta' Malta

Kristina Cassar <[redacted]>

Request for permission to conduct survey among diabetic patients attending Diabetes outpatients

Coppini David V at Health-MDH <[redacted]> 6 July 2022 at 13:07
To: Kristina Cassar <[redacted]>

Fine by me

From: Kristina Cassar <[redacted]>
Sent: 06 July 2022 11:15:29
To: Coppini David V at Health-MDH
Subject: Request for permission to conduct survey among diabetic patients attending Diabetes outpatients

CAUTION: This email originated from OUTSIDE the Government Email Infrastructure. DO NOT CLICK LINKS or OPEN attachments unless you recognise the sender and know the content is safe.

Dear Dr Coppini,

I am Dr Kristina Cassar, a Basic Specialist Trainee in Public Health Medicine, currently reading for a Master of Science in Public Health with the University of Malta. I am contacting you for permission to conduct a survey among patients under your care attending Diabetes outpatients at Mater Dei Hospital.

My dissertation is entitled "Improving Diabetes Outcomes: The Role of Physical Activity" and my supervisors are Dr Kathleen England and Professor Josanne Vassallo. I will be distributing a paper-based questionnaire to diabetic adults (18+ years), both type 1 and type 2 DM, attending Diabetes outpatients at Mater Dei Hospital, Diabetes clinics at health centres, and outpatients at Gozo General Hospital. The questionnaire will contain instruments which will assess their knowledge on physical activity recommendations, measure levels of physical activity carried out, and identify possible barriers and enablers to physical activity among such patients. Apart from this, patients will be asked to provide information regarding their demographics, type and duration of diabetes, treatment regimen, and presence of any co-morbidities or complications.

Individuals would initially be asked to participate in the study by a member of staff (nurse), who would distribute the information letter and consent form. Those who agree to participate would then be approached by the researcher (myself). Glycaemic control will be assessed by the most recent HbA1c, and BMI (self-reported weight and height) and/or waist circumference will be assessed. Participants will be asked to provide their name and ID number; these details will be discarded once the questionnaire has been linked to their HbA1c blood result and data will be analysed using a unique study code attributed to each questionnaire.

Permission from Prof Fava has been obtained separately. Permissions from the Data Protection Officer at MDH and FREC/UREC will be requested separately.

Kindly let me know should you require any additional information to grant permission. While thanking you for your time, I look forward to hearing from you at your earliest convenience.

Kind regards
Dr Kristina Cassar

L-Università ta' Malta

Kristina Cassar <[redacted]>

Request for permission to conduct survey among diabetic patients attending Diabetes outpatients

Gruppetta Mark at Health-MDH <[redacted]> 6 July 2022 at 14:38
To: Kristina Cassar <[redacted]>

Permission granted from my end

Mark Gruppetta

From: Kristina Cassar <[redacted]>
Sent: 06 July 2022 11:30:24
To: Gruppetta Mark at Health-MDH
Subject: Request for permission to conduct survey among diabetic patients attending Diabetes outpatients

Dear Dr Gruppetta,

I am Dr Kristina Cassar, a Basic Specialist Trainee in Public Health Medicine, currently reading for a Master of Science in Public Health with the University of Malta. I am contacting you for permission to conduct a survey among patients under your care attending Diabetes outpatients at Mater Dei Hospital.

My dissertation is entitled "Improving Diabetes Outcomes: The Role of Physical Activity" and my supervisors are Dr Kathleen England and Professor Josanne Vassallo. I will be distributing a paper-based questionnaire to diabetic adults (18+ years), both type 1 and type 2 DM, attending Diabetes outpatients at Mater Dei Hospital, Diabetes clinics at health centres, and outpatients at Gozo General Hospital. The questionnaire will contain instruments which will assess their knowledge on physical activity recommendations, measure levels of physical activity carried out, and identify possible barriers and enablers to physical activity among such patients. Apart from this, patients will be asked to provide information regarding their demographics, type and duration of diabetes, treatment regimen, and presence of any co-morbidities or complications.

Individuals would initially be asked to participate in the study by a member of staff (nurse), who would distribute the information letter and consent form. Those who agree to participate would then be approached by the researcher (myself). Glycaemic control will be assessed by the most recent HbA1c, and BMI (self-reported weight and height) and/or waist circumference will be assessed. Participants will be asked to provide their name and ID number; these details will be discarded once the questionnaire has been linked to their HbA1c blood result and data will be analysed using a unique study code attributed to each questionnaire.

Permission from Prof Fava has been obtained separately. Permissions from the Data Protection Officer at MDH and FREC/UREC will be requested separately.

Kindly let me know should you require any additional information to grant permission. While thanking you for your time, I look forward to hearing from you at your earliest convenience.

L-Università ta' Malta

Kristina Cassar <[redacted]>

Request for permission to conduct survey among diabetic patients attending Diabetes outpatients

Cachia Mario J at Health-MDH <[redacted]> 8 July 2022 at 12:01
To: Kristina Cassar <[redacted]>

Good afternoon,

I have no issues, please go ahead, so long as you have all permissions in place.

Regards

Mario J Cachia
Consultant
Diabetes & Endocrine Centre
Mater Dei Hospital.

Clinical Lead

Gender Wellbeing Clinic

T [redacted]

E [redacted]

Mater Dei Hospital, Triq id-Donaturi tad-Demm, l-Imsida, Malta MSD 2090 | Tel +356 2545 0000 | https://deputyprimeminister.gov.mt/en/MDH/Pages/Home.aspx | https://www.facebook.com/materdeihospital/

Gender Wellbeing Clinic: t [redacted] e: [redacted]

From: Kristina Cassar <[redacted]>
Sent: Wednesday, 06 July 2022 11:21
To: Cachia Mario J at Health-MDH <[redacted]>
Subject: Request for permission to conduct survey among diabetic patients attending Diabetes outpatients

Dear Dr Cachia,

I am Dr Kristina Cassar, a Basic Specialist Trainee in Public Health Medicine, currently reading for a Master of Science in Public Health with the University of Malta. I am contacting you for permission to conduct a survey among patients under your care attending Diabetes outpatients at Mater Dei Hospital.

My dissertation is entitled "Improving Diabetes Outcomes: The Role of Physical Activity" and my supervisors are Dr Kathleen England and Professor Josanne Vassallo. I will be distributing a paper-based questionnaire to diabetic adults (18+ years), both type 1 and type 2 DM, attending Diabetes outpatients at Mater Dei Hospital, Diabetes clinics at health centres, and outpatients at Gozo General Hospital. The questionnaire will contain instruments which will assess their knowledge on physical activity recommendations, measure levels of physical activity carried out, and identify possible barriers and enablers to physical activity among such patients. Apart from this, patients will be asked to provide information regarding their demographics, type and duration of diabetes, treatment regimen, and presence of any co-morbidities or complications.

Individuals would initially be asked to participate in the study by a member of staff (nurse), who would distribute the information letter and consent form. Those who agree to participate would then be approached by the researcher (myself). Glycaemic control will be assessed by the most recent HbA1c, and BMI (self-reported weight and height) and/or waist circumference will be assessed. Participants will be asked to provide their name and ID number; these details will be discarded once the questionnaire has been linked to their HbA1c blood result and data will be analysed using a unique study code attributed to each questionnaire.

Permission from Prof Fava has been obtained separately. Permissions from the Data Protection Officer at MDH and FREC/UREC will be requested separately.

Kindly let me know should you require any additional information to grant permission. While thanking you for your time, I look forward to hearing from you at your earliest convenience.

Kind regards

Dr Kristina Cassar

L-Università ta' Malta

Kristina Cassar <[redacted]>

Request for permission to conduct survey among diabetic patients attending Diabetes outpatients

Agius Rachel at Health-MDH <[redacted]> 11 July 2022 at 14:10
To: Kristina Cassar <[redacted]>

Good afternoon

no objection from my end

KR

Dr Agius

From: Kristina Cassar <[redacted]>
Sent: 06 July 2022 11:29:28
To: Agius Rachel at Health-MDH
Subject: Request for permission to conduct survey among diabetic patients attending Diabetes outpatients

Dear Dr Agius,

I am Dr Kristina Cassar, a Basic Specialist Trainee in Public Health Medicine, currently reading for a Master of Science in Public Health with the University of Malta. I am contacting you for permission to conduct a survey among patients under your care attending Diabetes outpatients at Mater Dei Hospital.

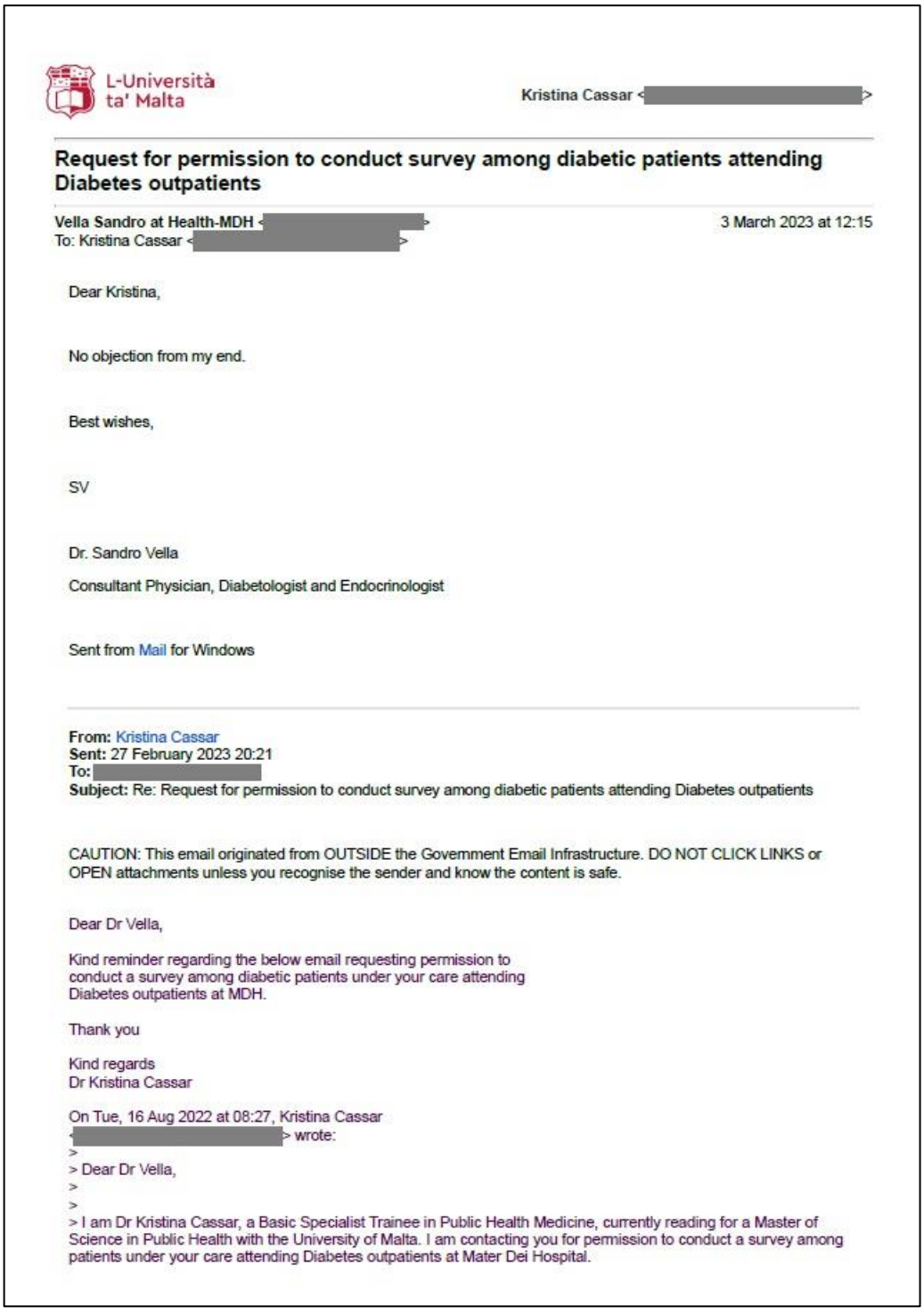
My dissertation is entitled "Improving Diabetes Outcomes: The Role of Physical Activity" and my supervisors are Dr Kathleen England and Professor Josanne Vassallo. I will be distributing a paper-based questionnaire to diabetic adults (18+ years), both type 1 and type 2 DM, attending Diabetes outpatients at Mater Dei Hospital, Diabetes clinics at health centres, and outpatients at Gozo General Hospital. The questionnaire will contain instruments which will assess their knowledge on physical activity recommendations, measure levels of physical activity carried out, and identify possible barriers and enablers to physical activity among such patients. Apart from this, patients will be asked to provide information regarding their demographics, type and duration of diabetes, treatment regimen, and presence of any co-morbidities or complications.

Individuals would initially be asked to participate in the study by a member of staff (nurse), who would distribute the information letter and consent form. Those who agree to participate would then be approached by the researcher (myself). Glycaemic control will be assessed by the most recent HbA1c, and BMI (self-reported weight and height) and/or waist circumference will be assessed. Participants will be asked to provide their name and ID number; these details will be discarded once the questionnaire has been linked to their HbA1c blood result and data will be analysed using a unique study code attributed to each questionnaire.

Permission from Prof Fava has been obtained separately. Permissions from the Data Protection Officer at MDH and FREC/UREC will be requested separately.

Kindly let me know should you require any additional information to grant permission. While thanking you for your time, I look forward to hearing from you at your earliest convenience.

Kind regards
Dr Kristina Cassar



L-Università ta' Malta

Kristina Cassar <[redacted]>

Request for permission to conduct survey among diabetic patients attending Diabetes outpatients

Vella Sandro at Health-MDH <[redacted]> 3 March 2023 at 12:15
To: Kristina Cassar <[redacted]>

Dear Kristina,

No objection from my end.

Best wishes,

SV

Dr. Sandro Vella

Consultant Physician, Diabetologist and Endocrinologist

Sent from Mail for Windows

From: Kristina Cassar
Sent: 27 February 2023 20:21
To: [redacted]
Subject: Re: Request for permission to conduct survey among diabetic patients attending Diabetes outpatients

CAUTION: This email originated from OUTSIDE the Government Email Infrastructure. DO NOT CLICK LINKS or OPEN attachments unless you recognise the sender and know the content is safe.

Dear Dr Vella,

Kind reminder regarding the below email requesting permission to conduct a survey among diabetic patients under your care attending Diabetes outpatients at MDH.

Thank you

Kind regards
Dr Kristina Cassar

On Tue, 16 Aug 2022 at 08:27, Kristina Cassar <[redacted]> wrote:
>
> Dear Dr Vella,
>
>
> I am Dr Kristina Cassar, a Basic Specialist Trainee in Public Health Medicine, currently reading for a Master of Science in Public Health with the University of Malta. I am contacting you for permission to conduct a survey among patients under your care attending Diabetes outpatients at Mater Dei Hospital.

>
>
> My dissertation is entitled "Improving Diabetes Outcomes: The Role of Physical Activity" and my supervisors are Dr Kathleen England and Professor Josanne Vassallo. I will be distributing a paper-based questionnaire to type 2 diabetic adults (18-69 years) attending Diabetes outpatients at Mater Dei Hospital, Diabetes clinics at health centres, and outpatients at Gozo General Hospital. The questionnaire will contain instruments which will assess their knowledge on physical activity recommendations, measure levels of physical activity carried out, and identify possible barriers and enablers to physical activity among such patients. Apart from this, patients will be asked to provide information regarding their demographics, type and duration of diabetes, treatment regimen, and presence of any co-morbidities or complications.
>
>
> Individuals would initially be asked to participate in the study by a member of staff (nurse), who would distribute the information letter and consent form. Those who agree to participate would then be approached by the researcher (myself). Glycaemic control will be assessed by the most recent HbA1c, and BMI (self-reported weight and height) and/or waist circumference will be assessed. Participants will be asked to provide their name and ID number; these details will be discarded once the questionnaire has been linked to their HbA1c blood result and data will be analysed using a unique study code attributed to each questionnaire.
>
>
>
> Permissions from Prof Fava and Data Protection Officer at MDH have been obtained. Permission from FREC/UREC will be requested separately.
>
>
> Kindly let me know should you require any additional information to grant permission. While thanking you for your time, I look forward to hearing from you at your earliest convenience.
>
>
>
> Kind regards
>
> Dr Kristina Cassar

L-Università ta' Malta

Kristina Cassar <[redacted]>

Request for permission to conduct survey among diabetic patients attending Diabetes outpatients

Josanne Vassallo <[redacted]> 14 March 2023 at 23:02
To: Kristina Cassar <[redacted]>

Dear Kristina

Since I am supervising it stands to reason and I formally confirm that I have no objection to your recruiting my patients. Feel free to drop by at room 16 with any queries or issues you may have.

Kind regards

Prof
Josanne Vassallo MD PhD FRCP FACP FACE
Professor of Medicine & Consultant Endocrinologist
Principal Investigator, Molecular & Cellular Endocrinology Research Lab
Centre for Molecular Medicine and Biobanking
Chairperson, Medical Education Unit

Department of Medicine
Faculty of Medicine and Surgery
University of Malta Medical School
Block A Level 0
Mater Dei Hospital
Msida MSD 2090
Malta

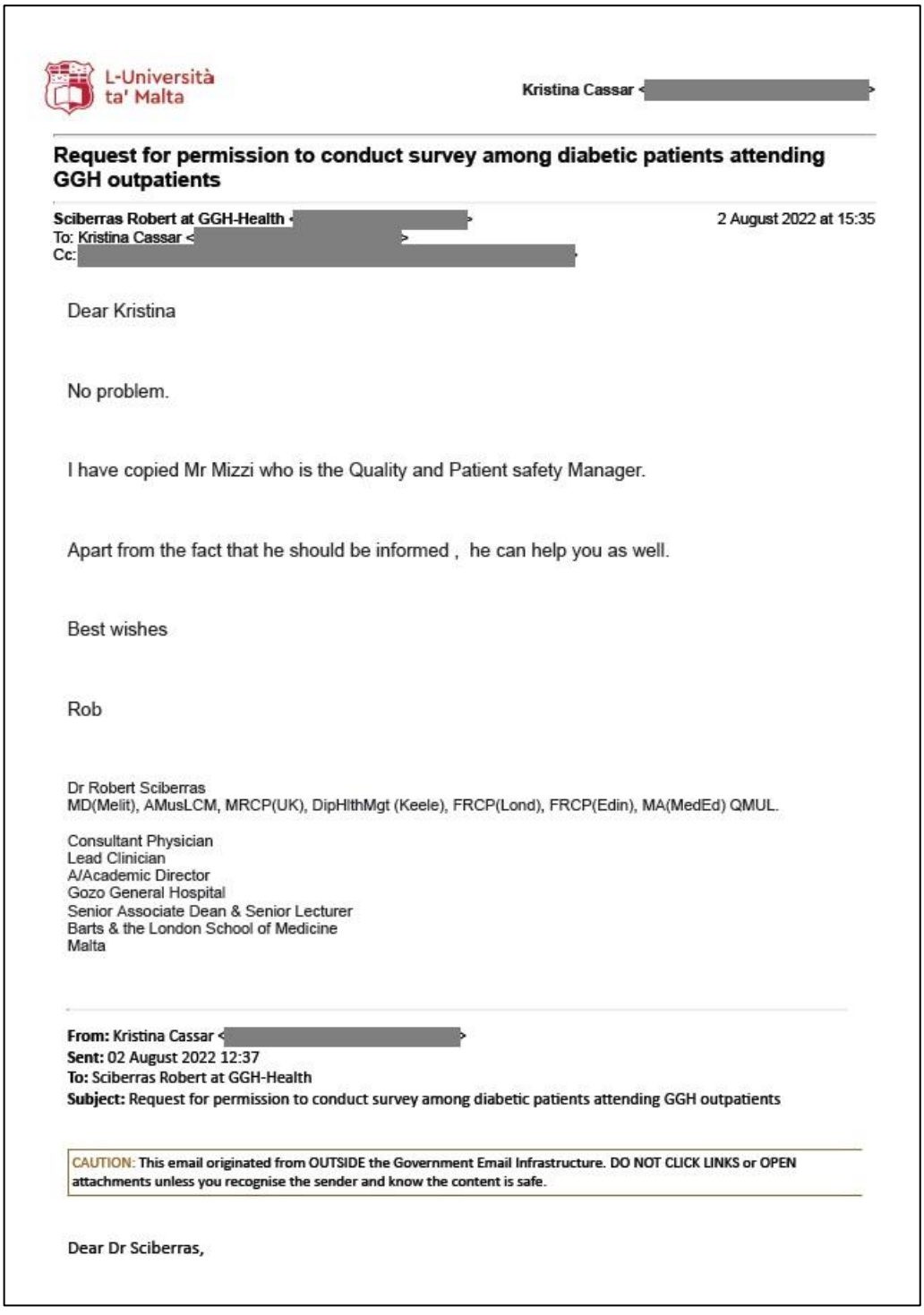
Tel: [redacted]

email: [redacted]

On Tue, 14 Mar 2023 at 22:06, Kristina Cassar <[redacted]> wrote:

> Dear Prof Vassallo,
>
> With reference to my dissertation entitled "Improving Diabetes Outcomes: The Role of Physical Activity" supervised by Dr Kathleen England and yourself, whereby I will be recruiting type 2 diabetic adults (18-69 years) attending Diabetes outpatients at Mater Dei Hospital, Diabetes clinics at health centres, and outpatients at Gozo General Hospital.
>
> May I kindly request permission to conduct the survey among patients under your care attending Diabetes outpatients at Mater Dei Hospital.
>
> Permissions from Prof Fava, Data Protection Officer at MDH, and the Research Ethics Committee of the University of Malta have already been obtained.
>
> Thank you & kind regards
> Dr Kristina Cassar

Approvals from the individual consultants at Gozo General Hospital



L-Università ta' Malta

Kristina Cassar <[redacted]>

Request for permission to conduct survey among diabetic patients attending GGH outpatients

Sciberras Robert at GGH-Health <[redacted]> 2 August 2022 at 15:35
To: Kristina Cassar <[redacted]>
Cc: [redacted]

Dear Kristina

No problem.

I have copied Mr Mizzi who is the Quality and Patient safety Manager.

Apart from the fact that he should be informed , he can help you as well.

Best wishes

Rob

Dr Robert Sciberras
MD(Melit), AMusLCM, MRCP(UK), DipHlthMgt (Keele), FRCP(Lond), FRCP(Edin), MA(MedEd) QMUL.

Consultant Physician
Lead Clinician
A/Academic Director
Gozo General Hospital
Senior Associate Dean & Senior Lecturer
Barts & the London School of Medicine
Malta

From: Kristina Cassar <[redacted]>
Sent: 02 August 2022 12:37
To: Sciberras Robert at GGH-Health
Subject: Request for permission to conduct survey among diabetic patients attending GGH outpatients

CAUTION: **This email originated from OUTSIDE the Government Email Infrastructure. DO NOT CLICK LINKS or OPEN attachments unless you recognise the sender and know the content is safe.**

Dear Dr Sciberras,

I am Dr Kristina Cassar, a Basic Specialist Trainee in Public Health Medicine currently reading for a Master of Science in Public Health with the University of Malta. I am contacting you for permission to conduct a survey among diabetic patients under your care attending outpatients at Gozo General Hospital.

My dissertation is entitled "Improving Diabetes Outcomes: The Role of Physical Activity" and my supervisors are Dr Kathleen England and Professor Josanne Vassallo. The aim of my research project is to examine the knowledge and adherence to physical activity recommendations and explore perceived benefits and barriers to physical activity among Diabetic adults in Malta and Gozo.

Participants will be recruited from Diabetes outpatients at Mater Dei Hospital, Gozo General Hospital, and Diabetes clinics within Primary Health Care when they visit for their follow-up appointment. Partici pants must be aged 18-69 years and diagnosed with Type 2 Diabetes Mellitus. Individuals would initially be asked to participate in the study by a member of staff (nurse), who would distribute the information letter and consent form. Those who agree to participate will be asked to fill in a paper-based questionnaire provided to them on the day and have their waist circumference measured. The questionnaire will contain instruments which will assess their knowledge on physical activity recommendations, measure levels of physical activity carried out, and identify possible barriers and enablers to physical activity among such patients. Apart from this, patients will be asked to provide information regarding their demographics, type and duration of diabetes, treatment regimen, and presence of any co-morbidities or complications. Glycaemic control will be assessed by the most recent HbA1c from iSOFT Clinical Manager - participants will be asked to provide their name and ID number on the front page of the questionnaire; these details will be discarded once the questionnaire has been linked to their HbA1c blood result and data will be analysed anonymously.

Provisional approval (pending Ethics Committee approval) to conduct the study at GGH from the Data Protection Office of GGH (Ms Georgene Xuereb) and Executive Director has already been obtained, and ethics clearance will be obtained prior to starting data collection.

Kindly let me know should you require any additional information. While thanking you for your time, I look forward to hearing from you at your earliest convenience.

Kind regards,
Dr Kristina Cassar

L-Università ta' Malta

Kristina Cassar <[redacted]>

Request for permission to conduct survey among diabetic patients under your care attending GGH outpatients

Curmi Victor at GGH-Health <[redacted]> 3 August 2022 at 10:32
To: Kristina Cassar <[redacted]>

Dear Dr Cassar

I find no objection for you carrying out a survey among diabetic patients under my care.

Kind regards

Dr. V. Curmi

From: Kristina Cassar <[redacted]>
Sent: 02 August 2022 12:39:23
To: Curmi Victor at GGH-Health
Subject: Request for permission to conduct survey among diabetic patients under your care attending GGH outpatients

Dear Dr Curmi,

I am Dr Kristina Cassar, a Basic Specialist Trainee in Public Health Medicine currently reading for a Master of Science in Public Health with the University of Malta. I am contacting you for permission to conduct a survey among diabetic patients under your care attending outpatients at Gozo General Hospital.

My dissertation is entitled "Improving Diabetes Outcomes: The Role of Physical Activity" and my supervisors are Dr Kathleen England and Professor Josanne Vassallo. The aim of my research project is to examine the knowledge and adherence to physical activity recommendations and explore perceived benefits and barriers to physical activity among Diabetic adults in Malta and Gozo.

Participants will be recruited from Diabetes outpatients at Mater Dei Hospital, Gozo General Hospital, and Diabetes clinics within Primary Health Care when they visit for their follow-up appointment. Partici pants must be aged 18-69 years and diagnosed with Type 2 Diabetes Mellitus. Individuals would initially be asked to participate in the study by a member of staff (nurse), who would distribute the information letter and consent form. Those who agree to participate will be asked to fill in a paper-based questionnaire provided to them on the day and have their waist circumference measured. The questionnaire will contain instruments which will assess their knowledge on physical activity recommendations, measure levels of physical activity carried out, and identify possible barriers and enablers to physical activity among such patients. Apart from this, patients will be asked to provide information regarding their demographics, type and duration of diabetes, treatment regimen, and

presence of any co-morbidities or complications. Glycaemic control will be assessed by the most recent HbA1c from iSOFT Clinical Manager - participants will be asked to provide their name and ID number on the front page of the questionnaire; these details will be discarded once the questionnaire has been linked to their HbA1c blood result and data will be analysed anonymously.

Provisional approval (pending Ethics Committee approval) to conduct the study at GGH from the Data Protection Office of GGH (Ms Georgene Xuereb) and Executive Director has already been obtained, and ethics clearance will be obtained prior to starting data collection.

Kindly let me know should you require any additional information. While thanking you for your time, I look forward to hearing from you at your earliest convenience.

Kind regards,
Dr Kristina Cassar

L-Università ta' Malta

Kristina Cassar <[redacted]>

Request for permission to conduct survey among diabetic patients under your care attending GGH outpatients

Bigeni Sarah at GGH-Health <[redacted]> 10 August 2022 at 20:24
To: Kristina Cassar <[redacted]>

Dear Kristina,

I give you permission to conduct the survey on my diabetic patients. My DOP clinic is on Mondays.

Kind regards,

SB
[redacted]

From: Kristina Cassar <[redacted]>
Sent: 02 August 2022 12:36:50
To: Bigeni Sarah at GGH-Health
Subject: Request for permission to conduct survey among diabetic patients under your care attending GGH outpatients

CAUTION: This email originated from OUTSIDE the Government Email Infrastructure. DO NOT CLICK LINKS or OPEN attachments unless you recognise the sender and know the content is safe.

Dear Dr Bigeni,

I am Dr Kristina Cassar, a Basic Specialist Trainee in Public Health Medicine currently reading for a Master of Science in Public Health with the University of Malta. I am contacting you for permission to conduct a survey among diabetic patients under your care attending outpatients at Gozo General Hospital.

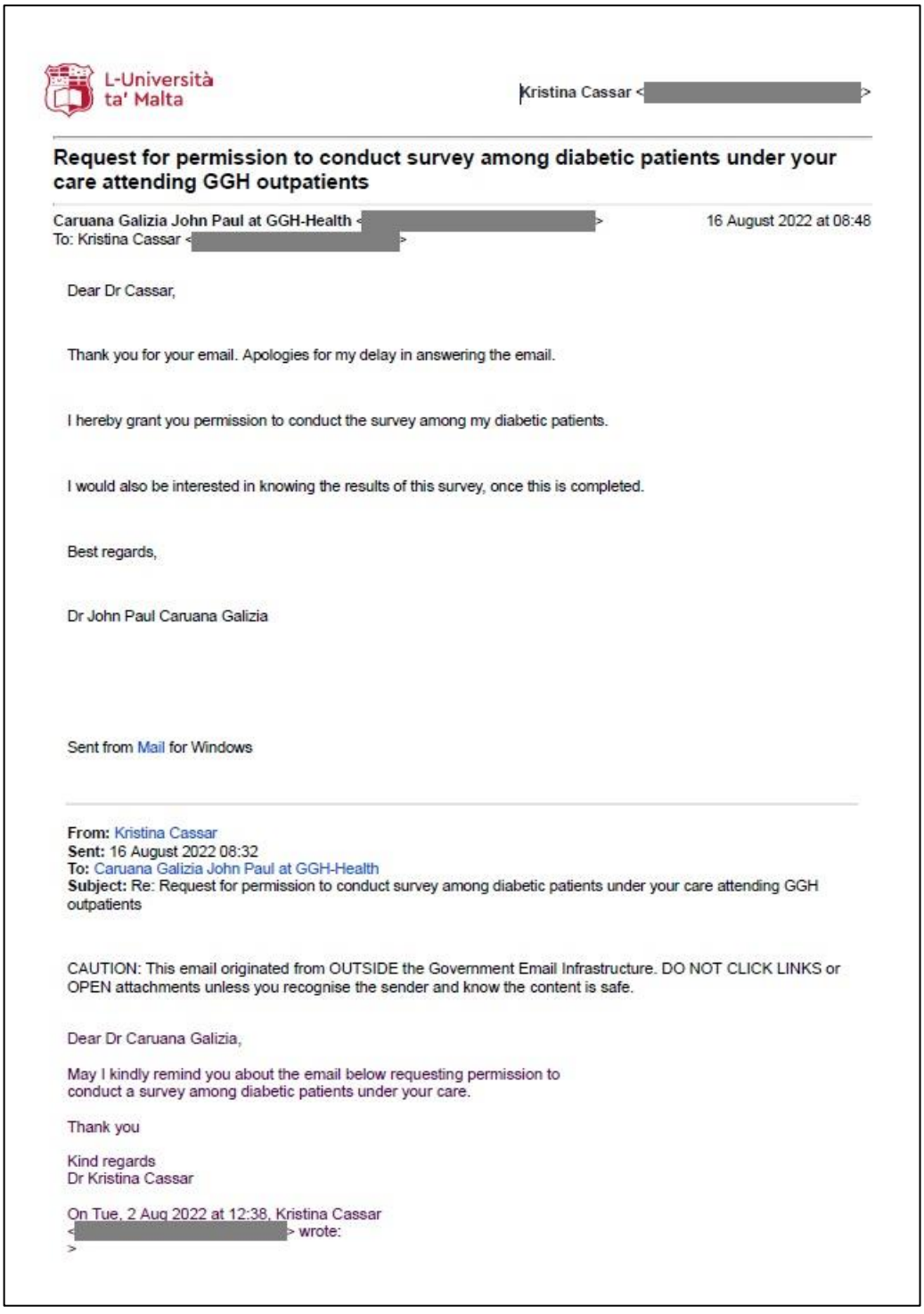
My dissertation is entitled "Improving Diabetes Outcomes: The Role of Physical Activity" and my supervisors are Dr Kathleen England and Professor Josanne Vassallo. The aim of my research project is to examine the knowledge and adherence to physical activity recommendations and explore perceived benefits and barriers to physical activity among Diabetic adults in Malta and Gozo.

Participants will be recruited from Diabetes outpatients at Mater Dei Hospital, Gozo General Hospital, and Diabetes clinics within Primary Health Care when they visit for their follow-up appointment. Partici pants must be aged 18-69 years and diagnosed with Type 2 Diabetes Mellitus. Individuals would initially be asked to participate in the study by a member of staff (nurse), who would distribute the information letter and consent form. Those who agree to participate will be asked to fill in a paper-based questionnaire provided to them on the day and have their waist circumference measured. The questionnaire will contain instruments which will assess their knowledge on physical activity recommendations, measure levels of physical activity carried out, and identify possible barriers and enablers to physical activity among such patients. Apart from this, patients will be asked to provide information regarding their demographics, type and duration of diabetes, treatment regimen, and presence of any co-morbidities or complications. Glycaemic control will be assessed by the most recent HbA1c from iSOFT Clinical Manager - participants will be asked to provide their name and ID number on the front page of the questionnaire; these details will be discarded once the questionnaire has been linked to their HbA1c blood result and data will be analysed anonymously.

Provisional approval (pending Ethics Committee approval) to conduct the study at GGH from the Data Protection Office of GGH (Ms Georgene Xuereb) and Executive Director has already been obtained, and ethics clearance will be obtained prior to starting data collection.

Kindly let me know should you require any additional information. While thanking you for your time, I look forward to hearing from you at your earliest convenience.

Kind regards,
Dr Kristina Cassar



L-Università ta' Malta

Kristina Cassar <[redacted]>

Request for permission to conduct survey among diabetic patients under your care attending GGH outpatients

Caruana Galizia John Paul at GGH-Health <[redacted]> 16 August 2022 at 08:48
To: Kristina Cassar <[redacted]>

Dear Dr Cassar,

Thank you for your email. Apologies for my delay in answering the email.

I hereby grant you permission to conduct the survey among my diabetic patients.

I would also be interested in knowing the results of this survey, once this is completed.

Best regards,

Dr John Paul Caruana Galizia

Sent from Mail for Windows

From: Kristina Cassar
Sent: 16 August 2022 08:32
To: Caruana Galizia John Paul at GGH-Health
Subject: Re: Request for permission to conduct survey among diabetic patients under your care attending GGH outpatients

CAUTION: This email originated from OUTSIDE the Government Email Infrastructure. DO NOT CLICK LINKS or OPEN attachments unless you recognise the sender and know the content is safe.

Dear Dr Caruana Galizia,

May I kindly remind you about the email below requesting permission to conduct a survey among diabetic patients under your care.

Thank you

Kind regards
Dr Kristina Cassar

On Tue, 2 Aug 2022 at 12:38, Kristina Cassar <[redacted]> wrote:
>

Appendix F: Information letter & Consent form (English and Maltese versions)

Information letter – English version

L-Università ta' Malta
Faculty of Medicine & Surgery

Information Letter

Dear Participant,

My name is Kristina Cassar and I am currently reading for a Master of Science in Public Health at the University of Malta. As part of my course requirements, I am conducting a research study entitled "Improving Diabetes Outcomes: The Role of Physical Activity". The aim of this study is to assess physical activity participation among diabetics, as well as barriers and enablers. Your participation in this study would help us gain a better understanding of perceived barriers towards carrying out physical activity and identify motivating factors to increase physical activity levels. Results from this study will be used to help us find ways to help diabetic individuals improve the management of their condition. All data collected from this research shall be used solely for the purposes of this study.

Participation in this study involves completing the questionnaire which will be provided to you today and allowing me to measure your waist/abdominal circumference. This should take around twenty (20) minutes. Additionally, I ask you to provide your name and ID number to obtain your most recent HbA1c blood result which will give an indication of how well-controlled your condition is. [redacted] will act as the intermediary to provide me with your HbA1c result from your medical records. The blood result will be linked to your questionnaire answers and your personal information will be deleted within one month from data collection, so that it will be difficult to trace back your answers to you or to anyone else. Your information will be held securely, and all data will be processed according to the General Data Protection Regulation (GDPR).

Data collected will be pseudonymised, that is, your identity will not be noted on the questionnaire replies, but instead, a code will be assigned. The codes that link your questionnaire replies to your identity will be stored securely and separately from the completed questionnaire replies. Data will be stored safely in an encrypted file on the researcher's password-protected computer and hard-copy materials will be placed in a locked cabinet/drawer. Only the researcher, and in exceptional circumstances the supervisor and examiners, will have access to the personal information. The personal information which will be used for linkage between the HbA1c and individual questionnaire replies will be deleted within one month from data collection. Consent forms will be destroyed on completion of the Masters course in March 2024.

Participation in this study does not entail any known or anticipated risks. Participation is completely voluntary and you are free to accept or refuse to take part without giving a reason. You are not obliged to answer all the questions and may withdraw from the study at any time without giving a reason. In the event that you choose to withdraw from the study, any data collected from you will be erased as long as this is technically possible, that is, before your personal information has been erased, which will happen within one month from data collection. Following this, it will not be possible to trace back your individual replies. Furthermore, withdrawal from the study will not have any negative repercussions on you.

I can assure you that confidentiality will be maintained throughout the study and that your identity and personal information will not be revealed in any publications, reports or presentations arising from this research.

Under the General Data Protection Regulation (GDPR) and national legislation that implements and further specifies the relevant provisions of said Regulation, you have the right to obtain access to, rectify, and where applicable ask for the data concerning you to be erased.

A copy of the information letter and consent form will be provided for future reference.

Thank you for your time and consideration. Should you have any questions or concerns, please do not hesitate to contact me on [redacted] or by e-mail on [redacted]. You may also contact my supervisor Dr Kathleen England on [redacted] or by sending an email on [redacted].

Yours Sincerely,

[redacted]

Dr Kristina Cassar
Researcher

[redacted]

Dr Kathleen England
Research Supervisor

Information letter – Maltese version

L-Università ta' Malta
Faculty of Medicine & Surgery

Ittra ta' Informazzjoni

Għażiż/a Parteċipant/a,

Jiena Kristina Cassar, fil-preżent qed insegwi Master of Science in Public Health mal-Università ta' Malta. Bħala parti mir-rekwiżiti tal-kors, qiegħda nagħmel riċerka bit-titlu "Improving Diabetes Outcomes: The Role of Physical Activity". L-għan ta' dan l-istudju huwa li nevalwa l-parteċipazzjoni fl-attività fiżika fost id-dijabetiċi, kif ukoll ostakli u faċilitaturi. Is-sehem tiegħek f'dan l-istudju jista' jgħin biex ikollna aktar għarfien dwar ostakli lejn it-twettieq ta' attività fiżika kif ukoll biex nidentifikaw fatturi motivanti biex jiżdied il-livell ta' attività fiżika. Ir-riżultati ta' dan l-istudju ser jintużaw biex jgħinuna nsibu modi kif ngħinu lill-individwi dijabetiċi jtejjbu l-kura tal-kundizzjoni tagħhom. L-informazzjoni kollha miġbura minn din ir-riċerka ser tintuża biss għall-għanijiet ta' dan l-istudju.

Il-parteċipazzjoni tiegħek f'dan l-istudju tinvolvi li timla l-kwestjonarju li ser jiġi pprovdut lilek illum u li tippermettili nkejjel qaddek/iċ-ċirkonferenza addominali. Dan għandu jieħu madwar għoxrin (20) minuta. Barra minn hekk, nitolbok tipprovdi ismek u n-numru tal-karta tal-identità sabiex jinkiseb l-aktar riżultat riċenti tad-demm tiegħek tal-HbA1c li jagħti indikazzjoni ta' kemm hi kkontrollata tajjeb il-kundizzjoni tiegħek. [redacted], ser tagixxi bħala l-intermedjarju biex tagħtini r-riżultat tal-HbA1c mir-rekords mediċi tiegħek. Ir-riżultat tad-demm ser jiġi marbut mat-tweġibiet tal-kwestjonarju tiegħek u d-dettalji personali tiegħek jitħassru fi żmien xahar mill-ġbir tad-data, b'tali mod li jkun diffiċli biex it-tweġibiet tiegħek jiġu ntraċċati lura lejk jew lejn xi ħadd ieħor. L-informazzjoni tiegħek ser tinżamm b'mod sigur, u d-data ser tiġi pproċessata skond ir-Regolament Ġenerali dwar il-Protezzjoni tad-Data (GDPR).

L-informazzjoni tiegħek ser tkun psewdonimizzata, jiġifieri, l-identita' tiegħek mhix ser titniżżel fuq it-tweġibiet tal-kwestjonarju, imma minflok, ser jiġi assenjat kodiċi. Il-kodiċijiet li jorbtu t-tweġibiet tal-kwestjonarju mal-identita' tiegħek ser jinżammu b'mod sigur u separat mit-tweġibiet tal-kwestjonarju. L-informazzjoni ser tinżamm b'mod sigur f'file kodifikat fuq il-kompjuter tar-riċerkatriċi, protett b'password u kwalunkwe materjal stampat ser jitqiegħed f'armarju/kexxun imsakkar. Ir-riċerkatriċi biss, u f'ċirkostanzi eċċezzjonali s-supervizura u l-eżaminaturi, ser ikollhom aċċess għall-informazzjoni personali tiegħek. L-informazzjoni personali li ser tintuża sabiex jiġi marbut l-HbA1c mat-tweġibiet tal-kwestjonarju ser titħassar fi żmien xahar mill-ġbir tad-data. Il-formoli tal-kunsens ser jinqerdu mat-tlestija tal-kors tal-Masters f'Marzu 2024.

Il-parteċipazzjoni tiegħek f'dan l-istudju ma tinvolvi l-ebda riskju magħruf jew antiċipat. Il-parteċipazzjoni tiegħek hija għażla għal kollox volontarja u tista' taċċetta jew tirrifjuta li tieħu sehem mingħajr ma tagħti raġuni. M'intix obbligat/a li twieġeb il-mistoqsijiet kollha u tista' tieqaf milli tieħu sehem fi x'ħin trid mingħajr ma tagħti raġuni. F'każ li tagħżel li ma tkomplix tieħu sehem fl-istudju, l-informazzjoni li tkun laħqet inġabret mingħandek titħassar sakemm dan ikun teknikament possibbli, jiġifieri, qabel ma titħassar l-informazzjoni personali tiegħek fi żmien xahar mill-ġbir tad-data. Wara li jsir dan, ma jkunx possibli li t-tweġibiet tiegħek jiġu ntraċċati. Barra minn hekk, jekk tagħżel li ma tkomplix tieħu sehem fl-istudju, dan mhux ser ikollu riperkussjonijiet negattivi fuqek.

Nassigurak li ser tinżamm il-kunfidenzjalità matul l-istudju kollu u li l-identità u l-informazzjoni personali tiegħek mhux ser jiġu żvelati fl-ebda pubblikazzjoni, rapporti jew preżentazzjonijiet li joħorġu minn din ir-riċerka.

Taħt ir-Regolament Ġenerali dwar il-Protezzjoni tad-Data (GDPR) u l-leġiżlazzjoni nazzjonali li timplimenta u tispeċifika aktar id-dispożizzjonijiet relevanti tal-imsemmi Regolament, għandek id-dritt li tikseb aċċess għal, tikkoreġi, u fejn applikabbli titlob li d-data li tikkonċerna lilek titħassar.

Ser tingħata kopja tal-ittra ta' informazzjoni u l-formola tal-kunsens għar-referenza tiegħek.

Grazzi ħafna tal-ħin u s-sehem tiegħek f'dan l-istudju. F'każ li jkollok xi mistoqsijiet jew tixtieq tiċċara xi affarijiet, tista' ċċempilli fuq [redacted] jew tibgħatli email fuq [redacted]. Tista' wkoll tikkuntattja lis-supervižura Dr Kathleen England fuq [redacted] jew billi tibgħat email fuq [redacted].

Dejjem tiegħek,

[redacted]

Dr Kristina Cassar
Riċerkatriċi

[redacted]

Dr Kathleen England
Supervižura tar-riċerka

Consent form – English version

L-Università ta' Malta
Faculty of Medicine & Surgery

Consent form

I have been asked to consent to participate in a research study entitled "Improving Diabetes Outcomes: The Role of Physical Activity". I have been informed about the purpose and details of this study. I have had the opportunity to read the information letter, ask questions, and any difficulties which I raised have been adequately clarified.

I give my consent to the Principal Investigator to use my name and ID number for the purpose of obtaining the most recent HbA1c blood result. I understand that [redacted] will act as the intermediary to provide the Principal Investigator with the HbA1c result from my personal medical records. The blood result will be linked to my questionnaire answers and my name and ID number will be discarded within one month from data collection. Further analysis of data will be carried out in a pseudonymised (coded) way, such that it will be difficult to identify from whom the data was derived.

I understand that the results of this study may be used for medical and scientific purposes and that the results may be reported or published in medical/scientific conferences or in scientific journals. However, I shall not be personally identified in any way. All data will be treated with confidentiality.

I understand that data will be processed in accordance with the General Data Protection Regulation (GDPR). Under the General Data Protection Regulation (GDPR) and national legislation that implements and further specifies the relevant provisions of said Regulation, I have the right to obtain access to, rectify, and where applicable ask for the data concerning me to be erased.

I understand that the data collected will be pseudonymised, that is, my identity will not be noted on the questionnaire replies, but instead, a code will be assigned. The codes that link my questionnaire replies to my identity will be stored securely and separately from the completed questionnaire replies. I understand that data will be stored safely in an encrypted file on the researcher's password-protected computer and hard-copy materials will be placed in a locked cabinet/drawer. Only the researcher, and in exceptional circumstances the supervisor and examiners, will have access to my personal information. The personal information which will be used for linkage between the HbA1c and individual questionnaire replies will be deleted within one month from data collection. Consent forms will be destroyed on completion of the Masters course in March 2024.

I understand that participation in this study does not entail any known or anticipated risks. I understand that I am under no obligation to participate in this study and am doing so voluntarily. I may withdraw from the study at any time, without giving any reason. In the event that I choose to withdraw from the study, any data collected will be erased as long as this is technically possible, that is, before my personal information has been erased, which will happen within one month from data collection. Following this, it will not be possible to trace back my replies. Furthermore, withdrawal from the study will not influence in any way the care and attention and treatment normally given to me.

I understand that I will not receive any remuneration for participating in this study.

In case of queries during the study I may contact the Principal Investigator.

I confirm that I am eighteen (18) years of age or over.

I agree to have my waist circumference measured: ☐

Signature of participant: _____

Name of participant (*in block letters*): _____

Signature of Principal Investigator: [redacted]

Name of Principal Investigator (*in block letters*): KRISTINA CASSAR

Contact email: [redacted]

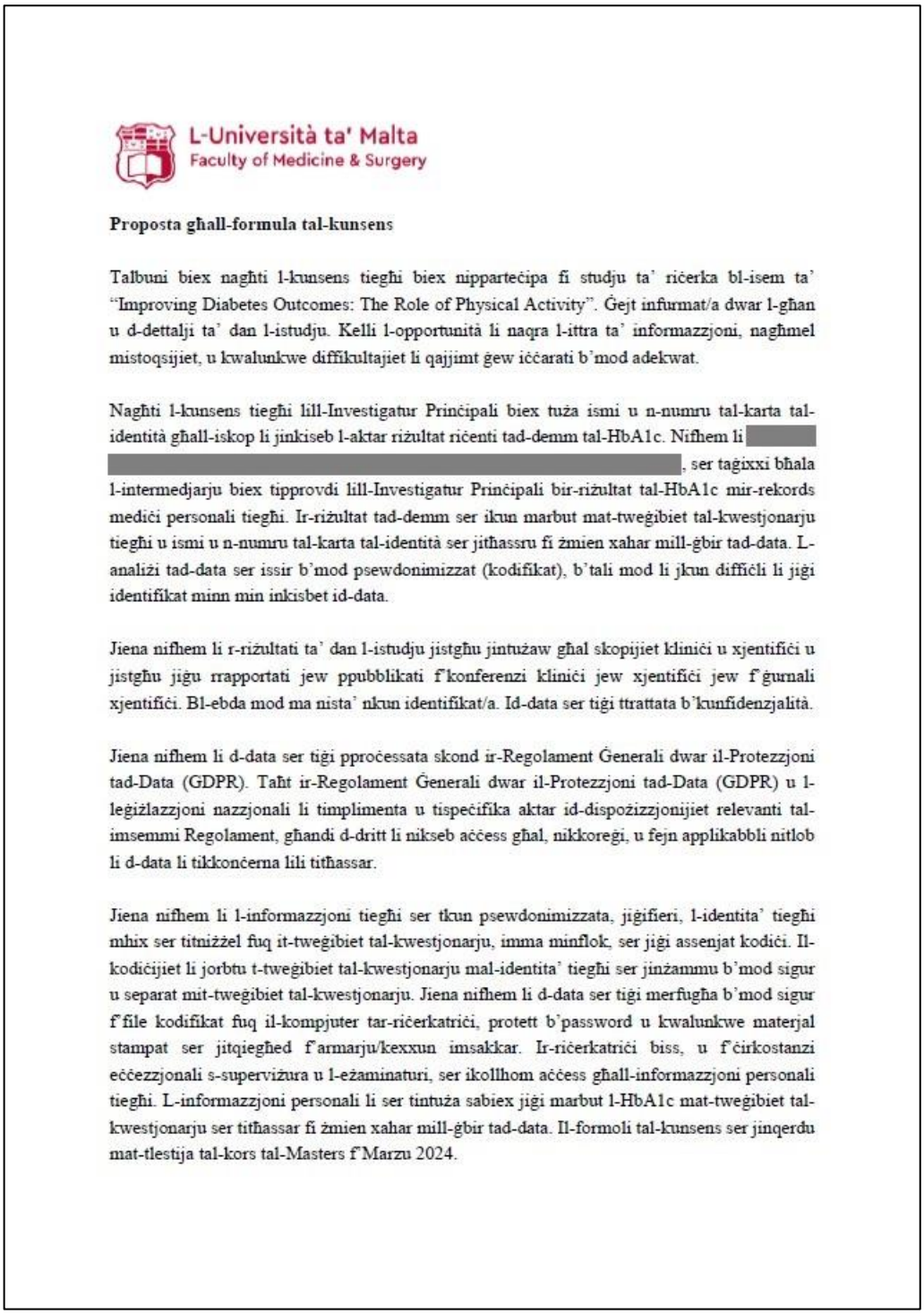
Contact mobile number: [redacted]

Date: _____

[redacted]

Dr Kathleen England
Research Supervisor

Consent form – Maltese version



L-Università ta' Malta
Faculty of Medicine & Surgery

Proposta għall-formula tal-kunsens

Talbuni biex nagħti l-kunsens tiegħi biex nipparteċipa fi studju ta' riċerka bl-isem ta' "Improving Diabetes Outcomes: The Role of Physical Activity". Ġejt infurmat/a dwar l-għan u d-dettalji ta' dan l-istudju. Kelli l-opportunità li naqra l-ittra ta' informazzjoni, nagħmel mistoqsijiet, u kwalunkwe diffikultajiet li qajjimt ġew iċċarati b'mod adekwat.

Nagħti l-kunsens tiegħi lill-Investigatur Prinċipali biex tuża ismi u n-numru tal-karta tal-identità għall-iskop li jinkiseb l-aktar riżultat riċenti tad-demm tal-HbA1c. Nifhem li [redacted], ser tagixxi bħala l-intermedjarju biex tipprovdi lill-Investigatur Prinċipali bir-riżultat tal-HbA1c mir-rekords mediċi personali tiegħi. Ir-riżultat tad-demm ser ikun marbut mat-tweġibiet tal-kwestjonarju tiegħi u ismi u n-numru tal-karta tal-identità ser jitħassru fi żmien xahar mill-ġbir tad-data. L-analiżi tad-data ser issir b'mod psewdonimizzat (kodifikat), b'tali mod li jkun diffiċli li jiġi identifikat minn min inkisbet id-data.

Jiena nifhem li r-riżultati ta' dan l-istudju jistgħu jintużaw għal skopijiet kliniċi u xjentifiċi u jistgħu jiġu rrapportati jew ppubblikati f'konferenzi kliniċi jew xjentifiċi jew f'ġurnali xjentifiċi. Bl-ebda mod ma nista' nkun identifikat/a. Id-data ser tiġi ttrattata b'kunfidenzjalità.

Jiena nifhem li d-data ser tiġi pproċessata skond ir-Regolament Ġenerali dwar il-Protezzjoni tad-Data (GDPR). Taħt ir-Regolament Ġenerali dwar il-Protezzjoni tad-Data (GDPR) u l-leġiżlazzjoni nazzjonali li timplimenta u tispeċifika aktar id-dispożizzjonijiet relevanti tal-imsemmi Regolament, għandi d-dritt li nikseb aċċess għal, nikkoreġi, u fejn applikabbli nitlob li d-data li tikkonċerna lili titħassar.

Jiena nifhem li l-informazzjoni tiegħi ser tkun psewdonimizzata, jiġifieri, l-identita' tiegħi mhix ser titniżżel fuq it-tweġibiet tal-kwestjonarju, imma minflok, ser jiġi assenjat kodiċi. Il-kodiċijiet li jorbtu t-tweġibiet tal-kwestjonarju mal-identita' tiegħi ser jinżammu b'mod sigur u separat mit-tweġibiet tal-kwestjonarju. Jiena nifhem li d-data ser tiġi merfugħa b'mod sigur f'file kodifikat fuq il-kompjuter tar-riċerkatriċi, protett b'password u kwalunkwe materjal stampat ser jitqiegħed f'armarju/kexxun imsakkar. Ir-riċerkatriċi biss, u f'ċirkostanzi eċċezzjonali s-supervizura u l-eżaminaturi, ser ikollhom aċċess għall-informazzjoni personali tiegħi. L-informazzjoni personali li ser tintuża sabiex jiġi marbut l-HbA1c mat-tweġibiet tal-kwestjonarju ser titħassar fi żmien xahar mill-ġbir tad-data. Il-formoli tal-kunsens ser jinqerdu mat-tlestija tal-kors tal-Masters f'Marzu 2024.

Jiena nifhem li l-parteċipazzjoni tiegħi f'dan l-istudju ma tinvolvi l-ebda riskju magħruf jew antiċipat. Jiena nifhem li ma għandi l-ebda dmir li nieħu sehem f'dan l-istudju u dan qed nagħmlu minn rajja. Jiena nista', meta rrid, ma nkomplix nieħu sehem fl-istudju, mingħajr ma nagħti raġuni. F'każ li nagħżel li ma nkomplix nieħu sehem fl-istudju, l-informazzjoni li tkun laħqet inġabret mingħandi titħassar sakemm dan ikun teknikament possibbli, jiġifieri, qabel ma titħassar l-informazzjoni personali tiegħi fi żmien xahar mill-ġbir tad-data. Wara li jsir dan, ma jkunx possibli li t-tweġibiet tiegħi jiġu ntraċċati. Barra minn hekk, jekk nagħżel li ma nkomplix nieħu sehem fl-istudju, xorta tibqa' tingħata lili l-kura li s-soltu ningħata.

Jiena nifhem li mhux ser nirċievi ħlas talli nieħu sehem f'dan l-istudju.

F'każ ta' diffikultà waqt l-istudju, nista' nikkuntattja lill-Investigatur Prinċipali.

Jiena nikkonferma li għandi tmintax (18)-il sena jew aktar.

Naqbel li titkejjel iċ-ċirkonferenza tal-qadd tiegħi: ☐

Firma tal-parteċipant: _____

Isem il-parteċipant (*b'ittri kbar*): _____

Firma tal-Investigatur Prinċipali: [redacted]

Isem tal-Investigatur Prinċipali (*b'ittri kbar*): KRISTINA CASSAR

E-mail: [redacted]

Numru tal-mobajl: [redacted]

Data: _____

[redacted]
Dr Kathleen England
Research Supervisor

Appendix G: Analysis of data

Table G1

Analysis of socio-demographic variables

Variable	Data analysis
Age	Categorised into five age groups for descriptive purposes: 18-29, 30-39, 40-49, 50-59, 60-69 years. Due to small numbers in the younger age groups, three groups were created for data analysis: 18-49, 50-59, 60-69 years. For the purposes of univariate and multivariate analyses, age was treated as a continuous variable.
Gender	Three categories: Male, Female, Other
Locality of residence	Categorised into the six districts or local administrative units (LAUs) as defined by the National Statistics Office: Southern Harbour, Northern Harbour, South Eastern, Western, Northern, and Gozo and Comino. The LAUs have been created by Eurostat and are compatible with the Nomenclature of Territorial Units for Statistics (NUTS) (NSO, 2014).
Level of education achieved	Six categories: No formal education, Primary school, Secondary school, Post-secondary, Tertiary, Other

Table G2

Analysis of variables related to medical history

Variable	Data analysis
Duration of diabetes	Categorised into eight groups for descriptive purposes: 0-5, 5-10, 10-15, 15-20, 20-25, 25-30, 30-35, 35-40 years. For the purposes of univariate and multivariate analyses, duration was treated as a continuous variable.
Type of diabetes	Three categories: Type 1, Type 2, Don't know
Type of diabetic control	Three categories: Diet control only, Tablets/pills, Insulin injections only or with tablets/pills
Medical co-morbidities	For the purposes of statistical analysis, the total number of co-morbidities for each participant was calculated and this was treated as a continuous variable.
Diabetes-related complications	Three categories: Foot problems, Kidney disease, Eye problems due to diabetes. For the purposes of statistical analysis, the total number of complications for each participant was calculated and this was treated as a continuous variable.
Smoking status	Three categories: Current smoker, Ex-smoker, Non-smoker

BMI	BMI was calculated as the weight in kilogrammes (kg) divided by the square of the height in metres (m). For descriptive purposes, BMI was grouped into five categories using the cut-offs outlined in the NICE guidance on obesity (NICE, 2023): - Healthy weight (BMI 18.5-24.9 kg/m2) - Overweight (BMI 25-29.9 kg/m2) - Obesity class 1 (BMI 30-34.9 kg/m2) - Obesity class 2 (BMI 35-39.9 kg/m2) - Obesity class 3 (BMI 40 kg/m2 and over) For the purposes of univariate and multivariate analyses, BMI was treated as a continuous variable.
Waist circumference	Waist circumference was measured in centimetres (cm). It was categorised into three groups according to the WHO cut-off points for the risk of metabolic complications (WHO, 2011): - No increased risk (up to 94 cm in males; up to 80 cm in females) - Increased risk (more than 94 cm in males; more than 80 cm in females) - Substantially increased risk (more than 102 cm in males; more than 88 cm in females) For the purposes of univariate and multivariate analyses, waist circumference was also treated as a continuous variable.
Waist-to-height ratio	Waist-to-height ratio was calculated for those with a BMI under 35 kg/m^2 as the waist divided by the height (both in centimetres). This was categorised into three groups to define the degree of central adiposity as per the NICE guidance on obesity (NICE, 2023): - Healthy central adiposity (0.4-0.49) - Increased central adiposity (0.5-0.59) - High central adiposity (0.6 and over) For the purposes of univariate and multivariate analyses, waist-to-height ratio was also treated as a continuous variable.
HbA1c	Categorised into two groups for descriptive purposes, in line with the recommended target of 7% in T2DM (Royal Australian College of General Practitioners, 2020): 7% or less, more than 7%. For the purposes of univariate and multivariate analyses, HbA1c was treated as a continuous variable.

Table G3

Analysis of variables related to PA knowledge and PA participation

Variable	**Data analysis**
Knowledge of the importance of exercise	Three categories: Very, Somewhat, Not at all
Knowledge of PA recommendations	Five categories: Most days of the week for at least 30 minutes, Once a week for at least 30 minutes, Once a month for one hour, At least every fortnight for two hours, Unsure/don't know
PA participation	Categorised into three groups according to the IPAQ scoring protocol (IPAQ, 2022): - low (inactive): individuals not meeting any of the below criteria - moderate: vigorous intensity activity for at least 20 minutes daily on at least three days per week; moderate intensity activity and/or walking for at least 30 minutes daily on at least five days per week; or any combination of walking, moderate or vigorous intensity activities on five or more days, achieving a minimum of 600 MET-minutes/week - high: vigorous intensity activity on at least three days per week, accumulating at least 1,500 MET-minutes/week; or any combination of walking, moderate or vigorous intensity activities daily, achieving a minimum of 3,000 MET-minutes/week
Daily sitting time	Treated as a continuous variable

Table G4

Analysis of variables related to PA barriers and enablers

Variable	**Data analysis**
Exercise Benefits/Barriers (EBBS)	43-item instrument with a four-point forced-choice Likert scale to determine the strength of agreement with statements related to exercise. The score ranged from "strongly agree" = 4 to "strongly disagree" = 1, with the barriers items reverse-scored when the scale was analysed in its entirety. Scores for the benefits items (29) and barriers items (14) separately were also extracted for statistical analysis; in this case, the barriers items were not reverse-scored. Missing data was handled by either discarding the response if missing items amounted to more than 5% of the total instrument or by applying median substitution if the non-response rate did not exceed 5% (Appendix H). The scores were treated as continuous variables for statistical analysis.

Barriers to PA in diabetes (BAPAD)	11-item instrument with a seven-level rating scale asking participants to indicate the probability that each item would hinder them from practising regular PA. The score ranged from "1" = very unlikely to "7" = very likely. The mean score was calculated for the purposes of statistical analysis; thus, incomplete scales were not considered. The score was treated as a continuous variable for statistical analysis.
Other factors hindering from physical activity participation	Open-ended question analysed using thematic content analysis
Enablers towards physical activity participation	Open-ended question analysed using thematic content analysis

Appendix H: Exercise Benefits/Barriers Scale (EBBS) scoring information

EXERCISE BENEFITS/BARRIERS SCALE

Scoring Information

The instrument may be scored and used in its entirety or as two separate scales. The instrument has a four-response, forced-choice Likert-type format with responses ranging from 4 (strongly agree) to 1 (strongly disagree). Barrier Scale items are reverse-scored. Items on the Barrier Scale are numbers 4, 6, 9, 12, 14, 16, 19, 21, 24, 28, 33, 37, 40 and 42.

Missing data may be handled in one of two ways. If more than five percent of the items are unanswered, it is recommended that the response be discarded. If the missing item response rate is less than five percent, median substitution prevents falsely low scores.

Scores on the total instrument can range from 43 to 172. The higher the score, the more positively the individual perceives exercise. When the Benefits Scale is used alone, the score range is between 29 and 116. When the Barriers Scale is used alone, scores range between 14 and 56. If used alone, the Barriers Scale does not need to be reverse-scored. In this instance, the higher the score on the Barriers Scale, the greater the perception of barriers to exercise.

Appendix I: Data analysis of the EBBS - Mean rating scores (with 95% CI) for each item of the EBBS in order of decreasing agreement with the statements by study participants

Rank	Item in the EBBS	Mean score	95% CI
1	Exercise decreases feelings of stress and tension for me	3.17	3.12 - 3.23
2	Exercise improves my mental health	3.16	3.11 - 3.21
3	Exercising increases my level of physical fitness	3.16	3.11 - 3.21
4	Exercising improves functioning of my cardiovascular system	3.15	3.11 - 3.20
5	I have improved feelings of well-being from exercise	3.15	3.10 - 3.19
6	Exercise increases my muscle strength	3.14	3.09 - 3.18
7	Exercise improves my flexibility	3.12	3.08 - 3.17
8	My muscle tone is improved with exercise	3.12	3.07 - 3.16
9	Exercise gives me a sense of personal accomplishment	3.11	3.05 - 3.17
10	My physical endurance is improved by exercising	3.11	3.06 - 3.15
11	Exercise improves overall body functioning for me	3.10	3.06 - 3.15
12	Exercise improves the way my body looks	3.10	3.05 - 3.15
13	I will prevent heart attacks by exercising	3.10	3.04 - 3.15
14	My disposition (mood) is improved with exercise	3.08	3.03 - 3.13
15	Exercise increases my stamina	3.08	3.03 - 3.13
16	Exercising makes me feel relaxed	3.07	3.02 - 3.13
17	Exercising will keep me from having high blood pressure	3.05	3.00 - 3.11
18	Exercising increases my mental alertness	3.05	3.01 - 3.10
19	Exercising improves my self-concept (how I perceive myself)	3.05	3.00 - 3.10
20	Exercising helps me sleep better at night	3.05	2.99 - 3.10
21	Exercise improves the quality of my work	3.00	2.95 - 3.05
22	I will live longer if I exercise	2.99	2.94 - 3.05
23	Exercise allows me to carry out normal activities without becoming tired	2.96	2.90 - 3.01
24	I enjoy exercise	2.95	2.88 - 3.03
25	Exercise helps me decrease fatigue	2.91	2.85 - 2.96
26	Exercising is a good way for me to meet new people	2.82	2.76 - 2.88
27	Exercise is good entertainment for me	2.74	2.68 - 2.81
28	Exercising lets me have contact with friends and persons I enjoy	2.73	2.66 - 2.79
29	Exercising increases my acceptance by others	2.63	2.56 - 2.69
30	I am fatigued by exercise	2.59	2.52 - 2.66
31	Exercise tires me	2.58	2.50 - 2.65
32	Places for me to exercise are too far away	2.21	2.14 - 2.27
33	My spouse (or significant other) does not encourage exercising	2.20	2.13 - 2.27
34	There are too few places for me to exercise	2.19	2.13 - 2.26
35	Exercise is hard work for me	2.13	2.07 - 2.20
36	Exercising takes too much of my time	2.12	2.06 - 2.18
37	Exercise facilities do not have convenient schedules for me	2.12	2.06 - 2.18

38	My family members do not encourage me to exercise	2.08	2.02 - 2.15
39	Exercise takes too much time from my family responsibilities	2.02	1.97 - 2.08
40	Exercise takes too much time from family relationships	1.99	1.94 - 2.05
41	I am too embarrassed to exercise	1.95	1.89 - 2.02
42	It costs too much to exercise	1.90	1.83 - 1.97
43	I think people in exercise clothes look funny	1.90	1.85 - 1.95