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Perceived barriers to leisure time physical activity in adults with type 2 diabetes attending primary health care in Oman

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TRANSPARENCY DECLARATION: This manuscript is an honest, accurate, and transparent account of the study being reported. There are no important aspects of the study that are omitted; and any possible discrepancies from the study are explained.

TECHNICAL APPENDIX: Data generated from this study is not available for public use. However it is available from the corresponding author on reasonable request and approvals from Oman Ministry of Health.

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CONFLICTS OF INTEREST: No competing interests.

ABSTRACT

Objectives: Physical activity is fundamental in diabetes management for good metabolic control. This study explored perceived barriers to performing leisure time physical activity and associated factors in adults with type 2 diabetes in Oman.

Design: Cross-sectional study using an Arabic version of the "Barriers to Being Active" questionnaire, socio-demographic information and questions on perceived stages of change in physical activity.

Setting: Seventeen primary health care centres randomly selected in Muscat.

Participants: Individuals >18 years with type 2 diabetes, attending diabetes clinic for > 2 years and with no contraindications to performing physical activity.

Primary and secondary outcome measures:

Participants were asked to rate how far different factors influenced their physical activity, under the following categories: fear of injury, lack of time, social support, energy, willpower, skills, resources, religion and environment. On a scale of 0-9, barriers were considered important if scored ≥5. Chi-square test was carried out to

determine differences in proportions of high barrier scores across socio-demographic factors and self-reported stages of physical activity.

Results: A total of 305 questionnaires were collected. Most (96%) reported at least one barrier to performing leisure time physical activity. Lack of willpower (44.4%), lack of resources (30.5%) and lack of social support (29.2%) were the most frequently reported barriers. Lack of willpower was significantly different in individuals with low vs high income (54.2% vs 40%, *P*=0.002) and in those reporting inactive vs active stages of change for physical activity (50.7% vs 34.7%, *P*=0.029), lack of resources was significantly different in those with low vs high income (40% vs 24.3%, *P*=0.004) and married vs unmarried (33.8% vs 18.5%, *P*=0.018). Lack of social support was significant in females vs males (35.4% vs 20.8%, *P*=0.005).

Conclusions: These findings suggest that physical activity interventions should be cost neutral and target psycho-social factors including self-efficacy and social support.

Key words: Physical Activity, Type 2 diabetes, Primary health care, Barriers, Oman

ARTICLE SUMMARY

Strengths and limitations of this study

- Barriers to performing leisure physical activity for adults with type 2 diabetes were investigated in Oman where prevalence of both diabetes and physical inactivity is high.
- Questions on possible barriers to performing physical activity linked to religion and environment were included.
- The tool used in this study was an English to Arabic language translated questionnaire that may have affected the validity of questions.
- The subjective nature of self-reports may have limited the accuracy of outcomes.

INTRODUCTION

Oman has witnessed enormous economic advancement in recent decades, along with significant increases in non-communicable diseases including a rising prevalence of diabetes. Diabetes prevalence in Oman has increased from 8.3% in 1991 to 12.3% in 2008 and recent estimates are in the order of 14.8%, exceeding global rates.[1 2] The World Health Organization (WHO) has indicated that physical inactivity is one of the top ten leading global causes of mortality and disability worldwide, and the principal cause for approximately 27% of diabetes, and approximately 30% of ischemic heart disease.[3] In Oman, it has been reported that almost 70% of the population are physically inactive (daily activity of ≤10 minutes).[4] This raises concerns regarding the impact these high levels of physical inactivity may be having on lifestyle related chronic diseases including diabetes, on health care expenditures and overall population health.[5]

The protective effects of physical activity (PA) in the management of diabetes, specifically type 2 diabetes (T2D), have been widely reported.[6 7] WHO recommends at least 150 minutes of moderate to vigorous physical activity or 75 minutes of vigorous PA/week.[8] However, over 60% of patients with diabetes in western countries do not meet the recommended levels of PA.[9 10] The Oman World Health Survey (OWHS) 2008, reported that in Oman, only 15% of patients with diabetes (98% of them with type 2 diabetes) met PA recommendations using the Global Physical Activity Questionnaire (GPAQ).[2]

The importance of leisure time PA in meeting PA recommendations is consistently[11] associated with reduced mortality risks (20% to >37% risk reduction) and favourable cardiovascular outcomes.[12] This relationship appears to have a dose-response effect where the upper threshold for mortality benefit occurs at 3 to 5 times the leisure PA recommendations of 7.5-<15 MET h/wk.[12] No clear association is observed for occupational or travel physical activity.[13]

Theoretical models underpinning effective interventions to promote personalized PA (contents, methods and approaches) should focus on benefits and ways to overcome barriers to PA.[14] Literature to date mainly from western countries has reported a number of potential barriers to performing PA in adults with diabetes. These include lack of time,[15-18] physical constrains including pain,[19] lack of knowledge and limited facilities.[20] Differences in reporting barriers to PA have been noted across genders, age groups, environments, cultures and disease status. Female gender, increasing age, unsafe neighbourhoods, being overweight and being a smoker increased the odds of reporting barriers to PA among migrant populations like African Americans, South Asian British and Mexican Americans.[21-23] In the Arab countries, modest evidence on barriers to PA in both the general population and in adults with T2D suggests that lack of time, co-existing diseases and adverse weather conditions[14 24-29] are the main factors. However, more information is required on barriers to physical activity in the Arabian Peninsula specifically the countries of the Gulf Cooperation Council (GCC) where culture, tradition, and environment are distinctive.

The current study aimed to identify significant barriers to performing leisure-time PA in adults with T2D in Oman, and associations with sociodemographic factors and perceived stages of change in PA.

METHODS

Study design, setting and participants

This cross-sectional interview based study was part of a larger study that examined correlates of physical activity and sitting time in adults with type 2 diabetes, and barriers to leisure physical activity in the same population. Results regarding the PA patterns of the population using the GPAQ are reported elsewhere.[30] This current paper identifies barriers to performing leisure physical activity expressed by Omani adults

with T2D using adapted questions from the Centers for Disease Control and Prevention (CDC) questionnaire[31] conducted in April/ May 2015 in Muscat (Urban communities). Reporting of this study follows the guidelines for strengthening the reporting of observational studies in epidemiology (STROBE).[32]

All patients with T2D attending their routine diabetes clinics in 17 randomly selected primary health care centres in Muscat were approached to take part in the study. Inclusion criteria were age >18 years and being followed up in a diabetes clinic for > 2 years and ability to provide informed consent. For illiterate participants, informed consents were taken from their spouse, son, daughter or other close family member. Participants with type 1 diabetes, newly diagnosed (<6 months) or who had difficulty in performing any physical activity, including history of myocardial infarction of <6 months and multiple organ failure, were excluded.

Data sources/ measurement

In addition to recording physiological data (BMI, medication, duration of diabetes, blood pressure, lipid profile, and comorbidities coinciding with diabetes) from the electronic health system, a multi-section questionnaire with a range of answers in closed format was administered by a trained interviewer. The following information was collected:

Socio-demographic data: included gender, age, marital status, education, household income, and work status

Perceptions on stage of change in physical activity: Based on the trans-theoretical theory of behaviour change,[33] subjects were asked to identify their perceived stage of change in physical activity. Participants were to select "Maintenance stage" if they were participating in moderate physical activity five or more times per week or in vigorous activity three to five times per week longer than six consecutive months or select

"Action stage" if less than six months. "Preparation stage" was selected by subjects who were thinking about starting exercise such as walking in the near future, or doing vigorous activity less than three times per week, or moderate activity less than five times per week. Contemplation stage "getting ready" was selected by subjects who were thinking about starting exercise or walk in the next six months. Subjects who were not thinking about starting any PA in the near future selected pre-contemplation stage "not ready".

CDC questionnaire on barriers to leisure PA:

An English to Arabic translated CDC questionnaire "Barriers to Being Active" was used in a study in Saudi Arabia[14] with 21 questions on seven barriers (lack of time, lack of social support, lack of energy, lack of willpower, fear of injury, lack of skill and lack of resources). Permission to use the questionnaire was obtained from the lead author on November 24, 2014 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2813614/figure/F0001/). The questionnaire was developed further to include two additional barrier categories, namely religion and environment. These additional questions were included due to other similar studies in neighbour countries with similar socio-economical characteristics.[28 29] Potential religious barriers considered questions on religious beliefs restricting PA, accepted clothing for PA and religious perceptions on PA.[14 25 26] Potential environmental barriers included questions on extreme weather conditions, physical activity in summer time and availability of appropriate environment for PA.[16 25] A set of three related questions (total of 27 questions) presented in random order within the questionnaire represented one barrier category.

A scoring system[31] was used to indicate how likely each statement/question was considered to be a barrier (very likely=3, somewhat likely=2, somewhat unlikely=1, very unlikely=0). Scores of the three theme-related questions were added up to provide

a total for each category of barriers. Possible scores for each barrier category ranged from 0-9. A score of ≥ 5 was considered as an important significant barrier.[31] The questionnaire was pre-tested in Muscat by distributing to 25 randomly selected adult patients with T2D from a population outside the sampled health centres. Amendments were made to ensure translation to Arabic was appropriate and PA related definitions were met. A copy of the used questionnaire can be found in online supplementary material1.

Study size

The sample size was calculated using an estimated 15% prevalence of adequate PA in patients with diabetes, as reported in the 2008 Oman World Health Survey (OWHS).[34] For 95% confidence limits, a response rate of 80%, and a precision of 20%, and smallest expected frequency of 15%, the calculated sample size was 305 participants across primary health centres in Muscat region, the capital of Oman.

Training

A multidisciplinary team of two nurses, one senior dietician, one medical orderly and two doctors were recruited for data collection. A one day training on administration of the questionnaire was delivered by the national focal point on PA in Oman Ministry of Health. Data entry, cross-checking and cleaning was done through Epi Info™ 7 by an independent personnel. Entered data was transferred to SPSS v21 for analysis and subsequent results.

Statistical methods

Descriptive statistics were expressed as percentages and mean (SD), median (quartiles) to describe the study sample characteristics. Sum of scores from the three related questions per category (range from 0-9) were expressed as median, the 25th, and 75th

quartiles. Data were dichotomised to scores <5 and ≥ 5 to determine the highly reported barriers.[31] Chi-square analysis was carried out to identify potential factors associated with high barrier scores (≥5) across the independent sociodemographic factors including gender (male vs female); age (≤57 vs >57); marital status (currently unmarried vs married); education (those unable to read or write ("uneducated") vs. those having attended primary school or beyond ("educated")); household income (<500 vs ≥500 Omani rials - 'OR'); and employment (unemployed (including those retired) vs employed). Self-reported stage of change in PA was expressed as one of two categories: inactive if reporting "pre-contemplation" or "contemplation" and potentially active if reporting being at "preparation", "action", or "maintenance" stages of PA. Corrected P-values (Yate's continuity) were reported for high barrier scores against the studied independent variables.

RESULTS

Socio-demographic

Out of 312 patients approached, 305 (98%) completed the questionnaire. Slightly more females were represented in this sample (57.4%, 175/305) than males. Mean (SD) age was 57(10.8) years with more than two-thirds being married (78.8%) and just about half unable to read or write (48.9%). More than a third of the study population (39.3%) reported household income of <500 OR (less than national average) [35] and the majority (77%) reported unemployment (including retirement). More males than females were educated (70% vs 37%) and employed (45% vs 7%) (**Table 1**).

Physiological status

Median (LQ, UQ) duration of diabetes in this population was 6.0 (4.0-10.0) years. The majority of the participants had hypertension (n=217, 71%) or/and hyperlipidaemia (n=189, 62%) coinciding with their diabetes. All of them were using anti-hypertensive

or/and lipid lowering medications as appropriate. More than three-quarters of those taking anti-hypertensives (78%) and two-thirds of those using lipid lowering drugs (66%) had blood pressure readings and fasting serum cholesterol within target levels (BP<140/80 mmHg and fasting serum cholesterol of <5mmol/l).[36] Fifteen percent (n=45) were controlling their diabetes by diet alone versus 85% (n=260) on oral anti-hypoglycaemic medications, in which 25% (n=75) were additionally on insulin. Mean (SD) BMI was 31.0 (6.0) kg/m^2 where 89% (n=271) had BMI >25kg/m^2 in which 50% (n=153) were obese (BMI>30 kg/m^2) and 39% (n=118) were overweight (BMI>25-29.99 kg/m^2). Glycated haemoglobin HbA1c was >7% in more than half of the population (58%) indicating poor diabetes control **Table 1**).

Self-reported stages of PA

Only 17% (n=52) of participants considered themselves actively participating in regular moderate or vigorous PA (22% of males vs 13% of females). Of the remainder, the majority reported being "not ready" (n=112, 37%), "getting ready" (n=95, 31%) or in "preparation" (n=46, 15%) (**Table 1**).

Table 1: Selected participants characteristics

Population characteristics	Male 130(43%)	Female 175(57%)	Total population n=305(100%)
Age (years)	(25th,50th,75th) 51,60,66	(25th,50th,75th) 49,56,63	(25th,50th,75th) 50,57,65
≤57	56(43)	99(57)	155(51)
>57	74(57)	79(43)	150(49)
Marital status			
Currently unmarried	10(8)	55(31)	65(21)
Currently married	130(92)	120(69)	240(79)
Education			
Not educated	39(30)	110(63)	149(49)
Educated	91(70)	65(37)	156(51)
Income			

<500 OR	51(39)	69(40)	120(39)
≥500 OR	79(61)	106(60)	185(61)
Employment			
Not employed	71(55)	163(93)	234(77)
Employed	59(45)	12(7)	71(23)
Physiological			
Duration of diabetes (years)	(25^{th},50^{th}, 75^{th}) 4,6,10	(25^{th},50^{th}, 75^{th}) 4,6,10	(25^{th},50^{th}, 75^{th}) 4,6,10
Self-reported comorbidities*			
Yes	116(89.2)	161(92)	277(91)
No	14(10.8)	14(8)	28 (9)
Current medication			
Anti-HTN	93(72)	124(71)	217(71)
Lipid lowering drugs	80(62)	109(62)	189(62)
Oral-hypoglycaemic drugs	114(88)	146(83)	260(85)
Oral-hypoglycaemic drugs with Insulin	32(25)	43(25)	75(25)
Diet control	16(12)	29(17)	45(15)
BP (systolic/diastolic) mmHg**			
Within target (<140/<80)	103(79)	134(77)	237(78)
High (≥140/≥80)	27(21)	41(23)	68(22)
Fasting lipid profile (mmol/l)**			
Cholesterol within target (< 5.0)	86(66)	115(66)	201(66)
Cholesterol high (≥5.0)	44(34)	60(34)	104(34)
BMI(kg/m2)**	(25^{th},50^{th}, 75^{th}) 25.7,28.9,33.3	(25^{th},50^{th}, 75^{th}) 27.5,31.6,35.3	(25^{th},50^{th}, 75^{th}) 26.8,30.1,34.6
Healthy weight range (18.5-24.99)	23(18)	11(6)	34(11)
Overweight (>25-29.99)	58(45)	60(34)	118(39)
Obese (>30)	49(59)	104(59)	153(50)
HbA1c(%)**	(25^{th},50^{th}, 75^{th}): 7.4(6.7,7.4,9)	(25^{th},50^{th}, 75^{th}): 7.7(6.3,7.7,8.5)	(25^{th},50^{th}, 75^{th}): 7.6(6.6,7.6,8.7)
Normal ≤7%	58(45)	69(40)	127(42)
High >7%	72(55)	106(61)	178(58)
Self-reported stages of PA			
Not ready (Pre-contemplation)	40(31)	72(41)	112(37)
Getting ready(contemplation)	41(32)	54(31)	95(31)
Preparation	20(15)	26(15)	46(15)
Action	10(8)	4(2)	14(5)
Maintenance	19(14)	19(11)	38(12)

*Reported hypertension, hyperlipidaemia, thyroid dysfunction or any other chronic condition coinciding with diabetes.
** Oman diabetes mellitus management guidelines (2015)

CDC questionnaire on barriers to leisure PA

The majority of the population, 96.4% (n=294), reported at least one barrier to performing leisure physical activity (97.7% females: 95.4% males). Population distributions were not normal across all reported barrier categories. Median sum scores

were all <5 as illustrated in (**Error! Reference source not found.**). Except for reporting lack of will and lack of resources, 75% of sum scores of other reported barriers were ≤ 5.

INSERT FIGURE 1 ABOUT HERE

Categorizing barrier scores to <5 and ≥5 (significant barrier) highlighted that 'lack of willpower' (n=139, 45.6%), 'lack of resources' (n=93, 30.5%) and 'lack of social support' (n=89, 29.2%) were the most frequently reported 'significant barriers' to physical activity. Barriers found to be significant in both males and females were lack of willpower (41.5% m: 48.6% f) and lack of resources (32.3% m: 29.1% f). In addition, lack of time in males (26.9%) and lack of social support in females (35.4%) were also significant (Figure 2).

INSERT FIGURE 2 ABOUT HERE

Associations between proportions indicating a high barrier score (≥5) with sociodemographic factors and self-reported stages of PA differed across the nine studied barrier categories: "Lack of time" was reported as a significant barrier more frequently by males (*P*=0.02), younger adults (*P*=0.002) and those who were married (*P*=0.002), employed (*P*=<0.001) or educated (*P*=<0.001). "Lack of social support" on the other hand, was reported as a significant barrier more frequently by females (*P*=0.008) and "Lack of energy" by employed (*P*=0.003), or educated (*P*=0.042) adults. However, "Lack of willpower" was reported as a significant barrier more frequently by individuals with lower income (*P*=0.021), or individuals at inactive stages of PA (*P*=0.012). Moreover, "Fear of injury" was reported as a significant barrier more frequently by

older adults (*P*=0.008), unemployed (*P*=0.007), uneducated (*P*=<0.001), or individuals reporting in-active stages of PA (*P*=<0.001). Furthermore, "Lack of skills" was reported as a significant barrier more frequently by females (*P*=0.003), younger adults (*P*=0.025), unemployed (*P*=0.004) or uneducated (*P*=0.01). Additionally, "Lack of resources" was reported as a significant barrier more frequently by married adults (*P*=0.026) or with lower income (*P*=0.005). It is notable that the religious and environmental barriers had no significant associations with any of the studied factors (Table 2).

Table 2: Factors influencing high barrier scores to leisure physical activity in adult population with type 2 diabetes

	Lack of time		Lack of social support		Lack of energy		Lack of willpower		Fear of injury		Lack of skills		Lack of resources		Religious barriers		Environmental barriers	
N (%)	<5 243 (79.7)	>=5 62 (20.3)	<5 216 (70.8)	>=5 89 (29.2)	<5 249 (81.6)	>=5 56 (18.4)	<5 166 (54.4)	>=5 139 (45.6)	<5- 227 (74.4)	>=5 78 (25.6)	<5 239 (78.4)	>=5 66 (21.6)	<5 212 (69.5)	>=5 93 (30.5)	<5 292 (95.7)	>=5 13 (4.3)	<5 269 (88.2)	>=5 36 (11.8)
Gender:																		
Male 130(42.6)	95 (73.1)	35 (26.9)	103 (79.2)	27 (20.8)	102 (78.5)	28 (21.5)	76 (58.5)	54 (41.5)	98 (75.4)	32 (24.6)	113 (86.9)	17 (13.1)	88 (67.7)	42 (32.3)	125 (96.2)	5 (3.8)	117 (90)	13 (10)
Female 175(57.4)	148 (84.6)	27 (15.4)	113 (64.6)	62 (35.4)	147 (84)	28 (16)	90 (51.4)	85 (48.6)	129 (73.7)	46 (26.3)	126 (72)	49 (28)	124 (70.9)	51 (29.1)	167 (95.4)	8 (4.6)	152 (86.9)	23 (13.1)
Corrected x^2 (P-value)	5.4(0.020)*		7.1(0.008)*		1.2(0.278)		1.2(0.270)		0.04(0.843)		8.9(0.003)*		0.2(0.640)		0.001(0.981)		0.4(0.508)	
Age:																		
<=57 155(50.8)	112 (72.3)	43 (27.7)	114 (73.5)	41 (26.5)	122 (78.7)	33 (21.3)	84 (54.2)	71 (45.8)	126 (81.3)	29 (18.7)	130 (83.9)	25 (16.1)	103 (66.5)	52 (33.5)	148 (95.5)	7 (4.5)	136 (87.7)	19 (12.3)
>57 150(49.2)	131 (87.3)	19 (12.7)	102 (68)	48 (32)	127 (84.7)	23 (15.3)	82 (54.7)	68 (45.3)	101 (67.3)	49 (32.7)	109 (72.7)	41 (27.3)	109 (72.7)	41 (27.3)	144 (96.0)	6 (4.0)	133 (88.7)	17 (11.3)
Corrected x^2 (P-value)	9.7(0.002)*		0.9(0.347)		1.4(0.232)		0.0(1.0)		7.1(0.008)*		5.0(0.025)*		1.1(0.292)		0.00(1.0)		0.0(0.942)	
Marital status:																		
Unmarried 65(21.3)	58 (89.2)	7 (10.8)	42 (64.6)	23 (35.4)	54 (83.1)	11 (16.9)	37 (56.9)	28 (43.1)	45 (69.2)	20 (30.8)	49 (75.4)	16 (24.6)	53 (81.5)	12 (18.5)	60 (92.3)	5 (7.7)	56 (86.2)	9 13.8)
Married 240(78.7)	185 (77.1)	55 (22.9)	174 (72.5)	66 (27.5)	195 (81.3)	45 (18.8)	129 (53.8)	111 (46.3)	182 (75.8)	58 (24.2)	190 (79.2)	50 (20.8)	159 (66.3)	81 (33.8)	232 (96.7)	8 (3.3)	213 (88.8)	27 (11.3)
Corrected x^2 (P-value)	3.9(0.047)*		1.2(0.277)		0.0(0.875)		0.1(0.753)		0.9(0.356)		0.2(0.626)		4.9(0.026)*		1.4(0.231)		0.1(0.720)	
Employment:																		
Un employed 234(76.7)	205 (87.6)	29 (12.4)	160 (68.4)	74 (31.6)	200 (85.5)	34 (14.5)	124 (53)	110 (47)	165 (70.5)	69 (29.5)	174 (74.4)	60 (25.6)	160 (68.4)	74 (31.6)	223 (95.3)	11 (4.7)	207 (88.5)	27 (11.5)
Employed	38	33	56	15	49	22	42	29	62	9	65	6	52	19	69	2	62	9

71(23.3)	(53.5)	(46.5)	(78.9)	(21.1)	(69)	(31)	(59.2)	(40.8)	(87.3)	(12.7)	(91.5)	(8.5)	(73.2)	(26.8)	(97.2)	(2.8)	(87.3)	(12.7)
Corrected x^2 (P-value)	37.0(<0.001)*		2.4(0.120)		8.8(0.003)*		0.6(0.437)		7.2(0.007)*		8.5(0.004)*		0.4(0.527)		0.1(0.740)		0.0(0.960)	
Education:																		
Uneducated 149(48.9)	132 (88.6)	17 (11.4)	99 (66.4)	50 (33.6)	129 (86.6)	20 (13.4)	81 (54.4)	68 (45.6)	96 (64.4)	53 (35.6)	107 (71.8)	42 (28.2)	105 (70.5)	44 (29.5)	140 (94.0)	9 (6.0)	133 (89.3)	16 (10.7)
Educated-156(51.1)	111 (71.2)	45 (28.8)	117 (75)	39 (25)	120 (76.9)	36 (23.1)	85 (54.5)	71 (45.5)	131 (84)	25 (16)	132 (84.6)	24 (15.4)	107 (68.6)	49 (31.4)	152 (97.4)	4 (2.6)	136 (87.2)	20 (12.8)
Corrected x^2 (P-value)	13.2(<0.001)*		2.3(0.129)		4.1(0.042)*		0.0(1.0)		14.2(<0.001)*		6.6(0.010)*		0.1(0.816)		1.5(0.162)		0.1(0.700)	
Income:																		
<500 120(39.3)	100 (83.3)	20 (16.7)	88 (73.3)	32 (26.7)	94 (78.3)	26 (21.7)	55 (45.8)	65 (54.2)	95 (79.2)	25 (20.8)	92 (76.7)	28 (23.3)	72 (60)	48 (40)	113 (94.2)	7 (5.8)	110 (91.7)	10 (8.3)
>=500 185(60.7)	143 (77.3)	42 (22.7)	128 (69.2)	57 (30.8)	155 (83.8)	30 (16.2)	111 (60)	74 (40)	132 (71.4)	53 (28.6)	147 (79.5)	38 (20.5)	140 (75.7)	45 (24.3)	179 (96.8)	6 (3.2)	159 (85.9)	26 (14.1)
Corrected x^2 (P-value)	1.3(0.257)		0.4(0.516)		1.1(0.294)		5.3(0.021)*		1.9(0.163)		0.2(0.663)		7.7(0.005)*		0.6(0.422)		1.8(0.183)	
Self-reported stages of PA:																		
Not active 207(67.9)	169 (81.6)	38 (18.4)	148 (71.5)	59 (28.5)	170 (82.1)	37 (17.9)	102 (49.3)	105 (50.7)	141 (68.1)	66 (31.9)	157 (75.8)	50 (24.2)	146 (70.5)	61 (29.5)	198 (95.7)	9 (4.3)	179 (86.5)	28 (13.5)
Active 98(32.1)	74 (75.5)	24 (24.5)	68 (69.4)	30 (30.6)	79 (80.6)	19 (19.4)	64 (65.3)	34 (34.7)	86 (87.8)	12 (12.2)*	82 (83.7)	16 (16.3)	66 (67.3)	32 (32.7)	94 (95.9)	4 (4.1))	90 (91.8)	8 (8.2)
Corrected x^2 (P-value)	1.2(0.276)		0.1(0.808)		0.0(0.873)		6.2(0.012)*		12.5(<0.001)*		2.0(0.161)		0.2(0.667)		0.00(1.0)		1.4(0.244)	

* Significant at P<0.05

DISCUSSION

Despite evidence on the effectiveness of meeting PA levels in the management of T2D, and associated cardiovascular risk factors, PA is poorly addressed in routine diabetes care.[37] Low PA levels in populations with T2D are consistently reported in western countries namely USA[38] as well as Arabic speaking countries namely Oman, Saudi Arabia and Lebanon.[2 39 40] Addressing perceived barriers to performing recommended PA levels in this population is crucial for planning effective PA promoting interventions.

Within a series of formative studies to inform a culturally congruent PA intervention in diabetes care,[41] this study has looked at perceived barriers to performing leisure time physical activity in an adult population with T2D attending primary care using an adapted CDC questionnaire translated to Arabic language.[14]

The current findings relating to willpower, resources and social support were also reported as the top three barriers to PA in the Saudi population attending primary care by AlQuaiz (2009). In the west, USA in particular, the strongest reported barriers to physical activity among adults with T2D were pain (41%), followed by lack of willpower (27%), and poor health (21%).[42]

Lack of willpower was significantly reported by individuals with low income. Since this study focused on leisure PA, individuals with low income may have less access to PA facilities and discretionary time to perform PA. However, despite evidence on a positive association between socioeconomic status and physical activity in countries of low and middle income, this association is inconsistent or inverse from high-income countries.[43] [44] More evidence is required from high income and Arabic speaking countries namely Oman to validate the impact of economic status on leisure PA for individuals with T2D. Additionally, reporting lack of willpower in this population was significant in

individuals who reported being at inactive stages of physical activity (pre-contemplation or contemplation stages of physical activity). Progressive stages of behavioural change according to the trans-theoretical model were direct correlates to PA in a review article by Trost (2002)[45] and direct determinants in another by Van Stralen (2009) .[46] This finding supports the need for programs to help raise self-willpower/determination through stepped process of behaviour change from inactive (pre-contemplation) to active stages of PA (action and maintenance).[47] Five behaviour change techniques namely: prompt focus on past success, barrier identification/ problem-solving, use of follow-up prompts, providing information on where and when to perform the behaviour and prompt review of behavioural goals of PA, have been significantly associated with increased PA behaviour in T2D and improving HbA1c in western countries.[48] PA interventions underpinned by behaviour changes techniques should be considered in Arabic speaking populations with T2D namely Oman.

Limited resources including high cost and limited facilities for PA were similarly reported as significant barriers to PA across different cultures. [20 22] In this study, it was reported as significant by individuals who were married and those with low income. Married individuals could have more financial commitments to their families especially in the GCC countries where extended families are common. [49] This may alter an individual's priorities for house-hold income expenditure. Low income was similarly reported in the Saudi study as a significant factor through the reporting of lack of resources being a barrier due to the perceived high cost of utilising PA facilities in order to be physically active, or purchasing PA equipment. [14] This may reflect a narrow view on what constitutes PA and a misconception that expensive equipment is required. Hence, irrespective of culture, interventions promoting cost neutral PA such as walking in populations would be highly desirable to overcome this barrier. [41 50]

Lack of social support was frequently reported by females in this study. [22 51] Meeting cultural norms and social expectations related to safety, security and conservative dress mainly for females were reported as barriers to PA in South Asian (Pakistani and Indian) British populations[18 21] and populations in Arabic counties such as Qatar.[52] Evaluation of interventions to provide the necessary social support and networks to PA specifically for women with T2D, particularly in the GCC, and including group-based activities and buddying, [53-55] are required.

Other reported barriers such as fear of injury and lack of skills varied across subgroups in particular, older, unemployed, and uneducated individuals. Older individuals with T2D are more vulnerable to have poor vision and osteoarthritic changes that may cause fall and injuries. Moreover the negative influence of pain to PA in older population with T2D was reported in western countries,[42] and hence potential barriers to their participation. Programs to promote PA should be individualized for type, frequency and intensity of PA and incorporate safety measures to prevent PA induced pain and injuries in older individuals.[56] Lack of time on the other hand, has been a highly cited barrier to PA in the general population as well as populations with diabetes.[15-18 21 22 42 57] However, unlike the study by Alquaiz (2009), significant scores for lack of time in this study were higher in males compared to females[14] and also a lack of energy, which may be a reflection of the fact that more males than females were educated and employed. This in addition to family and social commitments may have jeopredized their time for PA especially if individuals were younger and married. This discussion highlights the importance of changing people's perceptions of PA and consideration of opportunities in other PA domains namely work, and travel that could enable individuals with less leisure time to increase overall PA and behaviour.

Factors which are independent of an individual's decision-making, such as environment and religion had no significant associations in the current study despite the hot weather

during data collection of this study in April/May. These null results, may be real or may be due to the validity/ wording of the questions and their interpretation. To address this gap in the literature, a qualitative exploration of possible environmental, including seasonal variations, and religious factors affecting PA performance may be warranted. Additionally, results of this study cannot be generalised across all regions in Oman. More information is required from rural Omani communities where perceptions on PA may be different. Other limitations of this study include the subjective nature of self-reports and validity of the questions linked to translation of the questionnaire to Arabic language. Future attempts to explore barriers to PA should equally include work and travel domains to cater diversities in both PA behaviour and sedentary lifestyle across subgroups of adults with T2D.

CONCLUSION

This study identified lack of willpower low resources and low social support (especially in females) as the most common barriers to performing leisure PA. Physical activity counselling linked to behaviour change techniques that influence individuals' readiness to change should be considered for augmenting self-efficacy issues. The provision of options for PA resources and social support should also be integrated in intervention design. Due to the range of barriers reported in the current study, PA counselling should aim to increase individuals' understanding of what constitutes PA and be flexible and tailored to the specific needs of subgroups of adults with T2D.

ETHICAL CONSIDERATION

Ethical approval was obtained from the Regional Research Committee in Muscat, Oman Ministry of Health. All eligible participants provided informed consent prior to data

collection. For illiterate individuals, consents to participate in this study were provided by their accompanying support member (spouse, son or daughter).

COMPETING INTERESTS

The authors declare that they have no competing interests.

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AUTHERS' CONTRIBUTION

TS is the principal investigator in charge of the project. SM, YA, EB, AC and ASA have all been involved in designing the intervention and the evaluation. TS prepared the initial draft of the manuscript and all other authors have contributed. All authors have critically reviewed and approved the final version of the manuscript.

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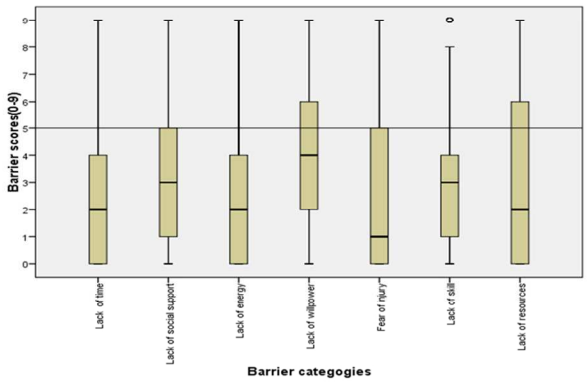
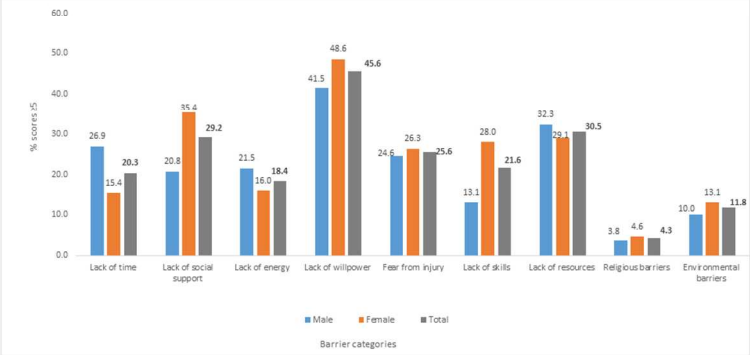
Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (significant scores defined as ≥5)

Figure 2: Percentage of reported barrier scores ≥5 by gender



Box and Whisker plots for the reported barrier sum scores of 0-9 (significant scores defined as ≥5)

338x190mm (96 x 96 DPI)



Percentage of reported barrier scores ≥5 by gender

338x190mm (96 x 96 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

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Perceived barriers to leisure time physical activity in adults with type 2 diabetes attending primary health care in Oman (questionnaire survey)

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Perceived barriers to leisure time physical activity in adults with type 2 diabetes attending primary health care in Oman (questionnaire survey)

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TRANSPARENCY DECLARATION: This manuscript is an honest, accurate, and transparent account of the study being reported. There are no important aspects of the study that are omitted; and any possible discrepancies from the study are explained.

TECHNICAL APPENDIX: Data generated from this study is not available for public use. However it is available from the corresponding author on reasonable request and approvals from Oman Ministry of Health.

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CONFLICTS OF INTEREST: No competing interests.

ABSTRACT

Objectives: Physical activity is fundamental in diabetes management for good metabolic control. This study aimed to identify barriers to performing leisure time physical activity and explore differences based on gender, age, marital status, employment, education, income and perceived stages of change in physical activity in adults with type 2 diabetes in Oman.

Design: Cross-sectional study using an Arabic version of the "Barriers to Being Active" 27 item questionnaire, socio-demographic information and questions on perceived stages of change in physical activity.

Setting: Seventeen primary health care centres randomly selected in Muscat, Oman.

Participants: Individuals >18 years with type 2 diabetes, attending diabetes clinic for > 2 years and with no contraindications to performing physical activity.

Primary and secondary outcome measures:

Participants were asked to rate how far different factors influenced their physical activity, under the following categories: fear of injury, lack of time, social support,

energy, willpower, skills, resources, religion and environment. On a scale of 0-9, barriers were considered important if scored ≥5.

Results: A total of 305 questionnaires were collected. Most (96%) reported at least one barrier to performing leisure time physical activity. Lack of willpower (44.4%), lack of resources (30.5%) and lack of social support (29.2%) were the most frequently reported barriers. Using chi-square test, lack of willpower was significantly different in individuals with low vs high income (54.2% vs 40%, *P*=0.002) and in those reporting inactive vs active stages of change for physical activity (50.7% vs 34.7%, *P*=0.029), lack of resources was significantly different in those with low vs high income (40% vs 24.3%, *P*=0.004) and married vs unmarried (33.8% vs 18.5%, *P*=0.018). Lack of social support was significant in females vs males (35.4% vs 20.8%, *P*=0.005).

Conclusions: These findings suggest that physical activity interventions should be cost neutral and target psycho-social factors including self-efficacy and social support.

Key words: Physical Activity, Type 2 diabetes, Primary health care, Barriers, Oman

ARTICLE SUMMARY

Strengths and limitations of this study

- Barriers to performing leisure physical activity for adults with type 2 diabetes were investigated in Oman where prevalence of both diabetes and physical inactivity is high.
- Questions on possible barriers to performing physical activity linked to religion and environment were included.
- The tool used in this study was an English to Arabic language translated questionnaire that may have affected the validity of questions.
- The subjective nature of self-reports may have limited the accuracy of outcomes.

INTRODUCTION

Oman is located in Southwest Asia on the Southeast coast of the Arabian Peninsula. Similar to its neighbouring countries (United Arab Emirates, Saudi Arabia, Qatar, Bahrain, and Kuwait), Oman has witnessed enormous economic advancement in recent decades, along with significant increases in non-communicable diseases including a rising prevalence of diabetes. Diabetes prevalence in Oman has increased from 8.3% in 1991 to 12.3% in 2008 and recent estimates are in the order of 14.8%, exceeding global rates.[1 2] The World Health Organization (WHO) has indicated that physical inactivity is one of the top ten leading global causes of mortality and disability worldwide, and the principal cause for approximately 27% of diabetes, and approximately 30% of ischemic heart disease.[3] In Oman, it has been reported that almost 70% of the population are physically inactive (daily activity of ≤10 minutes).[4] This raises concerns regarding the impact these high levels of physical inactivity may be having on lifestyle related chronic diseases including diabetes, on health care expenditures and overall population health.[5]

The protective effects of physical activity (PA) in the management of diabetes, specifically type 2 diabetes (T2D), have been widely reported.[6 7] WHO recommends at least 150 minutes of moderate to vigorous physical activity or 75 minutes of vigorous PA/week.[8] However, over 60% of patients with diabetes in western countries do not meet the recommended levels of PA.[9 10] The Oman World Health Survey (OWHS) 2008, reported that in Oman, only 15% of patients with diabetes (98% of them with type 2 diabetes) met PA recommendations using the Global Physical Activity Questionnaire (GPAQ).[2]

The importance of leisure time PA in meeting PA recommendations is consistently[11] associated with reduced mortality risks (20% to >37% risk reduction) and favourable cardiovascular outcomes.[12] This relationship appears to have a dose-response effect where the upper threshold for mortality benefit occurs at 3 to 5 times the leisure PA

recommendations of 7.5-<15 MET h/wk.[12] No clear association is observed for occupational or travel physical activity.[13]

Theoretical models underpinning effective interventions to promote personalized PA (contents, methods and approaches) should focus on benefits and ways to overcome barriers to PA.[14] Literature to date mainly from western countries has reported a number of potential barriers to performing PA in adults with diabetes. These include lack of time,[15-18] physical constrains including pain,[19] lack of knowledge and limited facilities.[20] Differences in reporting barriers to PA have been noted across genders, age groups, environments, cultures and disease status. Female gender, increasing age, unsafe neighbourhoods, being overweight and being a smoker increased the odds of reporting barriers to PA among migrant populations like African Americans, South Asian British and Mexican Americans.[21-23] In the Arab countries, modest evidence on barriers to PA in both the general population and in adults with T2D suggests that lack of time, co-existing diseases and adverse weather conditions[14 24-29] are the main factors. Moreover, the climate in this region may be a drawback to meeting recommended levels of PA due to high temperatures during the day, particularly in the sandy/desert areas. During the summer months, these countries including Oman experience major heat waves (>40 degrees celsius) and humidity levels that could reach 90%.

The current study aimed to identify barriers to performing leisure-time PA in adults with T2D in Oman, and the distribution of barrier scores across different socio-demographic characteristics and perceived stages of change in PA.

METHODS

Study design, setting and participants

This cross-sectional interview based study was part of a larger study that examined correlates of physical activity and sitting time in adults with type 2 diabetes, and barriers to leisure physical activity in the same population. Results regarding the PA patterns of the population using the Global Physical Activity Questionnaire are reported elsewhere.[30] This current paper identified barriers to performing leisure physical activity expressed by Omani adults with T2D using adapted questions from the Centers for Disease Control and Prevention (CDC) questionnaire[31] conducted in April/ May 2015 in Muscat (Urban communities). Reporting of this study follows the guidelines for strengthening the reporting of observational studies in epidemiology (STROBE).[32]

All patients with T2D attending their routine diabetes clinics in 17 randomly selected primary health care centres in Muscat were approached to take part in the study. Inclusion criteria were age >18 years and being followed up in a diabetes clinic for >2 years and ability to provide informed consent. For illiterate participants, informed consents were taken from their spouse, son, daughter or other close family member. Participants with type 1 diabetes, newly diagnosed (<6 months) or who had difficulty in performing any physical activity, including history of myocardial infarction of <6 months and multiple organ failure, were excluded.

Data sources/ measurement

In addition to recording physiological data [Body Mass Index (BMI), medication, duration of diabetes, blood pressure (BP), lipid profile, and comorbidities coinciding with diabetes] from the electronic health system, a multi-section questionnaire with a

range of answers in closed format was administered by a trained interviewer. The following information was collected:

Socio-demographic data: included gender, age, marital status, education, household income, and employment.

Perceptions on stage of change in physical activity: Based on the trans-theoretical theory of behaviour change,[33] subjects were asked to identify their perceived stage of change in physical activity. Participants were to select "Maintenance stage" if they were participating in moderate physical activity five or more times per week or in vigorous activity three to five times per week longer than six consecutive months or select "Action stage" if less than six months. "Preparation stage" was selected by subjects who were thinking about starting exercise such as walking in the near future, or doing vigorous activity less than three times per week, or moderate activity less than five times per week. Contemplation stage "getting ready" was selected by subjects who were thinking about starting exercise or walk in the next six months. Subjects who were not thinking about starting any PA in the near future selected pre-contemplation stage "not ready".

CDC questionnaire on barriers to leisure PA:

An English to Arabic translated CDC questionnaire "Barriers to Being Active" was used in a study in Saudi Arabia[14] with 21 questions on seven barriers (lack of time, lack of social support, lack of energy, lack of willpower, fear of injury, lack of skill and lack of resources). Permission to use the questionnaire was obtained from the lead author on November 24, 2014 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2813614/figure/F0001/). However, in that tool no statements on religion or environment as possible barriers to PA were included. To address this gap and to formulate robust items on these topics we

undertook several procedures. Literature search was conducted to identify possible content for the new items from similar studies in neighbour countries with similar socio-economical characteristics.[28 29] Potential religious barriers considered questions on religious beliefs restricting PA, accepted clothing for PA and religious perceptions on PA.[14 25 26] Potential environmental barriers included questions on extreme weather conditions, physical activity in summer time and availability of appropriate environment for PA.[16 25] Content and face validity of the questionnaire were assessed by our investigatory team and draft questions were then discussed with a sample of patients prior to field testing and adjustments were made to ease comprehension and ensure translation to Arabic was appropriate.

A set of three related questions (total of 27 questions) presented in random order within the questionnaire represented one barrier category. A scoring system[31] was used to indicate how likely each statement/item was considered to be a barrier (very likely=3, somewhat likely=2, somewhat unlikely=1, very unlikely=0). Scores of the three theme-related questions were added up to provide a total for each category of barriers. Possible scores for each barrier category ranged from 0-9. A score of ≥ 5 was considered as an important barrier to overcome.[31] A copy of the used (Arabic) questionnaire can be found in online supplementary material.

To ensure common understanding and acceptability, an interview recording was undertaken in Muscat in 25 randomly selected adult with type 2 diabetes (population of interest) outside the sampled health centres of the study. Results were discussed and reviewed by the investigation team and an independent statistician.

Based on the data from the current study, the scale quality (27 item study questionnaire) including internal consistency reliability measures were investigated through the use of Factor Analysis using SPSS v22 and supported by McDonald's coefficient omega using the free and open source R. [34 35]

Study size

Power analysis was performed to estimate the prevalence of meeting PA recommendations in adult population with T2D in a parallel study conducted in the same population.[36] We assumed that meeting PA recommendation is indirectly related to reporting less barriers to PA[37] and used an estimated 15% prevalence of adequate PA in patients with diabetes, as reported in the 2008 Oman World Health Survey (OWHS).[38] Using 95% confidence limits, a response rate of 80%, and a precision of +/- 4%, and smallest expected frequency of 15%, the calculated sample size was ~300 participants across primary health centres in Muscat region, the capital of Oman.

Training

A multidisciplinary team of two nurses, one senior dietician, one medical orderly and two doctors were recruited for data collection. A one day training on administration of the questionnaire was delivered by the national focal point on PA in Oman Ministry of Health. Data entry, cross-checking and cleaning was done through Epi Info™ 7 by an independent personnel. Entered data was transferred to SPSS v22 for analysis and subsequent results.

Statistical methods

Descriptive statistics were expressed as percentages and mean (SD), median (quartiles) to describe the study sample characteristics. Sum of scores from the three related questions per category (range from 0-9) were expressed as median (LQ, UQ). Data were dichotomised to scores <5 and ≥ 5 to determine the highly reported barriers as advised in the CDC questionnaire and practised in a study in Saudi Arabia.[31] Chi-square analysis was carried out to identify with the distribution of the high barrier scores (≥5) across the independent sociodemographic factors including gender (male vs female);

age (to ensure sufficient power and adequate numbers for further statistical analysis the population was divided by the mean age ≤57 vs < 57 years); marital status (currently unmarried vs married); education (those unable to read or write ("uneducated") vs. those having attended primary school or beyond ("educated"); household income (<500 vs ≥500 Omani rials - 'OR'); and employment (unemployed, including those retired vs employed). Self-reported stage of change in PA was expressed as one of two categories: inactive if reporting "pre-contemplation" or "contemplation" and potentially active if reporting being at "preparation", "action", or "maintenance" stages of PA. Corrected P-values (Yate's continuity) were reported for high barrier scores against the studied independent variables.

RESULTS

Socio-demographic

Out of 312 patients approached, 305 (98%) completed the questionnaire. Slightly more females were represented in this sample (57.4%) than males. The population was slightly older with mean (SD) age of 57(10.8) years. Additionally, more than two-thirds being married (78.8%) and just about half unable to read or write (48.9%). More than a third of the study population (39.3%) reported household income of <500 OR (less than national average) [39] and the majority (77%) reported unemployment (including retirement). More males than females were educated (70% vs 37%) and employed (45% vs 7%) (Table 1).

Physiological status

Median (LQ, UQ) duration of diabetes in this population was 6.0 (4.0, 10.0) years. The majority of the participants had hypertension (n=217, 71%) or/and hyperlipidaemia (n=189, 62%) coinciding with their diabetes. All of them were using anti-hypertensive or/and lipid lowering medications as appropriate. More than three-quarters of those

taking anti-hypertensives (78%) and two-thirds of those using lipid lowering drugs (66%) had blood pressure (BP) readings and fasting serum cholesterol within target levels (BP<140/80 mmHg and fasting serum cholesterol of <5mmol/l).[40] Fifteen percent (n=45) were controlling their diabetes by diet alone versus 85% (n=260) on oral anti-hypoglycaemic medications, in which 25% (n=75) were additionally on insulin. Mean (SD) BMI was 31.0 (6.0) kg/m^2 where 89% (n=271) had BMI >25kg/m^2 in which 50% (n=153) were obese (BMI>30 kg/m^2) and 39% (n=118) were overweight (BMI>25-29.99 kg/m^2). Glycated haemoglobin HbA1c was >7% (>48 mmol/mol) in more than half of the population (58%) indicating poor diabetes control (Table 1).

Self-reported stages of PA

Only 17% (n=52) of participants considered themselves actively participating in regular moderate or vigorous PA (22% of males vs 13% of females). Of the remainder, the majority reported being "not ready" (37%), "getting ready" (31%) or in "preparation" (15%) (Table 1).

Table 1: Selected participants characteristics

Population characteristics	Total population n=305(100%)
Gender	
Male	130(42.6)
Female	175(57.4)
Age (years)	
≤57	155(51)
>57	150(49)
Marital status	
Currently unmarried	65(21)
Currently married	240(79)
Education	
Not educated	149(49)
Educated	156(51)
Income	
<500 OR	120(39)
≥500 OR	185(61)
Employment	

Not employed	234(77)	257
Employed	71(23)	
Physiological		
Duration of diabetes (years)	Median (LQ, UQ) 6(4, 10)	
Self-reported comorbidities*		
Yes	277(91)	262 263
No	28 (9)	264
Current medication		
Anti-HTN	217(71)	266
Lipid lowering drugs	189(62)	267
Oral-hypoglycaemic drugs	260(85)	268 269
Oral-hypoglycaemic drugs with Insulin	75(25)	270
Diet control	45(15)	271
Blood pressure (systolic/diastolic) mmHg**		
Within target (<140/<80)	237(78)	274 275
High (≥140/≥80)	68(22)	276
Fasting lipid profile (mmol/l)**		
Cholesterol within target (< 5.0)	201(66)	278 279
Cholesterol high (≥5.0)	104(34)	280
Body Mass Index (kg/m2)**		
Healthy weight range (18.5-24.99)	34(11)	282 283
Overweight (>25-29.99)	118(39)	284
Obese (>30)	153(50)	285
HbA1c(%)**(>48 mmol/mol)		
Normal ≤7%	127(42)	287
High >7%	178(58)	288
Self-reported stages of PA		
Not ready (Pre-contemplation)	112(37)	290 291
Getting ready(contemplation)	95(31)	292
Preparation	46(15)	293
Action	14(5)	294
Maintenance	38(12)	295 296

*Reported hypertension, hyperlipidaemia, thyroid dysfunction or any other chronic condition coinciding with diabetes.
**Oman diabetes mellitus management guidelines (2015)[40]

297 298

299 CDC questionnaire on barriers to leisure PA

300 The majority of the population, 97.7% (n=298), reported at least one barrier to
301 performing leisure physical activity median (LQ, UQ) was 6 (4, 7). Population
302 distributions were not normal across all reported barrier categories. Median sum scores
303 were all <5 as illustrated in (Figure 1). Except for reporting lack of willpower and lack
304 of resources, 75% of sum scores of other reported barriers were ≤ 5.

305

306 INSERT FIGURE 1 ABOUT HERE

Categorizing barrier scores to <5 and ≥5 (significant barrier) highlighted that 'lack of willpower' (n=139), 'lack of resources' (n=93) and 'lack of social support' (n=89) were the most frequently reported 'significant barriers' to physical activity (Figure 2). Barriers found to be significant in both males and females were lack of willpower (41.5% m: 48.6% f) and lack of resources (32.3% m: 29.1% f). In addition, lack of time in males (26.9%) and lack of social support in females (35.4%) were also noteworthy (Table 2).

INSERT FIGURE 2 ABOUT HERE

Distributions of significant high barrier score (≥5) across the studied sociodemographic factors and self-reported stages of change in PA differed among the nine barrier categories: "Lack of time" was frequently highly scored by males, younger adults and those who were married, employed or educated. Additionally, "Lack of social support" was highly scored by females and "Lack of energy" by employed, or educated adults. However, "Lack of willpower" was highly scored by individuals with lower income, or at inactive stages of PA. Moreover, "Fear of injury" was highly scored by older adults, unemployed, uneducated, or individuals reporting in-active stages of PA. Furthermore, "Lack of skills" was highly scored by females, younger adults, and unemployed or uneducated. "Lack of resources" on the other hand, was frequently highly scored by married adults or with lower income. It is notable that the religious and environmental barriers had no significant different distributions across any of the studied factors (Table 2)

Table 2: Distribution of high barrier scores (≥5) to leisure physical activity in adult population with type 2 diabetes across sociodemographic variables and self-reported stages of change in physical activity (n=305).

(%) Scores ≥ 5	Lack of time	Lack of social support	Lack of energy	Lack of willpower	Fear of injury	Lack of skills	Lack of resources	Religious barriers	Environmental barriers
Gender:									
Male	26.6	20.8	21.5	41.5	24.6	13.1	32.3	3.8	10.0
Female	15.4	35.4	16.0	48.6	26.3	28.0	29.1	4.6	13.1
Corrected x^2	5.4	7.1	1.2	1.2	0.04	8.9	0.2	0.001	0.4
(P-value)	(0.020)*	(0.008)*	(0.278)	(0.270)	(0.843)	(0.003)*	(0.640)	(0.981)	(0.508)
Age:									
<=57	27.7	26.5	21.3	45.8	18.7	16.1	33.5	4.5	12.3
>57	12.7	32.0	15.3	45.3	32.7	27.3	27.3	4.0	11.3
Corrected x^2	9.7	0.9	1.4	0.0	7.1	5.0	1.1	0.00	0.0
(P-value)	(0.002)*	(0.347)	(0.232)	(1.000)	(0.008)*	(0.025)*	(0.292)	(1.000)	(0.942)
Marital status:									
Unmarried	10.8	35.4	16.9	43.1	30.8	24.6	18.5	7.7	13.8
Married	22.9	27.5	18.8	46.3	24.2	20.8	33.8	3.3	11.3
Corrected x^2	3.9	1.2	0.0	0.1	0.9	0.2	4.9	1.4	0.1
(P-value)	(0.047)*	(0.277)	(0.875)	(0.753)	(0.356)	(0.626)	(0.026)*	(0.231)	(0.720)
Employment:									
Un-employed	12.4	31.6	14.5	47.0	29.5	25.6	31.6	4.7	11.5
Employed	46.5	21.1	31.0	40.8	12.7	8.5	26.8	2.8	12.7
Corrected x^2	37.0	2.4	8.8	0.6	7.2	8.5	0.4	0.1	0.0
(P-value)	(<0.001)*	(0.120)	(0.003)*	(0.437)	(0.007)*	(0.004)*	(0.527)	(0.740)	(0.960)
Education:									
Un-educated	11.4	33.6	13.4	45.6	35.6	28.2	29.5	6.0	10.7
Educated	28.8	25.0	23.1	45.5	16.0	15.4	31.4	2.6	12.8

Corrected x^2 (P-value)	13.2 (<0.001)*	2.3 (0.129)	4.1 (0.042)*	0.0 (1.0)	14.2 (<0.001)*	6.6 (0.010)*	0.1 (0.816)	1.5 (0.162)	0.1 (0.700)
Income:									
<500	16.7	26.7	21.7	54.2	20.8	23.3	40.0	5.8	8.3
>=500	22.7	30.8	16.2	40.0	28.6	20.5	24.3	3.2	14.1
Corrected x^2	1.3	0.4	1.1	5.3	1.9	0.2	7.7	0.6	1.8
(P-value)	(0.257)	(0.516)	(0.294)	(0.021)*	(0.163)	(0.663)	(0.005)*	(0.422)	(0.183)
Self-reported stages of PA:									
Not active	18.4	28.5	17.9	50.7	31.9	24.2	29.5	4.3	13.5
Active	24.5	30.6	19.4	34.7	12.2	16.3	32.7	4.1	8.2
Corrected x^2	1.2	0.1	0.0	6.2	12.5	2.0	0.2	0.00	1.4
(P-value)	(0.276)	(0.808)	(0.873)	(0.012)*	(<0.001)*	(0.161)	(0.667)	(1.0)	(0.244)

* Significant at P<0.05

Factor analysis and reliability test results

Initially, the factorability of the 27 items/questions was examined. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.7, above the commonly recommended value of 0.6. Bartlett's test of sphericity (test of at least one significant correlation between 2 of the items studied) was also significant (χ_2 (351) = 2600.175, p < .05).[41] The communalities (proportion of item's variance explained by the extracted factors) were all above 0.3, further confirming that each item shared some common variance with other items. Given these overall indicators, factor analysis was regarded to be suitable with all the 27 items/questions.

Principal components analysis (PCA) was used because the primary purpose was to identify composite scores for the factors underlying the items/questions in the study scale. Initial eigenvalues (statistical values used in deciding how many factors to extract in the overall factor analysis where values of ≥1.0 are considered statistically sound)[42] indicated that the first eight factors (namely fear of injury, environmental barriers, lack of willpower, lack of time/ lack of energy, lack of resources, religious barriers, lack of skills/ lack of social support and lack of energy) explained 13.1%, 11.4%, and 9.2%, 9.0%, 7.2%, 5.1%, 4.3% and 3.8% of the variance respectively.

None of the 27 items/questions were eliminated because they all met a minimum criteria of having a primary factor loading of 0.45 or above (magnitude of item-factor relationship desirable at ≥ 0.3). Majority of the factor loadings within the study items/questions were in the same direction of the barrier categories except for items/questions related to lack of energy (Q3 & 17) and lack of social support (Q2 &16) which loaded up with lack of time (Q1, 8 & 15) and lack of skills (Q6 & 13) respectively indicating cross contributions. McDonald's coefficient Omega was equal to 0.75 indicating moderate reliability of the scale.[42]

Further Factor analysis and reliability tests were conducted on the studied barrier subscales (3 questions per barrier). Table 3 provides the KMO values, factor loadings, communalities and McDonald's coefficient Omega for all the nine subscales used in the current study indicating excellent sub-scale quality.

Table 3: KMO values, factor loadings, communalities and McDonald's coefficient Omega for the study subscales

Barrier categories	Items/questions	KMO	factor loadings	Communalities	Omega
Lack of time	Q15	0.6	0.8	0.7	0.9
	Q1		0.8	0.6	
	Q8		0.6	0.4	
Lack of social support	Q16	0.5	0.7	0.5	0.9
	Q2		0.7	0.5	
	Q9		0.5	0.3	
Lack of energy	Q3	0.6	0.8	0.6	0.9
	Q17		0.7	0.5	
	Q10		0.6	0.3	
Lack of willpower	Q18	0.6	0.8	0.7	0.9
	Q4		0.7	0.6	
	Q11		0.7	0.5	
Fear of injury	Q19	0.6	0.9	0.8	0.9
	Q12		0.8	0.7	
	Q5		0.8	0.6	
Lack of skills	Q6	0.5	0.8	0.7	0.9
	Q13		0.6	0.4	
	Q20		0.6	0.3	
Lack of resources	Q7	0.7	0.8	0.7	0.9
	Q21		0.8	0.7	
	Q14		0.8	0.6	
Religious barriers	Q25	0.7	0.9	0.8	0.9
	Q23		0.9	0.8	
	Q27		0.8	0.6	
Environmental barriers	Q24	0.7	0.9	0.9	0.9
	Q26		0.9	0.8	
	Q22		0.8	0.7	

DISCUSSION

Despite evidence on the effectiveness of meeting PA levels in the management of T2D, and associated cardiovascular risk factors, [6 7] PA is poorly addressed in routine diabetes care.[43] Low PA levels in populations with T2D are consistently reported in western countries, for example, USA[44] as well as Arabic speaking countries namely Oman,

Saudi Arabia and Lebanon.[2 45 46] Addressing perceived barriers to performing recommended PA levels in this population is crucial for planning effective PA promoting interventions.

Within a series of formative studies to inform a culturally congruent PA intervention in diabetes care,[47] this study has looked at perceived barriers to performing leisure time physical activity in an adult population with T2D attending primary care using an adapted CDC questionnaire translated to Arabic language.[14]

The current findings relating to willpower, resources and social support were also reported as the top three barriers to PA in the Saudi population attending primary care by AlQuaiz (2009).[14] In the West, USA in particular, the strongest reported barriers to physical activity among adults with T2D were pain (41%), followed by lack of willpower (27%), and poor health (21%).[48]

In the current study, lack of willpower was significantly highly reported by individuals with low income. This finding is difficult to interpret in the absence of true verifications for the self-reported house hold income. However low income could be linked to financial constrains which were reported to have negative influence on intention to participate in leisure-time physical activity in adult population with T2D in Canada.[49] Additionally in a study in USA, older individuals with low income who were found hopeless and had low participation in social activities had less odds of engaging in PA.[50] None the less, more evidence is needed to explain how income alters the willpower for performing leisure PA in Arabic speaking countries namely Oman. Comparably, Lack of willpower was more likely to be reported by individuals at inactive stages of physical activity (pre-contemplation or contemplation stages of physical activity) than those in active stages. Progressive stages of behavioural change according to the trans-theoretical model were direct correlates to PA in a review article by Trost (2002)[51] and direct determinants in another by Van Stralen (2009).[52] This finding supports the need

for programs to help raise self-willpower/determination through stepped process of behaviour change from inactive (pre-contemplation) to active stages of PA (action and maintenance).[53] Interestingly, fear of injury was the only other reported barrier significantly different between individuals at inactive vs active stages of change in PA. This could be explained by possible physical constraints pertaining to older age[50] and existing comorbidities in the current study population triggering fear of injuries associated with PA.

Limited resources including high cost and limited facilities for PA have been reported as significant barriers to PA across different cultures.[20 22] In the current study, limited resources were reported as significant by individuals who were married and those with low income. Married individuals could have more financial commitments to their families especially in the Gulf Cooperation Council countries where extended families are common.[54] This may alter an individual's priorities for house-hold income expenditure. Low income was similarly reported as a barrier in a Saudi population, possibly due to the perceived high cost of utilising PA facilities.[14] This may reflect a narrow view on what constitutes PA and a misconception that expensive equipment is required. Hence, irrespective of culture, interventions promoting cost neutral PA such as walking in populations would be highly desirable to overcome this barrier.[47 55]

Lack of social support was frequently reported by females in this study. Meeting cultural norms and social expectations related to safety, security and conservative dress mainly for females were reported as barriers to PA in South Asian (Pakistani and Indian) British populations[18 21] and populations in Arabic counties such as Qatar.[56] Evaluation of interventions to provide the necessary social support and networks to PA specifically for women with T2D, particularly in the countries of the Gulf Cooperation Council are required. Activities including group-based activities and buddying,[57-59] are worth further investigation.

Other reported barriers such as fear of injury and lack of skills varied across subgroups in particular, older, unemployed, and uneducated individuals. Older individuals with T2D are more vulnerable to have poor vision and osteoarthritic changes that may cause fall and injuries.[60] Moreover the negative influence of pain to PA in older population with T2D was reported in western countries,[48] and hence potential barriers to individuals' participation. Programs to promote PA should be individualized for type, frequency and intensity of PA and incorporate safety measures to prevent PA induced pain and injuries in older individuals.[61]

Lack of time on the other hand, has been a highly cited barrier to PA in the general population as well as populations with diabetes.[15-18 21 22 48 62] However, unlike the study by Alquaiz (2009), significant scores for lack of time in this study were higher in males compared to females[14] along-with a lack of energy, which may be a reflection of the fact that more males than females were educated and employed. This perception of 'lack of time', in addition to family and social commitments may jeopardized their time for PA especially if individuals were younger and married. This discussion highlights the importance of changing people's perceptions of PA but also consideration of opportunities in other PA domains namely work and travel that could enable individuals with less leisure time to increase overall PA and behaviour.

Factors which are independent of an individual's decision-making, such as environment and religion had no significant associations in the current study despite the hot weather during data collection of this study in April/May. These null results, may be real or may be due to the wording of the questions and their interpretation. To address this gap in the literature, a qualitative exploration of possible environmental, including seasonal variations, and religious factors affecting PA performance may be warranted.

Additionally, results of this study cannot be generalised across all regions in Oman. More information is required from rural Omani communities where perceptions on PA

may be different. Despite the excellent scale reliability measures in the current data, the results cannot be generalized due to possible differences in scale quality across various data.[42] Despite efforts to minimize potential bias due to the subjective nature of self-reports, accuracy of outcomes cannot be fully ensure.

Finally, future attempts to explore barriers to PA should equally include work and travel domains to cater diversities in both PA behaviour and sedentary lifestyle across subgroups of adults with T2D.

CONCLUSION

This study identified lack of willpower, low resources and low social support (especially in females) as the most common barriers to performing leisure PA. Physical activity counselling linked to behaviour change techniques that influence individuals' readiness to change should be considered for augmenting self-efficacy issues. The provision of options for PA resources and social support should also be integrated in intervention design. Due to the range of barriers reported in the current study, PA counselling should aim to increase individuals' understanding of what constitutes PA and be flexible and tailored to the specific needs of subgroups of adults with T2D.

ETHICAL CONSIDERATION

Ethical approval was obtained from the Regional Research Committee in Muscat, Oman Ministry of Health. All eligible participants provided informed consent prior to data collection. For illiterate individuals, consents to participate in this study were provided by their accompanying support member (spouse, son or daughter).

COMPETING INTERESTS

The authors declare that they have no competing interests.

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AUTHORS' CONTRIBUTION

TS is the principal investigator in charge of the project. SM, YA, EB, AC and ASA have all been involved in designing the intervention and the evaluation. TS prepared the initial draft of the manuscript and all other authors have contributed. All authors have critically reviewed and approved the final version of the manuscript.

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Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high scores defined as ≥5)

Figure 2: Percentage of reported high barrier scores (≥5)

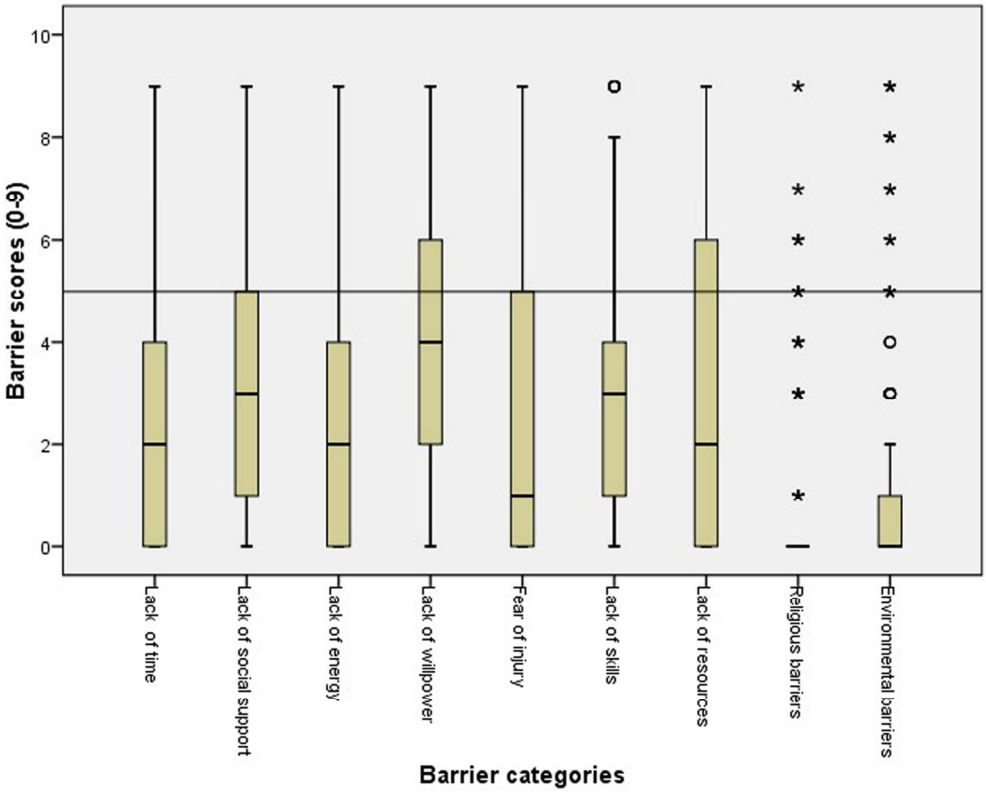

Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high scores defined as ≥5)

132x106mm (300 x 300 DPI)

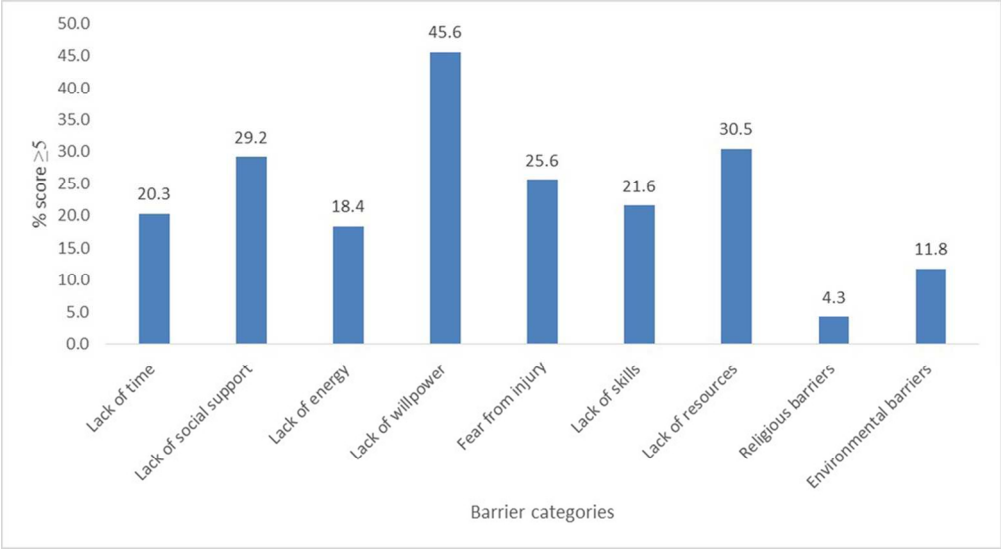

Figure 2: Percentage of reported high barrier scores (≥5)

96x53mm (300 x 300 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

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Perceived barriers to leisure time physical activity in adults with type 2 diabetes attending primary health care in Oman: a cross-sectional survey

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TRANSPARENCY DECLARATION: This manuscript is an honest, accurate, and transparent account of the study being reported. There are no important aspects of the study that are omitted; and any possible discrepancies from the study are explained.

TECHNICAL APPENDIX: Data generated from this study is not available for public use. However it is available from the corresponding author on reasonable request and approvals from Oman Ministry of Health.

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CONFLICTS OF INTEREST: No competing interests.

ABSTRACT

Objectives: Physical activity is fundamental in diabetes management for good metabolic control. This study aimed to identify barriers to performing leisure time physical activity and explore differences based on gender, age, marital status, employment, education, income and perceived stages of change in physical activity in adults with type 2 diabetes in Oman.

Design: Cross-sectional study using an Arabic version of the "Barriers to Being Active" 27 item questionnaire.

Setting: Seventeen primary health centres randomly selected in Muscat.

Participants: Individuals >18 years with type 2 diabetes, attending diabetes clinic for > 2 years and with no contraindications to performing physical activity.

Primary and secondary outcome measures:

Participants were asked to rate how far different factors influenced their physical activity, under the following categories: fear of injury, lack of time, social support, energy, willpower, skills, resources, religion and environment. On a scale of 0-9, barriers were considered important if scored ≥5.

Results: A total of 305 questionnaires were collected. Most (96%) reported at least one barrier to performing leisure time physical activity. Lack of willpower (44.4%), lack of resources (30.5%) and lack of social support (29.2%) were the most frequently reported barriers. Using chi-square test, lack of willpower was significantly different in individuals with low vs high income (54.2% vs 40%, *P*=0.002) and in those reporting inactive vs active stages of change for physical activity (50.7% vs 34.7%, *P*=0.029), lack of resources was significantly different in those with low vs high income (40% vs

24.3%, *P*=0.004) and married vs unmarried (33.8% vs 18.5%, *P*=0.018). Lack of social support was significant in females vs males (35.4% vs 20.8%, *P*=0.005).

Conclusions: The findings can inform the design on physical activity intervention studies by testing the impact of cost neutral programs on improving barriers to physical activity including approaches that enhance self-efficacy and social support.

Key words: Physical Activity, Type 2 diabetes, Primary health care, Barriers, Oman

ARTICLE SUMMARY

Strengths and limitations of this study

- Barriers to performing leisure physical activity for adults with type 2 diabetes were investigated in Oman where prevalence of both diabetes and physical inactivity is high.
- Questions on possible barriers to performing physical activity linked to religion and environment were included.
- The tool used in this study was an English to Arabic language translated questionnaire that may have affected the validity of questions.
- Due to the cross-sectional nature of this study, causative inferences cannot be made.

INTRODUCTION

Oman is located in Southwest Asia on the Southeast coast of the Arabian Peninsula. Similar to its neighbouring countries (United Arab Emirates, Saudi Arabia, Qatar, Bahrain, and Kuwait), Oman has witnessed enormous economic advancement in recent decades, along with significant increases in non-communicable diseases including a rising prevalence of diabetes. Diabetes prevalence in Oman has increased from 8.3% in 1991 to 12.3% in 2008 and recent estimates are in the order of 14.8%, exceeding global rates.[1 2] The World Health Organization (WHO) has indicated that physical inactivity is one of the top ten leading global causes of mortality and disability worldwide, and the

principal cause for approximately 27% of diabetes, and approximately 30% of ischemic heart disease.[3] In Oman, it has been reported that almost 70% of the population are physically inactive (daily activity of ≤10 minutes).[4] This raises concerns regarding the impact these high levels of physical inactivity may be having on lifestyle related chronic diseases including diabetes, on health care expenditures and overall population health.[5]

The protective effects of physical activity (PA) in the management of diabetes, specifically type 2 diabetes (T2D), have been widely reported.[6 7] WHO recommends at least 150 minutes of moderate to vigorous physical activity or 75 minutes of vigorous PA/week.[8] However, over 60% of patients with diabetes in western countries do not meet the recommended levels of PA.[9 10] The Oman World Health Survey (OWHS) 2008, reported that in Oman, only 15% of patients with diabetes (98% of them with type 2 diabetes) met PA recommendations using the Global Physical Activity Questionnaire (GPAQ).[2]

The importance of leisure time PA in meeting PA recommendations is consistently[11] associated with reduced mortality risks (20% to >37% risk reduction) and favourable cardiovascular outcomes.[12] This relationship appears to have a dose-response effect where the upper threshold for mortality benefit occurs at 3 to 5 times the leisure PA recommendations of 7.5-<15 MET h/wk.[12] No clear association is observed for occupational or travel physical activity.[13]

Theoretical models underpinning effective interventions to promote personalized PA (contents, methods and approaches) should focus on benefits and ways to overcome barriers to PA.[14] Literature to date mainly from western countries has reported a number of potential barriers to performing PA in adults with diabetes. These include lack of time,[15-18] physical constrains including pain,[19] lack of knowledge and limited facilities.[20] Differences in reporting barriers to PA have been noted across genders, age groups, environments, cultures and disease status. Female gender, increasing age, unsafe

neighbourhoods, being overweight and being a smoker increased the odds of reporting barriers to PA among migrant populations like African Americans, South Asian British and Mexican Americans.[21-23] In the Arab countries, modest evidence on barriers to PA in both the general population and in adults with T2D suggests that lack of time, co-existing diseases and adverse weather conditions[14 24-29] are the main factors. Moreover, the climate in this region may be a drawback to meeting recommended levels of PA due to high temperatures during the day, particularly in the sandy/desert areas. During the summer months, these countries including Oman experience major heat waves (>40 degrees celsius) and humidity levels that could reach 90%.

The current study aimed to identify barriers to performing leisure-time PA in adults with T2D in Oman, and the distribution of barrier scores across different socio-demographic characteristics and perceived stages of change in PA.

METHODS

Study design, setting and participants

This cross-sectional interview based study was part of a larger study that examined correlates of physical activity and sitting time in adults with type 2 diabetes, and barriers to leisure physical activity in the same population. Results regarding the PA patterns of the population using the Global Physical Activity Questionnaire are reported elsewhere.[30] This current paper identified barriers to performing leisure physical activity expressed by Omani adults with T2D using adapted questions from the Centers for Disease Control and Prevention (CDC) questionnaire[31] conducted in April/ May 2015 in Muscat (Urban communities). Reporting of this study follows the guidelines for strengthening the reporting of observational studies in epidemiology (STROBE).[32]

All patients with T2D attending their routine diabetes clinics in 17 randomly selected primary health care centres in Muscat were approached to take part in the study. Inclusion criteria were age >18 years and being followed up in a diabetes clinic for >2 years and ability to provide informed consent. For illiterate participants, informed consents were taken from their spouse, son, daughter or other close family member. Participants with type 1 diabetes, newly diagnosed (<6 months) or who had difficulty in performing any physical activity, including history of myocardial infarction of <6 months and multiple organ failure, were excluded.

Data sources/ measurement

In addition to recording physiological data [Body Mass Index (BMI), medication, duration of diabetes, blood pressure (BP), lipid profile, and comorbidities coinciding with diabetes] from the electronic health system, a multi-section questionnaire with a range of answers in closed format was administered by a trained interviewer. The following information was collected:

Socio-demographic data: included gender, age, marital status, education, household income, and employment.

Perceptions on stage of change in physical activity: Based on the trans-theoretical theory of behaviour change,[33] subjects were asked to identify their perceived stage of change in physical activity. Participants were to select "Maintenance stage" if they were participating in moderate physical activity five or more times per week or in vigorous activity three to five times per week longer than six consecutive months or select "Action stage" if less than six months. "Preparation stage" was selected by subjects who were thinking about starting exercise such as walking in the near future, or doing vigorous activity less than three times per week, or moderate activity less than five times per week. Contemplation stage "getting ready" was selected by subjects who were

thinking about starting exercise or walk in the next six months. Subjects who were not thinking about starting any PA in the near future selected pre-contemplation stage "not ready".

CDC questionnaire on barriers to leisure PA:

An English to Arabic translated CDC questionnaire "Barriers to Being Active" was used in a study in Saudi Arabia[14] with 21 questions on seven barriers (lack of time, lack of social support, lack of energy, lack of willpower, fear of injury, lack of skill and lack of resources). Permission to use the questionnaire was obtained from the lead author on November 24, 2014 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2813614/figure/F0001/). However, in that tool no statements on religion or environment as possible barriers to PA were included. To address this gap and to formulate robust items on these topics we undertook several procedures. Literature search was conducted to identify possible content for the new items from similar studies in neighbour countries with similar socio-economical characteristics.[28 29] Potential religious barriers considered questions on religious beliefs restricting PA, accepted clothing for PA and religious perceptions on PA.[14 25 26] Potential environmental barriers included questions on extreme weather conditions, physical activity in summer time and availability of appropriate environment for PA.[16 25] Content and face validity of the questionnaire were assessed by our investigatory team and draft questions were then discussed with a sample of patients prior to field testing and adjustments were made to ease comprehension and ensure translation to Arabic was appropriate.

A set of three related questions (total of 27 questions) presented in random order within the questionnaire represented one barrier category. A scoring system[31] was used to indicate how likely each statement/item was considered to be a barrier (very likely=3, somewhat likely=2, somewhat unlikely=1, very unlikely=0). Scores of the three theme-

related questions were added up to provide a total for each category of barriers. Possible scores for each barrier category ranged from 0-9. A score of ≥ 5 was considered as an important barrier to overcome.[31] A copy of the used (Arabic) questionnaire can be found in online supplementary material (5).

To ensure common understanding and acceptability, an interview recording was undertaken in Muscat in 25 randomly selected adult with type 2 diabetes (population of interest) outside the sampled health centres of the study. Results were discussed and reviewed by the investigation team and an independent statistician.

Based on the data from the current study, the scale quality (27 item study questionnaire) including internal consistency reliability measures were investigated through the use of factor analysis using SPSS v22 and supported by McDonald's coefficient omega using the free and open source R. [34 35]

Study size

Power analysis was performed to estimate the prevalence of meeting PA recommendations in adult population with T2D in a parallel study conducted in the same population.[36] We assumed that meeting PA recommendation is at least in part facilitated by reporting fewer barriers to PA[37] and used an estimated 15% prevalence of adequate PA in patients with diabetes, as reported in the 2008 Oman World Health Survey (OWHS).[38] Using 95% confidence limits, a response rate of 80%, and a precision of +/-4%, and smallest expected frequency of 15%, the calculated sample size was ~300 participants across primary health centres in Muscat region, the capital of Oman.

Training

A multidisciplinary team of two nurses, one senior dietician, one medical orderly and two doctors were recruited for data collection. A one day training on administration of the questionnaire was delivered by the national focal point on PA in Oman Ministry of Health. Data entry, cross-checking and cleaning was done through Epi Info™ 7 by an independent personnel. Entered data was transferred to SPSS v22 for analysis and subsequent results.

Statistical methods

Descriptive statistics were expressed as percentages and mean (SD), median (quartiles) to describe the study sample characteristics. Sum of scores from the three related questions per category (range from 0-9) were expressed as median (LQ, UQ). Correlations between the sum of scores of the nine barrier categories were tested. Furthermore, data were dichotomised to scores <5 and ≥ 5 to determine the highly reported barriers as advised in the CDC questionnaire and practised in a study in Saudi Arabia.[31] Chi-square analysis was carried out to identify with the distribution of the high barrier scores (≥5) across the independent sociodemographic factors including gender (male vs female); age (to ensure sufficient power and adequate numbers for further statistical analysis the population was divided by the mean age ≤57 vs < 57 years); marital status (currently unmarried vs married); education (those unable to read or write ("uneducated") vs. those having attended primary school or beyond ("educated"); household income (<500 vs ≥500 Omani rials - 'OR'); and employment (unemployed, including those retired vs employed). Self-reported stage of change in PA was expressed as one of two categories: inactive if reporting "pre-contemplation" or "contemplation" and potentially active if reporting being at "preparation", "action", or

"maintenance" stages of PA. Corrected P-values (Yate's continuity) were reported for high barrier scores against the studied independent variables.

Factor analysis namely principal components analysis (PCA) was performed to identify composite scores for the components underlying the items/questions in the study scale. Eigenvalues values of ≥1.0 were used to determine the number of components in the overall factor analysis which are considered statistically sound.[39] Furthermore, factor loading matrix was examined using Oblimin rotation [40] where correlations between the extracted components were obtained.

RESULTS

Socio-demographic

Out of 312 patients approached, 305 (98%) completed the questionnaire. Slightly more females were represented in this sample (57.4%) than males. The population was slightly older with mean (SD) age of 57(10.8) years. Additionally, more than two-thirds being married (78.8%) and just about half unable to read or write (48.9%). More than a third of the study population (39.3%) reported household income of <500 OR (less than national average) [41] and the majority (77%) reported unemployment (including retirement). More males than females were educated (70% vs 37%) and employed (45% vs 7%) (Table 1).

Physiological status

Median (LQ, UQ) duration of diabetes in this population was 6.0 (4.0, 10.0) years. The majority of the participants had hypertension (n=217, 71%) or/and hyperlipidaemia (n=189, 62%) coinciding with their diabetes. All of them were using anti-hypertensive or/and lipid lowering medications as appropriate. More than three-quarters of those taking anti-hypertensives (78%) and two-thirds of those using lipid lowering drugs

(66%) had blood pressure (BP) readings and fasting serum cholesterol within target levels (BP<140/80 mmHg and fasting serum cholesterol of <5mmol/l).[42] Fifteen percent (n=45) were controlling their diabetes by diet alone versus 85% (n=260) on oral anti-hypoglycaemic medications, in which 25% (n=75) were additionally on insulin. Mean (SD) BMI was 31.0 (6.0) kg/m^2 where 89% (n=271) had BMI >25kg/m^2 in which 50% (n=153) were obese (BMI>30 kg/m^2) and 39% (n=118) were overweight (BMI>25-29.99 kg/m^2). Glycated haemoglobin HbA1c was >7% (>48 mmol/mol) in more than half of the population (58%) indicating poor diabetes control (Table 1).

Self-reported stages of PA

Only 17% (n=52) of participants considered themselves actively participating in regular moderate or vigorous PA (22% of males vs 13% of females). Of the remainder, the majority reported being "not ready" (37%), "getting ready" (31%) or in "preparation" (15%) (Table 1).

Table 1: Selected participants characteristics

Population characteristics	Total population n=305(100%)
Gender	
Male	130(42.6)
Female	175(57.4)
Age (years)	
≤57	155(51)
>57	150(49)
Marital status	
Currently unmarried	65(21)
Currently married	240(79)
Education	
Not educated	149(49)
Educated	156(51)
Income	
<500 OR	120(39)
≥500 OR	185(61)
Employment	
Not employed	234(77)
Employed	71(23)

Physiological	
Duration of diabetes (years)	Median (LQ, UQ) 6(4, 10)
Self-reported comorbidities*	
Yes	277(91)
No	28 (9)
Current medication	
Anti-HTN	217(71)
Lipid lowering drugs	189(62)
Oral-hypoglycaemic drugs	260(85)
Oral-hypoglycaemic drugs with Insulin	75(25)
Diet control	45(15)
Blood pressure (systolic/diastolic) mmHg**	
Within target (<140/<80)	237(78)
High (≥140/≥80)	68(22)
Fasting lipid profile (mmol/l)**	
Cholesterol within target (< 5.0)	201(66)
Cholesterol high (≥5.0)	104(34)
Body Mass Index (kg/m2)**	
Healthy weight range (18.5-24.99)	34(11)
Overweight (>25-29.99)	118(39)
Obese (>30)	153(50)
HbA1c(%)**(>48 mmol/mol)	
Normal ≤7%	127(42)
High >7%	178(58)
Self-reported stages of PA	
Not ready (Pre-contemplation)	112(37)
Getting ready(contemplation)	95(31)
Preparation	46(15)
Action	14(5)
Maintenance	38(12)

*Reported hypertension, hyperlipidaemia, thyroid dysfunction or any other chronic condition coinciding with diabetes. **Oman diabetes mellitus management guidelines (2015)[42]

CDC questionnaire on barriers to leisure PA

The majority of the population, 97.7% (n=298), reported at least one barrier to performing leisure physical activity median (LQ, UQ) was 6 (4, 7). Population distributions were not normal across all reported barrier categories. Median sum scores were all <5 as illustrated in (Figure 1). Except for reporting lack of willpower and lack of resources, 75% of sum scores of other reported barriers were ≤ 5.

INSERT FIGURE 1 ABOUT HERE

Categorizing barrier scores to <5 and ≥5 (significant barrier) highlighted that 'lack of willpower' (n=139), 'lack of resources' (n=93) and 'lack of social support' (n=89) were the most frequently reported 'significant barriers' to physical activity (Figure 2). Barriers found to be significant in both males and females were lack of willpower (41.5% m: 48.6% f) and lack of resources (32.3% m: 29.1% f). In addition, lack of time in males (26.9%) and lack of social support in females (35.4%) were also noteworthy (Table 2).

INSERT FIGURE 2 ABOUT HERE

Correlations between the sum scores of the nine studied barriers showed several weak (R<0.500) but significant (P-value <0.050) associations. Positive correlations of >0.400 were noted among lack of energy with lack of time; lack of skill with lack of social support; and lack of skills with lack of willpower (Table 2). Interestingly, no significant correlations were seen within the religious and environmental barriers except for one weak significant positive correlation between lack of resources and environmental barriers.

	Lack of	Lack of social	Lack of energy	Lack of willpower	Fear of injury	Lack of	Lack of resources	Religious barriers	Environmental barriers

	time	support				skill			
Lack of time	1.000	.134*	.464*	.118*	-.116*	.035	.013	-.092	.013
Lack of social support	.134*	1.000	.125*	.288*	.262*	.430*	.083	.011	.039
Lack of energy	.464*	.125*	1.000	.306*	-.013	.178*	.171*	-.070	.099
Lack of willpower	.118*	.288*	.306*	1.000	.058	.497*	.260*	-.112	.053
Fear of injury	-.116*	.262*	-.013	.058	1.000	.338*	-.218*	.032	-.090
Lack of skill	.035	.430*	.178*	.497*	.338*	1.000	.182*	-.052	.005
Lack of resources	.013	.083	.171*	.260*	-.218*	.182*	1.000	.038	.281*
Religious barriers	-.092	.011	-.070	-.112	.032	-.052	.038	1.000	.007
Environmental barriers	.013	.039	.099	.053	-.090	.005	.281*	.007	1.000

Table 2: Correlations between sum scores of barrier categories

*P-value <0.050

Distributions of significant high barrier score (≥5) across the studied sociodemographic factors and self-reported stages of change in PA differed among the nine barrier categories: "Lack of time" was frequently highly scored by males, younger adults and those who were married, employed or educated. Additionally, "Lack of social support" was highly scored by females and "Lack of energy" by employed, or educated adults. However, "Lack of willpower" was highly scored by individuals with lower income, or at inactive stages of PA. Moreover, "Fear of injury" was highly scored by older adults, unemployed, uneducated, or individuals reporting in-active stages of PA. Furthermore, "Lack of skills" was highly scored by females, younger adults, and unemployed or uneducated. "Lack of resources" on the other hand, was frequently highly scored by married adults or with lower income. It is notable that the religious and environmental barriers had no significant different distributions across any of the studied factors (Table 3).

Table 3: Distribution of high barrier scores (≥5) to leisure physical activity in adult population with type 2 diabetes across sociodemographic variables and self-reported stages of change in physical activity (n=305).

(%) Scores ≥ 5	Lack of time	Lack of social support	Lack of energy	Lack of willpower	Fear of injury	Lack of skills	Lack of resources	Religious barriers	Environmental barriers
Gender:									
Male	26.6	20.8	21.5	41.5	24.6	13.1	32.3	3.8	10.0
Female	15.4	35.4	16.0	48.6	26.3	28.0	29.1	4.6	13.1
Corrected x^2	5.4	7.1	1.2	1.2	0.04	8.9	0.2	0.001	0.4
(P-value)	(0.020)*	(0.008)*	(0.278)	(0.270)	(0.843)	(0.003)*	(0.640)	(0.981)	(0.508)
Age:									
<=57	27.7	26.5	21.3	45.8	18.7	16.1	33.5	4.5	12.3
>57	12.7	32.0	15.3	45.3	32.7	27.3	27.3	4.0	11.3
Corrected x^2	9.7	0.9	1.4	0.0	7.1	5.0	1.1	0.00	0.0
(P-value)	(0.002)*	(0.347)	(0.232)	(1.000)	(0.008)*	(0.025)*	(0.292)	(1.000)	(0.942)
Marital status:									
Unmarried	10.8	35.4	16.9	43.1	30.8	24.6	18.5	7.7	13.8
Married	22.9	27.5	18.8	46.3	24.2	20.8	33.8	3.3	11.3
Corrected x^2	3.9	1.2	0.0	0.1	0.9	0.2	4.9	1.4	0.1
(P-value)	(0.047)*	(0.277)	(0.875)	(0.753)	(0.356)	(0.626)	(0.026)*	(0.231)	(0.720)
Employment:									
Un-employed	12.4	31.6	14.5	47.0	29.5	25.6	31.6	4.7	11.5
Employed	46.5	21.1	31.0	40.8	12.7	8.5	26.8	2.8	12.7
Corrected x^2	37.0	2.4	8.8	0.6	7.2	8.5	0.4	0.1	0.0
(P-value)	(<0.001)*	(0.120)	(0.003)*	(0.437)	(0.007)*	(0.004)*	(0.527)	(0.740)	(0.960)
Education:									
Un-educated	11.4	33.6	13.4	45.6	35.6	28.2	29.5	6.0	10.7
Educated	28.8	25.0	23.1	45.5	16.0	15.4	31.4	2.6	12.8
Corrected x^2	13.2	2.3	4.1	0.0	14.2	6.6	0.1	1.5	0.1

(P-value)	(<0.001)*	(0.129)	(0.042)*	(1.0)	(<0.001)*	(0.010)*	(0.816)	(0.162)	(0.700)
Income:									
<500	16.7	26.7	21.7	54.2	20.8	23.3	40.0	5.8	8.3
>=500	22.7	30.8	16.2	40.0	28.6	20.5	24.3	3.2	14.1
Corrected x^2	1.3	0.4	1.1	5.3	1.9	0.2	7.7	0.6	1.8
(P-value)	(0.257)	(0.516)	(0.294)	(0.021)*	(0.163)	(0.663)	(0.005)*	(0.422)	(0.183)
Self-reported stages of PA:									
Not active	18.4	28.5	17.9	50.7	31.9	24.2	29.5	4.3	13.5
Active	24.5	30.6	19.4	34.7	12.2	16.3	32.7	4.1	8.2
Corrected x^2	1.2	0.1	0.0	6.2	12.5	2.0	0.2	0.00	1.4
(P-value)	(0.276)	(0.808)	(0.873)	(0.012)*	(<0.001)*	(0.161)	(0.667)	(1.0)	(0.244)

* Significant at P<0.050

Factor analysis and reliability test results

Initially, the factorability of the 27 items/questions was examined. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.711, above the commonly recommended value of 0.600. Bartlett's test of sphericity (test of at least one significant correlation between 2 of the items studied) was also significant (χ_2 (351) = 2600.175, p < .05).[43] The communalities (proportion of item's variance explained by the extracted factors) were all above 0.300, further confirming that each item shared some common variance with other items. Given these overall indicators, factor analysis was regarded to be suitable with all the 27 items/questions.

PCA indicated that the first eight components (1-8) with eigenvalues of ≥1, namely lack of resources, fear of injury, lack of time/ lack of energy, environmental barriers, religious barriers, lack of willpower/skills, lack of skills/ social support and lack of energy/social support, explained 13.1%, 11.4%, and 9.2%, 9.0%, 7.2%, 5.1%, 4.3% and 3.8% of the variance respectively.

None of the 27 items were eliminated because they all met a minimum criteria of having a primary factor loading (how much a factor explains a variable) of 0.4 or above. Solutions for the eight components were examined using Oblimin rotation of the factor loading matrix. The factor loading matrix for this final solution is presented in Table 4. All factor loadings were in the same direction of the barrier categories used in the current study where a set of three items instructed a barrier category except for items/questions related to lack of skills (Q20), lack of social support (Q16) and lack of energy (Q10) which loaded up with lack of willpower (Q18, 11& 4), lack of skills (Q6 & 13) and lack of social support (Q9) respectively indicating cross contributions. Component correlation matrix, presented (Table 5), shows week correlations between the extracted eight components <0.200 except for the negative correlation of 0.201

between component 2 (fear of injury) and 7 (combination of lack of skills and social support).

McDonald's coefficient Omega was equal to 0.750 indicating moderate reliability of the 27 items/questions scale.[39]

Table 4: The extracted components and factor loadings based on a principal components analysis with Oblimin rotation for the 27 items/questions used in the current study (N = 305)

Items/ questions	Extracted components (1-8)*							
	1	2	3	4	5	6	7	8
Q21	.784							
Q7	.772							
Q14	.721							
Q19		.871						
Q5		.813						
Q12		.776						
Q1			.748					
Q15			.745					
Q17			.719					
Q3			.593					
Q8								
Q24				.922				
Q26				.909				
Q22				.837				
Q25					.899			
Q23					.870			
Q27					.774			
Q20						-.784		
Q18						-.764		
Q11						-.681		
Q4						-.577		
Q16							-.787	
Q13							-.705	
Q6							-.514	
Q2								
Q9								.818
Q10								.604

*1=lack of resources, 2=fear of injury, 3=lack of time/ lack of energy, 4=environmental barriers, 5=religious barriers, 6=lack of willpower/skills, 7=lack of skills/ social support and 8=lack of energy/social support.

Table 5: Component correlation matrix

Extracted components*	1	2	3	4	5	6	7	8
1	1.000	-.154	.007	.047	-.042	-.176	.002	.004
2	-.154	1.000	-.086	-.018	.011	-.052	-.201	-.005
3	.007	-.086	1.000	.060	-.116	-.120	-.044	.155
4	.047	-.018	.060	1.000	.008	-.020	-.009	.049
5	-.042	.011	-.116	.008	1.000	.081	-.018	-.029
6	-.176	-.052	-.120	-.020	.081	1.000	.189	-.144
7	.002	-.201	-.044	-.009	-.018	.189	1.000	-.140
8	.004	-.005	.155	.049	-.029	-.144	-.140	1.000

*1=lack of resources, 2=fear of injury, 3=lack of time/ lack of energy, 4=environmental barriers, 5=religious barriers, 6=lack of willpower/skills, 7=lack of skills/ social support and 8=lack of energy/social support.

Further Factor analysis and reliability tests were conducted on the studied barrier subscales (3 questions per barrier). Table 6 provide factor loadings and McDonald's coefficient Omega for all the nine subscales used in the current study indicating excellent sub-scale quality.

Table 6: Factor loadings and McDonald's coefficient Omega for the study subscales

Barrier categories	Items/questions	factor loadings	Omega
Lack of time	Q15	0.826	0.900
	Q1	0.798	
	Q8	0.618	
Lack of social support	Q16	0.734	0.900
	Q2	0.680	
	Q9	0.534	
Lack of energy	Q3	0.755	0.900
	Q17	0.720	
	Q10	0.581	
Lack of willpower	Q18	0.837	0.900
	Q4	0.746	
	Q11	0.691	
Fear of injury	Q19	0.904	0.900
	Q12	0.823	
	Q5	0.803	
Lack of skills	Q6	0.840	0.900
	Q13	0.646	
	Q20	0.560	
Lack of resources	Q7	0.837	0.900
	Q21	0.831	
	Q14	0.754	
Religious barriers	Q25	0.905	0.900
	Q23	0.872	
	Q27	0.786	

Environmental barriers	Q24	0.924	0.900
	Q26	0.913	
	Q22	0.847	

DISCUSSION

Despite evidence on the effectiveness of meeting PA levels in the management of T2D, and associated cardiovascular risk factors, [6 7] PA is poorly addressed in routine diabetes care.[44] Low PA levels in populations with T2D are consistently reported in western countries, for example, USA[45] as well as Arabic speaking countries namely Oman, Saudi Arabia and Lebanon.[2 46 47] Addressing perceived barriers to performing recommended PA levels in this population is crucial for planning effective PA promoting interventions.

Within a series of formative studies to inform a culturally congruent PA intervention in diabetes care,[48] this study has looked at perceived barriers to performing leisure time physical activity in an adult population with T2D attending primary care using an adapted CDC questionnaire translated to Arabic language.[14]

The current findings relating to willpower, resources and social support were also reported as the top three barriers to PA in the Saudi population attending primary care by AlQuaiz (2009).[14] In the West, USA in particular, the strongest reported barriers to physical activity among adults with T2D were pain (41%), followed by lack of willpower (27%), and poor health (21%).[49]

In the current study, lack of willpower was significantly highly reported by individuals with low income. This finding is difficult to interpret in the absence of true verifications for the self-reported house hold income. However low income could be linked to financial constraints which were reported to have negative influence on intention to participate in leisure-time physical activity in adult population with T2D in Canada.[50] Additionally in a study in USA, older individuals with low income who were found to

be depressed had had low participation in social activities had less odds of engaging in PA.[51] None the less, more evidence is needed to explain how income alters the willpower for performing leisure PA in Arabic speaking countries namely Oman. Comparably, lack of willpower was more likely to be reported by individuals at inactive stages of physical activity (pre-contemplation or contemplation stages of physical activity) than those in active stages. Progressive stages of behavioural change according to the trans-theoretical model were direct correlates to PA in a review article by Trost (2002)[52] and direct determinants in another by Van Stralen (2009).[53] This finding supports the need for programs to help raise self-willpower/determination through stepped process of behaviour change from inactive (pre-contemplation) to active stages of PA (action and maintenance).[54] Interestingly, fear of injury was the only other reported barrier significantly different between individuals at inactive vs active stages of change in PA. This could be explained by possible physical constraints pertaining to older age[51] and existing comorbidities in the current study population triggering fear of injuries associated with PA.

Limited resources including high cost and limited facilities for PA have been reported as significant barriers to PA across different cultures.[20 22] In the current study, limited resources were reported as significant by individuals who were married and those with low income. Married individuals could have more financial commitments to their families especially in the Gulf Cooperation Council countries where extended families are common.[55] This may alter an individual's priorities for house-hold income expenditure. Low income was similarly reported as a barrier in a Saudi population, possibly due to the perceived high cost of utilising PA facilities.[14] This may reflect a narrow view on what constitutes PA and a misconception that expensive equipment is required. Hence, irrespective of culture, interventions promoting cost neutral PA such as walking in populations would be highly desirable to overcome this barrier.[48 56]

Lack of social support was frequently reported by females in this study. Meeting cultural norms and social expectations related to safety, security and conservative dress mainly for females were reported as barriers to PA in South Asian (Pakistani and Indian) British populations[18 21] and populations in Arabic counties such as Qatar.[57] Evaluation of interventions to provide the necessary social support and networks to PA specifically for women with T2D, particularly in the countries of the Gulf Cooperation Council are warranted. Activities including group-based activities and buddying,[58-60] are worth further investigation.

Other reported barriers such as fear of injury and lack of skills varied across subgroups in particular, older, unemployed, and uneducated individuals. Older individuals with T2D are more vulnerable to have poor vision and osteoarthritic changes that may cause fall and injuries.[61] Moreover the negative influence of pain to PA in older population with T2D was reported in western countries,[49] and hence potential barriers to individuals' participation. These results suggest that programs to promote PA should be individualized for type, frequency and intensity of PA and incorporate safety measures to prevent PA induced pain and injuries in older individuals.[62]

Lack of time on the other hand, has been a highly cited barrier to PA in the general population as well as populations with diabetes.[15-18 21 22 49 63] However, unlike the study by Alquaiz (2009), significant scores for lack of time in this study were higher in males compared to females[14] along-with a lack of energy, which may be a reflection of the fact that more males than females were educated and employed. This perception of 'lack of time', in addition to family and social commitments may jeopardized their time for PA especially if individuals were younger and married. This discussion highlights the importance of changing people's perceptions of PA but also consideration of opportunities in other PA domains namely work and travel that could enable individuals with less leisure time to increase overall PA and behaviour.

Factors which are independent of an individual's decision-making, such as environment and religion had no significant associations in the current study despite the hot weather during data collection of this study in April/May. These null results, may be real or may be due to the wording of the questions and their interpretation. To address this gap in the literature, a qualitative exploration of possible environmental, including seasonal variations, and religious factors affecting PA performance may be warranted.

Additionally, results of this study cannot be generalised across all regions in Oman. More information is required from rural Omani communities where perceptions on PA may be different. Despite the excellent scale reliability measures in the current data, the results cannot be generalized due to possible differences in scale quality across various data.[39] Despite efforts to minimize potential bias due to the subjective nature of self-reports, accuracy of outcomes cannot be fully ensure. Moreover, due to the cross-sectional design of this study, causal inferences cannot be drawn.

Finally, future attempts to explore barriers to PA should equally include work and travel domains to cater for diversities in both PA behaviour and sedentary lifestyle across subgroups of adults with T2D.

CONCLUSION

This study identified lack of willpower, low resources and low social support (especially in females) as the most common barriers to performing leisure PA. Overall, the findings suggest that the design of physical activity interventions should consider a) the inclusion of individuals' readiness to change b) options for PA resources and social support c) approaches aimed at increasing individuals' understanding of what constitutes PA and d) methods that are flexible and tailored to the specific needs of subgroups of adults with T2D.

ETHICAL CONSIDERATION

Ethical approval was obtained from the Regional Research Committee in Muscat, Oman Ministry of Health. All eligible participants provided informed consent prior to data collection. For illiterate individuals, consents to participate in this study were provided by their accompanying support member (spouse, son or daughter).

COMPETING INTERESTS

The authors declare that they have no competing interests.

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AUTHORS' CONTRIBUTION

TS is the principal investigator in charge of the project. SM, YA, EB, AC and ASA have all been involved in designing the intervention and the evaluation. TS prepared the initial draft of the manuscript and all other authors have contributed. All authors have critically reviewed and approved the final version of the manuscript.

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DATA SHARING STATEMENT No additional data are available.

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Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high scores defined as ≥5)

Figure 2: Percentage of reported high barrier scores (≥5)

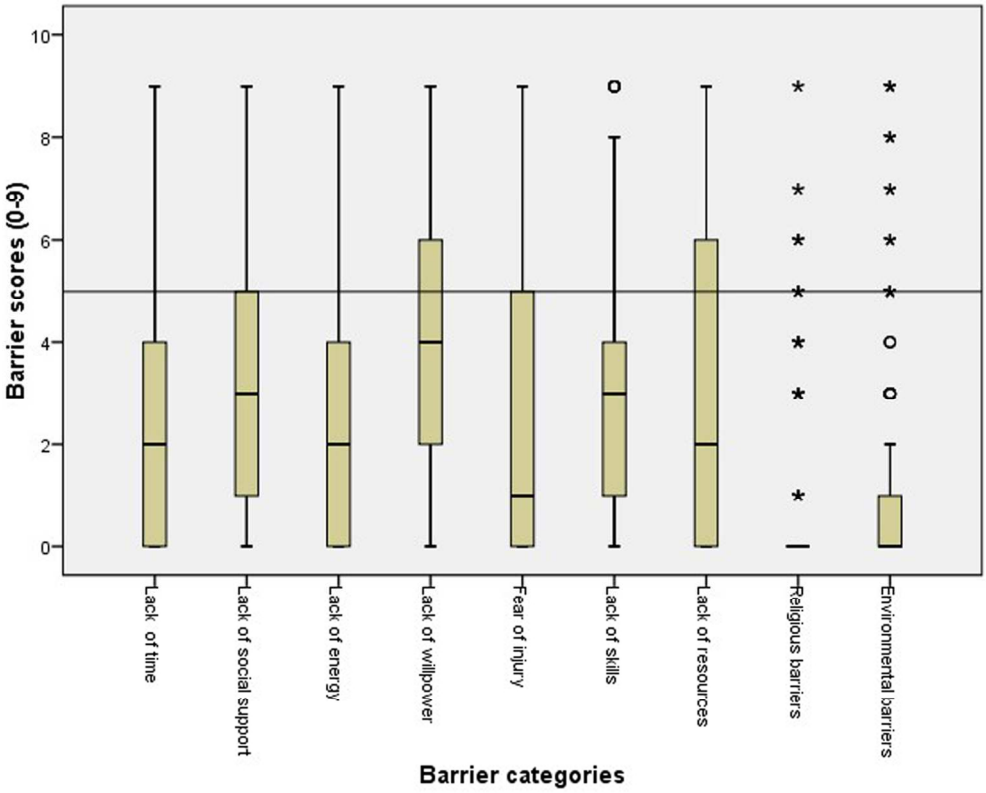

Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high scores defined as ≥5)

132x106mm (300 x 300 DPI)

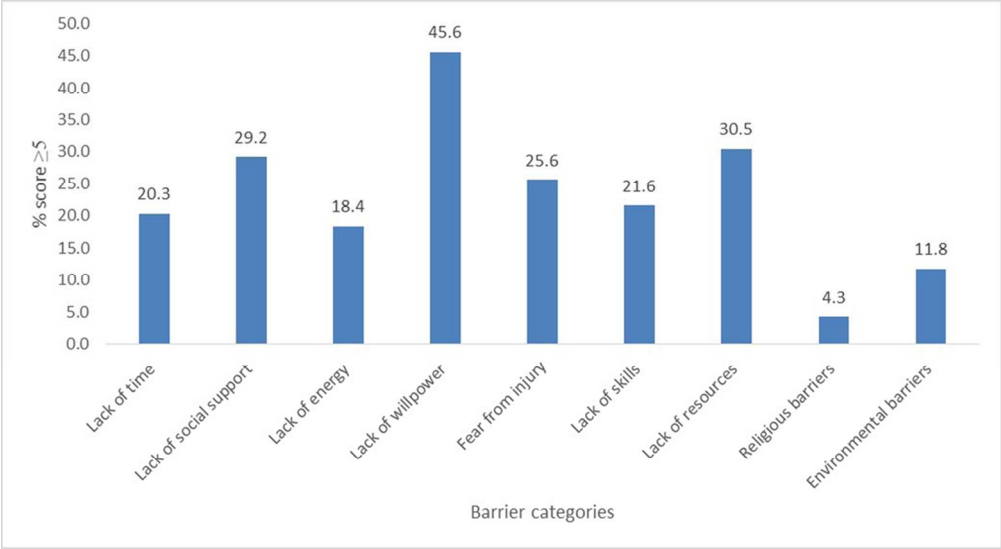

Figure 2: Percentage of reported high barrier scores (≥5)

96x53mm (300 x 300 DPI)

من فضلك أجب عن الأسئلة التالية					
		٣ نعم غالباً	٢ نعم أحياناً	١ لا نادراً	٠ لا أبداً
١	يومي مشغول جداً لذلك لا أستطيع أن أجعل لي وقت خاص بالتمارين ضمن جدولي اليومي				
٢	لا أحد من أفراد عائلتي أو أصدقائي يفضلون ممارسة الرياضة لذلك فأنى لا أجد فرصة لممارستها				
٣	أكون متعب جداً بعد العمل فلا أستطيع ممارسة الرياضة				
٤	كنت أفكر في زيادة التمارين الرياضية لكن لا يبدو أننى أستطيع البدء بذلك				
٥	أننى كبير في السن لذا فممارسة الرياضة تشكل خطرا على				
٦	لا أمارس الرياضة كثيرا وذلك لأنني لم أتعلم مهارات إي نوع من أنواع الرياضة				
٧	المسابح، المسارات، الدراجات ..... الخ غير متوفرة للاستخدام بالنسبة لي				
٨	ممارسة الرياضة تأخذ الكثير من وقت التزامات أخرى مثل وقت العمل والاسرة				
٩	أشعر بالخجل من منظري وأنا أمارس الرياضة مع الاخرين				
١٠	أنا لا أحصل على القدر المكافئ من النوم فلا أستطيع الاستيقاظ مبكراً أو البقاء في الليل لممارسة الرياضة				
١١	من الأسهل علي ايجاد عذر لعدم ممارسه الرياضه من الخروج لعمل شئ آخر				
١٢	أنا أعرف أناس كثيرين أذوا أنفسهم من كثرة ممارسة الرياضة				
١٣	أنا أرى أنه لا يمكن تعلم أي رياضه جديدة في مثل سني				
١٤	أن ممارسة الرياضة أمر مكلف جداً فيجب على شراء أدوات رياضيه أو أخذ دروس رياضيه				
١٥	وقت فراغي أثناء اليوم ضيق جداً لا يكفي لأداء التمارين الرياضية				
١٦	نشاطاتي الاجتماعية المعتادة مع العائلة والأصدقاء لا تتضمن أي نشاط رياضي				
١٧	أنا متعبة جداً خلال أيام الأسبوع واحتاج أيام العطلة للراحة وليس للرياضة				
١٨	أريد ان أمارس المزيد ولكن يبدوا أننى لا أستطيع أن استمر على شيء معين				
١٩	أخاف ان أوذى نفسي او أصاب بأزمه قلبيه				
٢٠	ليس لدي القدرة الكافية لتحويل ممارسة الرياضة لمتعه				
٢١	لو كانت هناك أجهزه رياضية وغرف للاستحمام في موقع العمل لكان من الأرجح ان أقوم بالتمارين الرياضية				
٢٢	معتقداتي الدينيه لا تسمح لي بممارسه النشاط البدني				
٢٣	الطقس (الحراو البرد الشديدين) لا يسمح لي بممارسه النشاط البدني				
٢٤	الملابس الرياضيه غير لا تتناسب مع مجتمعنا				
٢٥	النشاط البدني في الصيف غير مناسب لي				
٢٦	أخلاقياتي الدينيه لا تسمح لي بممارسه النشاط البدني				
٢٧	البيئه المحيطه لا يسمح لي بممارسه النشاط البدني				

STROBE Statement—checklist of items that should be included in reports of observational studies

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Perceived barriers to leisure time physical activity in adults with type 2 diabetes attending primary health care in Oman: a cross-sectional survey

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TRANSPARENCY DECLARATION: This manuscript is an honest, accurate, and transparent account of the study being reported. There are no important aspects of the study that are omitted; and any possible discrepancies from the study are explained.

TECHNICAL APPENDIX: Data generated from this study is not available for public use. However it is available from the corresponding author on reasonable request and approvals from Oman Ministry of Health.

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CONFLICTS OF INTEREST: No competing interests.

ABSTRACT

Objectives: Physical activity is fundamental in diabetes management for good metabolic control. This study aimed to identify barriers to performing leisure time physical activity and explore differences based on gender, age, marital status, employment, education, income and perceived stages of change in physical activity in adults with type 2 diabetes in Oman.

Design: Cross-sectional study using an Arabic version of the "Barriers to Being Active" 27 item questionnaire.

Setting: Seventeen primary health centres randomly selected in Muscat.

Participants: Individuals >18 years with type 2 diabetes, attending diabetes clinic for > 2 years and with no contraindications to performing physical activity.

Primary and secondary outcome measures:

Participants were asked to rate how far different factors influenced their physical activity, under the following categories: fear of injury, lack of time, social support, energy, willpower, skills, resources, religion and environment. On a scale of 0-9, barriers were considered important if scored ≥5.

Results: A total of 305 questionnaires were collected. Most (96%) reported at least one barrier to performing leisure time physical activity. Lack of willpower (44.4%), lack of resources (30.5%) and lack of social support (29.2%) were the most frequently reported barriers. Using chi-square test, lack of willpower was significantly different in individuals with low vs high income (54.2% vs 40%, *P*=0.002) and in those reporting inactive vs active stages of change for physical activity (50.7% vs 34.7%, *P*=0.029), lack of resources was significantly different in those with low vs high income (40% vs

24.3%, *P*=0.004) and married vs unmarried (33.8% vs 18.5%, *P*=0.018). Lack of social support was significant in females vs males (35.4% vs 20.8%, *P*=0.005).

Conclusions: The findings can inform the design on physical activity intervention studies by testing the impact of strategies which incorporate ways to address reported barriers including approaches that enhance self-efficacy and social support.

Key words: Physical Activity, Type 2 diabetes, Primary health care, Barriers, Oman

ARTICLE SUMMARY

Strengths and limitations of this study

- Barriers to performing leisure physical activity for adults with type 2 diabetes were investigated in Oman where prevalence of both diabetes and physical inactivity is high.
- Questions on possible barriers to performing physical activity linked to religion and environment were included.
- The tool used in this study was an English to Arabic language translated questionnaire that may have affected the validity of questions.

INTRODUCTION

Oman is located in Southwest Asia on the Southeast coast of the Arabian Peninsula. Similar to its neighbouring countries (United Arab Emirates, Saudi Arabia, Qatar, Bahrain, and Kuwait), Oman has witnessed enormous economic advancement in recent decades, along with significant increases in non-communicable diseases including a rising prevalence of diabetes. Diabetes prevalence in Oman has increased from 8.3% in 1991 to 12.3% in 2008 and recent estimates are in the order of 14.8%, exceeding global rates.[1 2] The World Health Organization (WHO) has indicated that physical inactivity is one of the top ten leading global causes of mortality and disability worldwide, and the principal cause for approximately 27% of diabetes, and approximately 30% of ischemic

heart disease.[3] In Oman, it has been reported that almost 70% of the population are physically inactive (daily activity of ≤10 minutes).[4] This raises concerns regarding the impact these high levels of physical inactivity may be having on lifestyle related chronic diseases including diabetes, on health care expenditures and overall population health.[5]

The protective effects of physical activity (PA) in the management of diabetes, specifically type 2 diabetes (T2D), have been widely reported.[6 7] WHO recommends at least 150 minutes of moderate to vigorous physical activity or 75 minutes of vigorous PA/week.[8] However, over 60% of patients with diabetes in western countries do not meet the recommended levels of PA.[9 10] The Oman World Health Survey (OWHS) 2008, reported that in Oman, only 15% of patients with diabetes (98% of them with type 2 diabetes) met PA recommendations using the Global Physical Activity Questionnaire (GPAQ).[2]

The importance of leisure time PA in meeting PA recommendations is consistently[11] associated with reduced mortality risks (20% to >37% risk reduction) and favourable cardiovascular outcomes.[12] This relationship appears to have a dose-response effect where the upper threshold for mortality benefit occurs at 3 to 5 times the leisure PA recommendations of 7.5-<15 MET h/wk.[12] No clear association is observed for occupational or travel physical activity.[13]

Theoretical models underpinning effective interventions to promote personalized PA (contents, methods and approaches) should focus on benefits and ways to overcome barriers to PA.[14] Literature to date mainly from western countries has reported a number of potential barriers to performing PA in adults with diabetes. These include lack of time,[15-18] physical constrains including pain,[19] lack of knowledge and limited facilities.[20] Differences in reporting barriers to PA have been noted across genders, age groups, environments, cultures and disease status. Female gender, increasing age, unsafe neighbourhoods, being overweight and being a smoker increased the odds of reporting

barriers to PA among migrant populations like African Americans, South Asian British and Mexican Americans.[21-23] In the Arab countries, modest evidence on barriers to PA in both the general population and in adults with T2D suggests that lack of time, co-existing diseases and adverse weather conditions[14 24-29] are the main factors. Moreover, the climate in this region may be a drawback to meeting recommended levels of PA due to high temperatures during the day, particularly in the sandy/desert areas. During the summer months, these countries including Oman experience major heat waves (>40 degrees celsius) and humidity levels that could reach 90%.

The current study aimed to identify barriers to performing leisure-time PA in adults with T2D in Oman, and the distribution of barrier scores across different socio-demographic characteristics and perceived stages of change in PA.

METHODS

Study design, setting and participants

This cross-sectional interview based study was part of a larger study that examined correlates of physical activity and sitting time in adults with type 2 diabetes, and barriers to leisure physical activity in the same population. Results regarding the PA patterns of the population using the Global Physical Activity Questionnaire are reported elsewhere.[30] This current paper identified barriers to performing leisure physical activity expressed by Omani adults with T2D using adapted questions from the Centers for Disease Control and Prevention (CDC) questionnaire[31] conducted in April/ May 2015 in Muscat (Urban communities). Reporting of this study follows the guidelines for strengthening the reporting of observational studies in epidemiology (STROBE).[32]

All patients with T2D attending their routine diabetes clinics in 17 randomly selected primary health care centres in Muscat were approached to take part in the study. Inclusion criteria were age >18 years and being followed up in a diabetes clinic for >2 years and ability to provide informed consent. For illiterate participants, informed consents were taken from their spouse, son, daughter or other close family member. Participants with type 1 diabetes, newly diagnosed (<6 months) or who had difficulty in performing any physical activity, including history of myocardial infarction of <6 months and multiple organ failure, were excluded.

Data sources/ measurement

In addition to recording physiological data [Body Mass Index (BMI), medication, duration of diabetes, blood pressure (BP), lipid profile, and comorbidities coinciding with diabetes] from the electronic health system, a multi-section questionnaire with a range of answers in closed format was administered by a trained interviewer. The following information was collected:

Socio-demographic data: included gender, age, marital status, education, household income, and employment.

Perceptions on stage of change in physical activity: Based on the trans-theoretical theory of behaviour change,[33] subjects were asked to identify their perceived stage of change in physical activity. Participants were to select "Maintenance stage" if they were participating in moderate physical activity five or more times per week or in vigorous activity three to five times per week longer than six consecutive months or select "Action stage" if less than six months. "Preparation stage" was selected by subjects who were thinking about starting exercise such as walking in the near future, or doing vigorous activity less than three times per week, or moderate activity less than five times per week. Contemplation stage "getting ready" was selected by subjects who were

thinking about starting exercise or walk in the next six months. Subjects who were not thinking about starting any PA in the near future selected pre-contemplation stage "not ready".

CDC questionnaire on barriers to leisure PA:

An English to Arabic translated CDC questionnaire "Barriers to Being Active" was used in a study in Saudi Arabia[14] with 21 questions on seven barriers (lack of time, lack of social support, lack of energy, lack of willpower, fear of injury, lack of skill and lack of resources). Permission to use the questionnaire was obtained from the lead author on November 24, 2014 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2813614/figure/F0001/). However, in that tool no statements on religion or environment as possible barriers to PA were included. To address this gap and to formulate robust items on these topics we undertook several procedures. Literature search was conducted to identify possible content for the new items from similar studies in neighbour countries with similar socio-economical characteristics.[28 29] Potential religious barriers considered questions on religious beliefs restricting PA, accepted clothing for PA and religious perceptions on PA.[14 25 26] Potential environmental barriers included questions on extreme weather conditions, physical activity in summer time and availability of appropriate environment for PA.[16 25] Content and face validity of the questionnaire were assessed by our investigatory team and draft questions were then discussed with a sample of patients prior to field testing and adjustments were made to ease comprehension and ensure translation to Arabic was appropriate.

A set of three related questions (total of 27 questions) presented in random order within the questionnaire represented one barrier category. A scoring system[31] was used to indicate how likely each statement/item was considered to be a barrier (very likely=3, somewhat likely=2, somewhat unlikely=1, very unlikely=0). Scores of the three theme-

related questions were added up to provide a total for each category of barriers. Possible scores for each barrier category ranged from 0-9. A score of ≥ 5 was considered as an important barrier to overcome.[31] A copy of the used (Arabic & English) questionnaire can be found in online supplementary material (1&2).

To ensure common understanding and acceptability, an interview recording was undertaken in Muscat in 25 randomly selected adult with type 2 diabetes (population of interest) outside the sampled health centres of the study. Results were discussed and reviewed by the investigation team and an independent statistician.

Based on the data from the current study, the scale quality (27 item study questionnaire) including internal consistency reliability measures were investigated through the use of factor analysis using SPSS v22 and supported by McDonald's coefficient omega using the free and open source R. [34 35]

Study size

Power analysis was performed to estimate the prevalence of meeting PA recommendations in adult population with T2D in a parallel study conducted in the same population.[36] We assumed that meeting PA recommendation is at least in part facilitated by reporting fewer barriers to PA[37] and used an estimated 15% prevalence of adequate PA in patients with diabetes, as reported in the 2008 Oman World Health Survey (OWHS).[38] Using 95% confidence limits, a response rate of 80%, and a precision of +/-4%, and smallest expected frequency of 15%, the calculated sample size was ~300 participants across primary health centres in Muscat region, the capital of Oman.

Training

A multidisciplinary team of two nurses, one senior dietician, one medical orderly and two doctors were recruited for data collection. A one day training on administration of the questionnaire was delivered by the national focal point on PA in Oman Ministry of Health. Data entry, cross-checking and cleaning was done through Epi Info™ 7 by an independent personnel. Entered data was transferred to SPSS v22 for analysis and subsequent results.

Statistical methods

Descriptive statistics were expressed as percentages and mean (SD), median (quartiles) to describe the study sample characteristics. Sum of scores from the three related questions per category (range from 0-9) were expressed as median (LQ, UQ). Correlations between the sum of scores of the nine barrier categories were tested. Furthermore, data were dichotomised to scores <5 and ≥ 5 to determine the highly reported barriers as advised in the CDC questionnaire and practised in a study in Saudi Arabia.[31] Chi-square analysis was carried out to identify with the distribution of the high barrier scores (≥5) across the independent sociodemographic factors including gender (male vs female); age (to ensure sufficient power and adequate numbers for further statistical analysis the population was divided by the mean age ≤57 vs < 57 years); marital status (currently unmarried vs married); education (those unable to read or write ("uneducated") vs. those having attended primary school or beyond ("educated"); household income (<500 vs ≥500 Omani rials - 'OR'); and employment (unemployed, including those retired vs employed). Self-reported stage of change in PA was expressed as one of two categories: inactive if reporting "pre-contemplation" or "contemplation" and potentially active if reporting being at "preparation", "action", or

"maintenance" stages of PA. Corrected P-values (Yate's continuity) were reported for high barrier scores against the studied independent variables.

Principal components analysis (PCA) was performed to identify composite scores for the components underlying the items/questions in the study scale. A nine factor solution was used to investigate the contributions of the 27 item/questions to the nine barrier categories.[39] Furthermore, factor loading matrix was examined using Oblimin rotation [40] where correlations between the extracted components were obtained.

RESULTS

Socio-demographic

Out of 312 patients approached, 305 (98%) completed the questionnaire. Slightly more females were represented in this sample (57.4%) than males. The population was slightly older with mean (SD) age of 57(10.8) years. Additionally, more than two-thirds being married (78.8%) and just about half unable to read or write (48.9%). More than a third of the study population (39.3%) reported household income of <500 OR (less than national average) [41] and the majority (77%) reported unemployment (including retirement). More males than females were educated (70% vs 37%) and employed (45% vs 7%) (Table 1).

Physiological status

Median (LQ, UQ) duration of diabetes in this population was 6.0 (4.0, 10.0) years. The majority of the participants had hypertension (n=217, 71%) or/and hyperlipidaemia (n=189, 62%) coinciding with their diabetes. All of them were using anti-hypertensive or/and lipid lowering medications as appropriate. More than three-quarters of those taking anti-hypertensives (78%) and two-thirds of those using lipid lowering drugs (66%) had blood pressure (BP) readings and fasting serum cholesterol within target

levels (BP<140/80 mmHg and fasting serum cholesterol of <5mmol/l).[42] Fifteen percent (n=45) were controlling their diabetes by diet alone versus 85% (n=260) on oral anti-hypoglycaemic medications, in which 25% (n=75) were additionally on insulin. Mean (SD) BMI was 31.0 (6.0) kg/m^2 where 89% (n=271) had BMI >25kg/m^2 in which 50% (n=153) were obese (BMI>30 kg/m^2) and 39% (n=118) were overweight (BMI>25-29.99 kg/m^2). Glycated haemoglobin HbA1c was >7% (>48 mmol/mol) in more than half of the population (58%) indicating poor diabetes control (Table 1).

Self-reported stages of PA

Only 17% (n=52) of participants considered themselves actively participating in regular moderate or vigorous PA (22% of males vs 13% of females). Of the remainder, the majority reported being "not ready" (37%), "getting ready" (31%) or in "preparation" (15%) (Table 1).

Table 1: Selected participants characteristics

Population characteristics	Total population n=305(100%)
Gender	
Male	130(42.6)
Female	175(57.4)
Age (years)	
≤57	155(51)
>57	150(49)
Marital status	
Currently unmarried	65(21)
Currently married	240(79)
Education	
Not educated	149(49)
Educated	156(51)
Income	
<500 OR	120(39)
≥500 OR	185(61)
Employment	
Not employed	234(77)
Employed	71(23)
Physiological	
Duration of diabetes (years)	Median (LQ, UQ)

	6(4, 10)	
Self-reported comorbidities*		
Yes	277(91)	265
No	28 (9)	266
Current medication		
Anti-HTN	217(71)	269
Lipid lowering drugs	189(62)	270
Oral-hypoglycaemic drugs	260(85)	271
Oral-hypoglycaemic drugs with Insulin	75(25)	272
Diet control	45(15)	273
Blood pressure (systolic/diastolic) mmHg**		274
Within target (<140/<80)	237(78)	277
High (≥140/≥80)	68(22)	278
Fasting lipid profile (mmol/l)**		
Cholesterol within target (< 5.0)	201(66)	281
Cholesterol high (≥5.0)	104(34)	282
Body Mass Index (kg/m2)**		
Healthy weight range (18.5-24.99)	34(11)	285
Overweight (>25-29.99)	118(39)	286
Obese (>30)	153(50)	287
HbA1c(%)**(>48 mmol/mol)		288
Normal ≤7%	127(42)	290
High >7%	178(58)	291
Self-reported stages of PA		
Not ready (Pre-contemplation)	112(37)	293
Getting ready(contemplation)	95(31)	294
Preparation	46(15)	295
Action	14(5)	296
Maintenance	38(12)	297
		298
		299

*Reported hypertension, hyperlipidaemia, thyroid dysfunction or any other chronic condition coinciding with diabetes. **Oman diabetes mellitus management guidelines (2015)[42]

300 **CDC questionnaire on barriers to leisure PA**

301 For the 27 items/questions scale, McDonald's coefficient Omega was equal to 0.750
302 indicating moderate reliability of the scale.[39] Further, PCA analysis with 9 components
303 solution generally supported the previous found subscales (three questions per barrier
304 category) in barriers to performing PA mainly component 2, 4, 5, 6, and 9 representing
305 fear from injury, environmental barriers, religious barriers, lack of willpower, and lack
306 of resources respectively (see supplementary materials 3). However, cross contributions
307 were evident in four out of the nine extracted components namely component 1 (lack of
308 willpower, time, energy and skills), component 3 (lack of time and energy), component

7 (lack of social support and skills), and component 8 (lack of social support and energy).

Each of the subscales for the nine studied barriers had good reliability [McDonald's coefficient Omega was equal to 0.900]. Based on this, further results are presented using sum scores.

The majority of the population, 97.7% (n=298), reported at least one barrier to performing leisure physical activity median (LQ, UQ) was 6 (4, 7). Population distributions were not normal across all reported barrier categories. Median sum scores were all <5 as illustrated in (Figure 1). Except for reporting lack of willpower and lack of resources, 75% of sum scores of other reported barriers were ≤ 5.

INSERT FIGURE 1 ABOUT HERE

Categorizing barrier scores to <5 and ≥5 (significant barrier) highlighted that 'lack of willpower' (n=139), 'lack of resources' (n=93) and 'lack of social support' (n=89) were the most frequently reported 'significant barriers' to physical activity (Figure 2). Barriers found to be significant in both males and females were lack of willpower (41.5% m: 48.6% f) and lack of resources (32.3% m: 29.1% f). In addition, lack of time in males (26.9%) and lack of social support in females (35.4%) were also noteworthy (Table 2).

INSERT FIGURE 2 ABOUT HERE

Correlations between the sum scores of the nine studied barriers were generally weak (R<0.200). Positive and significant correlations of >0.300 were noted among lack of energy with lack of time; lack of skill with lack of social support; lack of energy and lack of willpower; lack of skills with lack of willpower; and fear of injury with lack of

	Lack of time	Lack of social support	Lack of energy	Lack of willpower	Fear of injury	Lack of skill	Lack of resources	Religious barriers	Environmental barriers
Lack of time	1.000	.134*	.464*	.118*	-.116*	.035	.013	-.092	.013
Lack of social support	.134*	1.000	.125*	.288*	.262*	.430*	.083	.011	.039
Lack of energy	.464*	.125*	1.000	.306*	-.013	.178*	.171*	-.070	.099
Lack of willpower	.118*	.288*	.306*	1.000	.058	.497*	.260*	-.112	.053
Fear of injury	-.116*	.262*	-.013	.058	1.000	.338*	-.218*	.032	-.090
Lack of skill	.035	.430*	.178*	.497*	.338*	1.000	.182*	-.052	.005
Lack of resources	.013	.083	.171*	.260*	-.218*	.182*	1.000	.038	.281*
Religious barriers	-.092	.011	-.070	-.112	.032	-.052	.038	1.000	.007
Environmental barriers	.013	.039	.099	.053	-.090	.005	.281*	.007	1.000

skills (Table 2). Interestingly, no significant correlations were seen within the religious and environmental barriers except for one weak significant positive correlation between lack of resources and environmental barriers.

Table 2: Correlations between sum scores of barrier categories

*P-value <0.050

Distributions of significant high barrier score (≥5) across the studied sociodemographic factors and self-reported stages of change in PA differed among the nine barrier categories: "Lack of time" was frequently highly scored by males, younger adults and those who were married, employed or educated. Additionally, "Lack of social support" was highly scored by females and "Lack of energy" by employed, or educated adults. However, "Lack of willpower" was highly scored by individuals with lower income, or at inactive stages of PA. Moreover, "Fear of injury" was highly scored by older adults, unemployed, uneducated, or individuals reporting in-active stages of PA. Furthermore, "Lack of skills" was highly scored by females, younger adults, and unemployed or uneducated. "Lack of resources" on the other hand, was frequently highly scored by married adults or with lower income. It is notable that the religious and environmental

barriers had no significant different distributions across any of the studied factors (Table 3).

Table 3: Distribution of high barrier scores (≥5) to leisure physical activity in adult population with type 2 diabetes across sociodemographic variables and self-reported stages of change in physical activity (n=305).

(%) Scores ≥ 5	Lack of time	Lack of social support	Lack of energy	Lack of willpower	Fear of injury	Lack of skills	Lack of resources	Religious barriers	Environmental barriers
Gender:									
Male	26.6	20.8	21.5	41.5	24.6	13.1	32.3	3.8	10.0
Female	15.4	35.4	16.0	48.6	26.3	28.0	29.1	4.6	13.1
Corrected x^2	5.4	7.1	1.2	1.2	0.04	8.9	0.2	0.001	0.4
(P-value)	(0.020)*	(0.008)*	(0.278)	(0.270)	(0.843)	(0.003)*	(0.640)	(0.981)	(0.508)
Age:									
<=57	27.7	26.5	21.3	45.8	18.7	16.1	33.5	4.5	12.3
>57	12.7	32.0	15.3	45.3	32.7	27.3	27.3	4.0	11.3
Corrected x^2	9.7	0.9	1.4	0.0	7.1	5.0	1.1	0.00	0.0
(P-value)	(0.002)*	(0.347)	(0.232)	(1.000)	(0.008)*	(0.025)*	(0.292)	(1.000)	(0.942)
Marital status:									
Unmarried	10.8	35.4	16.9	43.1	30.8	24.6	18.5	7.7	13.8
Married	22.9	27.5	18.8	46.3	24.2	20.8	33.8	3.3	11.3
Corrected x^2	3.9	1.2	0.0	0.1	0.9	0.2	4.9	1.4	0.1
(P-value)	(0.047)*	(0.277)	(0.875)	(0.753)	(0.356)	(0.626)	(0.026)*	(0.231)	(0.720)
Employment:									
Un-employed	12.4	31.6	14.5	47.0	29.5	25.6	31.6	4.7	11.5
Employed	46.5	21.1	31.0	40.8	12.7	8.5	26.8	2.8	12.7
Corrected x^2	37.0	2.4	8.8	0.6	7.2	8.5	0.4	0.1	0.0
(P-value)	(<0.001)*	(0.120)	(0.003)*	(0.437)	(0.007)*	(0.004)*	(0.527)	(0.740)	(0.960)
Education:									
Un-educated	11.4	33.6	13.4	45.6	35.6	28.2	29.5	6.0	10.7
Educated	28.8	25.0	23.1	45.5	16.0	15.4	31.4	2.6	12.8
Corrected x^2	13.2	2.3	4.1	0.0	14.2	6.6	0.1	1.5	0.1

(P-value)	(<0.001)*	(0.129)	(0.042)*	(1.0)	(<0.001)*	(0.010)*	(0.816)	(0.162)	(0.700)
Income:									
<500	16.7	26.7	21.7	54.2	20.8	23.3	40.0	5.8	8.3
>=500	22.7	30.8	16.2	40.0	28.6	20.5	24.3	3.2	14.1
Corrected x^2	1.3	0.4	1.1	5.3	1.9	0.2	7.7	0.6	1.8
(P-value)	(0.257)	(0.516)	(0.294)	(0.021)*	(0.163)	(0.663)	(0.005)*	(0.422)	(0.183)
Self-reported stages of PA:									
Not active	18.4	28.5	17.9	50.7	31.9	24.2	29.5	4.3	13.5
Active	24.5	30.6	19.4	34.7	12.2	16.3	32.7	4.1	8.2
Corrected x^2	1.2	0.1	0.0	6.2	12.5	2.0	0.2	0.00	1.4
(P-value)	(0.276)	(0.808)	(0.873)	(0.012)*	(<0.001)*	(0.161)	(0.667)	(1.0)	(0.244)

* Significant at P<0.050

DISCUSSION

Despite evidence on the effectiveness of meeting PA levels in the management of T2D, and associated cardiovascular risk factors, [6 7] PA is poorly addressed in routine diabetes care.[43] Low PA levels in populations with T2D are consistently reported in western countries, for example, USA[44] as well as Arabic speaking countries namely Oman, Saudi Arabia and Lebanon.[2 45 46] Addressing perceived barriers to performing recommended PA levels in this population is crucial for planning effective PA promoting interventions.

Within a series of formative studies to inform a culturally congruent PA intervention in diabetes care,[47] this study has looked at perceived barriers to performing leisure time physical activity in an adult population with T2D attending primary care using an adapted CDC questionnaire translated to Arabic language.[14]

The current findings relating to willpower, resources and social support were also reported as the top three barriers to PA in the Saudi population attending primary care by AlQuaiz (2009).[14] In the West, USA in particular, the strongest reported barriers to physical activity among adults with T2D were pain (41%), followed by lack of willpower (27%), and poor health (21%).[48]

In the current study, lack of willpower was significantly highly reported by individuals from low income households. This finding is similar to a Canadian study which reported a negative association between financial position and on intention to participate in leisure-time physical activity in adult population with T2D in Canada.[49] Additionally in a study in USA, older individuals with low income who were found to be depressed had had low participation in social activities had less odds of engaging in PA.[50] None the less, more evidence is needed to explain how income alters the willpower for performing leisure PA in Arabic speaking countries namely Oman. Comparably, lack

of willpower was more likely to be reported by individuals at inactive stages of physical activity (pre-contemplation or contemplation stages of physical activity) than those in active stages. Progressive stages of behavioural change according to the trans-theoretical model were direct correlates to PA in a review article by Trost (2002)[51] and direct determinants in another by Van Stralen (2009).[52] This finding supports the need for programs to help raise self-willpower/determination through stepped process of behaviour change from inactive (pre-contemplation) to active stages of PA (action and maintenance).[53] Interestingly, fear of injury was the only other reported barrier significantly different between individuals at inactive vs active stages of change in PA. This could be explained by possible physical constraints pertaining to older age[50] and existing comorbidities in the current study population triggering fear of injuries associated with PA.

Limited resources including high cost and limited facilities for PA have been reported as significant barriers to PA across different cultures.[20 22] In the current study, limited resources were reported as significant by individuals who were married and those with low income. Married individuals could have more financial commitments to their families especially in the Gulf Cooperation Council countries where extended families are common.[54] This may alter an individual's priorities for house-hold income expenditure. Low income was similarly reported as a barrier in a Saudi population, possibly due to the perceived high cost of utilising PA facilities.[14] This may reflect a narrow view on what constitutes PA and a misconception that expensive equipment is required. Hence, irrespective of culture, interventions promoting cost neutral PA such as walking in populations would be highly desirable to overcome this barrier.[47 55]

Lack of social support was frequently reported by females in this study. Meeting cultural norms and social expectations related to safety, security and conservative dress mainly for females were reported as barriers to PA in South Asian (Pakistani and

Indian) British populations[18 21] and populations in Arabic counties such as Qatar.[56] Evaluation of interventions to provide the necessary social support and networks to PA specifically for women with T2D, particularly in the countries of the Gulf Cooperation Council are warranted. Activities including group-based activities and buddying,[57-59] are worth further investigation.

Other reported barriers such as fear of injury and lack of skills varied across subgroups in particular, older, unemployed, and uneducated individuals. Older individuals with T2D are more vulnerable to have poor vision and osteoarthritic changes that may cause fall and injuries.[60] Moreover the negative influence of pain to PA in older population with T2D was reported in western countries,[48] and hence potential barriers to individuals' participation. These results suggest that programs to promote PA should be individualized for type, frequency and intensity of PA and incorporate safety measures to prevent PA induced pain and injuries in older individuals.[61]

Lack of time on the other hand, has been a highly cited barrier to PA in the general population as well as populations with diabetes.[15-18 21 22 48 62] However, unlike the study by Alquaiz (2009), significant scores for lack of time in this study were higher in males compared to females[14] along-with a lack of energy, which may be a reflection of the fact that more males than females were educated and employed. This perception of 'lack of time', in addition to family and social commitments may jeopardized their time for PA especially if individuals were younger and married. This discussion highlights the importance of changing people's perceptions of PA but also consideration of opportunities in other PA domains namely work and travel that could enable individuals with less leisure time to increase overall PA and behaviour.

Factors which are independent of an individual's decision-making, such as environment and religion had no significant associations in the current study despite the hot weather during data collection of this study in April/May. These null results, may be real or may

be due to the wording of the questions and their interpretation. To address these gaps in the literature, a qualitative exploration of possible environmental, including seasonal variations, and religious factors affecting PA performance may be warranted.

Moreover, PCA showed cross contribution of items/questions within lack of willpower, time, energy and skills indicating doubtful responses. Similarly inputs from questions on lack of social support and lack of skills and energy were mixed. Future questionnaires on barriers to performing PA, especially in the Arabic speaking countries, should consider more specific questions.

Additionally, results of this study cannot be generalised across all regions in Oman. More information is required from rural Omani communities where perceptions on PA may be different. Despite the excellent scale reliability measures in the current data, the results cannot be generalized due to possible differences in scale quality across various data.[39] Despite efforts to minimize potential bias due to the subjective nature of self-reports, accuracy of outcomes cannot be fully ensure. Moreover, due to the cross-sectional design of this study, causal inferences cannot be drawn.

Finally, future attempts to explore barriers to PA should equally include work and travel domains to cater for diversities in both PA behaviour and sedentary lifestyle across subgroups of adults with T2D.

CONCLUSION

This study identified lack of willpower, low resources and low social support (especially in females) as the most common barriers to performing leisure PA. The current findings can be used to inform the design of physical activity interventions for testing in clinical trials. The specific areas which might be usefully included to address barriers to performing PA are a) assessment of individuals' readiness to change b) low cost options for PA resources and social support c) approaches aimed at increasing

individuals' understanding of what constitutes PA and d) methods that are flexible and tailored to the specific needs of subgroups of adults with T2D. In addition, approaches that enhance self-efficacy (and will power) and social support should be included.

ETHICAL CONSIDERATION

Ethical approval was obtained from the Regional Research Committee in Muscat, Oman Ministry of Health. All eligible participants provided informed consent prior to data collection. For illiterate individuals, consents to participate in this study were provided by their accompanying support member (spouse, son or daughter).

COMPETING INTERESTS

The authors declare that they have no competing interests.

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AUTHORS' CONTRIBUTION

TS is the principal investigator in charge of the project. SM, YA, EB, AC and ASA have all been involved in designing the intervention and the evaluation. TS prepared the initial draft of the manuscript and all other authors have contributed. All authors have critically reviewed and approved the final version of the manuscript.

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Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high scores defined as ≥5)

Figure 2: Percentage of reported high barrier scores (≥5)

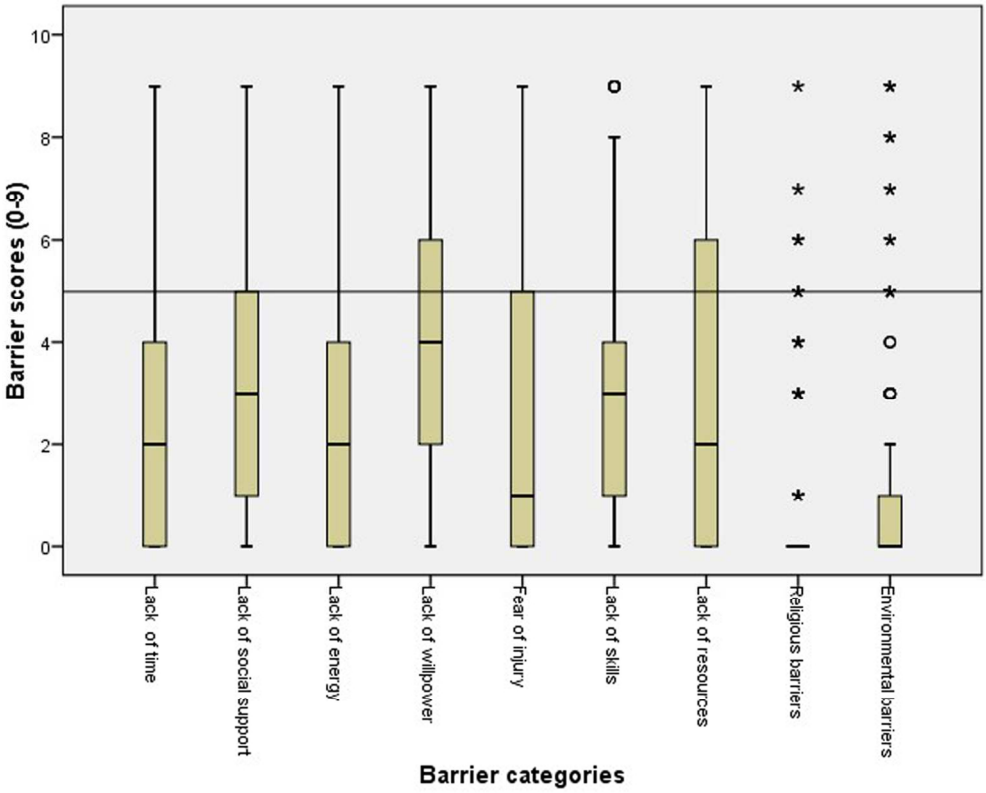

Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high scores defined as ≥5)

132x106mm (300 x 300 DPI)

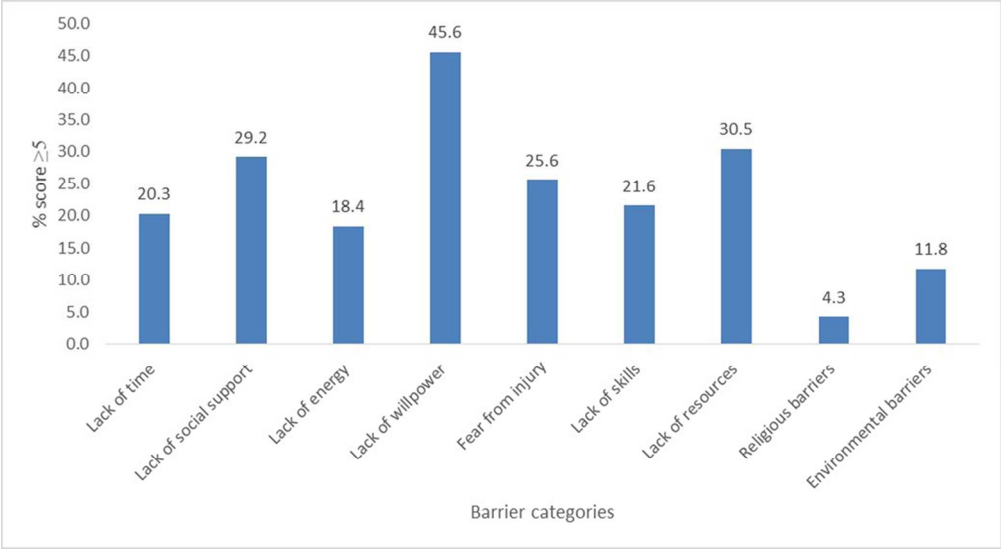

Figure 2: Percentage of reported high barrier scores (≥5)

96x53mm (300 x 300 DPI)

من فضلك أجب عن الأسئلة التالية					
		٣ نعم غالباً	٢ نعم أحياناً	١ لا نادراً	٠ لا أبداً
١	يومي مشغول جداً لذلك لا أستطيع أن أجعل لي وقت خاص بالتمارين ضمن جدولي اليومي				
٢	لا أحد من أفراد عائلتي أو أصدقائي يفضلون ممارسة الرياضة لذلك فأنى لا أجد فرصة لممارستها				
٣	أكون متعب جداً بعد العمل فلا أستطيع ممارسة الرياضة				
٤	كنت أفكر في زيادة التمارين الرياضية لكن لا يبدو أنني أستطيع البدء بذلك				
٥	أنني كبير في السن لذا فممارسة الرياضة تشكل خطرا على				
٦	لا أمارس الرياضة كثيرا وذلك لأنني لم أتعلم مهارات إي نوع من أنواع الرياضة				
٧	المسابح، المسارات، الدراجات ..... الخ غير متوفرة للاستخدام بالنسبة لي				
٨	ممارسة الرياضة تأخذ الكثير من وقت التزامات أخرى مثل وقت العمل والاسرة				
٩	أشعر بالخجل من منظري وأنا أمارس الرياضة مع الاخرين				
١٠	أنا لا أحصل على القدر المكافئ من النوم فلا أستطيع الاستيقاظ مبكراً أو البقاء في الليل لممارسة الرياضة				
١١	من الأسهل علي ايجاد عذر لعدم ممارسه الرياضه من الخروج لعمل شئ آخر				
١٢	أنا أعرف أناس كثيرين أذوا أنفسهم من كثرة ممارسة الرياضة				
١٣	أنا أرى أنه لا يمكن تعلم أي رياضه جديدة في مثل سني				
١٤	أن ممارسة الرياضة أمر مكلف جداً فيجب على شراء أدوات رياضيه أو أخذ دروس رياضيه				
١٥	وقت فراغي أثناء اليوم ضيق جداً لا يكفي لأداء التمارين الرياضية				
١٦	نشاطاتي الاجتماعية المعتادة مع العائلة والأصدقاء لا تتضمن أي نشاط رياضي				
١٧	أنا متعبة جداً خلال أيام الأسبوع واحتاج أيام العطلة للراحة وليس للرياضة				
١٨	أريد ان أمارس المزيد ولكن يبدوا أنني لا أستطيع أن استمر على شيء معين				
١٩	أخاف ان أوذى نفسي او أصاب بأزمه قلبيه				
٢٠	ليس لدي القدرة الكافية لتحويل ممارسة الرياضة لمتعه				
٢١	لو كانت هناك أجهزه رياضية وغرف للاستحمام في موقع العمل لكان من الأرجح ان أقوم بالتمارين الرياضية				
٢٢	معتقداتي الدينيه لا تسمح لي بممارسه النشاط البدني				
٢٣	الطقس (الحراو البرد الشديدين) لا يسمح لي بممارسه النشاط البدني				
٢٤	الملابس الرياضيه غير لا تتناسب مع مجتمعنا				
٢٥	النشاط البدني في الصيف غير مناسب لي				
٢٦	أخلاقياتي الدينيه لا تسمح لي بممارسه النشاط البدني				
٢٧	البيئه المحيطه لا يسمح لي بممارسه النشاط البدني				

How likely are you to say?	Very likely 3	Somewhat likely 2	Somewhat unlikely 1	Very unlikely 0
1. My day is so busy now, I just don't think I can make the time to include physical activity in my regular schedule.				
2. None of my family members or friends like to do anything active, so I don't have a chance to exercise.				
3. I'm just too tired after work to get any exercise.				
4. I've been thinking about getting more exercise, but I just can't seem to get started				
5. I'm getting older so exercise can be risky.				
6. I don't get enough exercise because I have never learned the skills for any sport.				
7. I don't have access to jogging trails, swimming pools, bike paths, etc.				
8. Physical activity takes too much time away from other commitments—time, work, family, etc.				
9. I'm embarrassed about how I will look when I exercise with others.				
10. I don't get enough sleep as it is. I just couldn't get up early or stay up late to get some exercise.				
11. It's easier for me to find excuses not to exercise than to go out to do something.				
12. I know of too many people who have hurt themselves by overdoing it with exercise.				
13. I really can't see me learning a new sport at my age.				
14. It's just too expensive. You have to take a class or join a club or buy the right equipment.				
15. My free times during the day are too short to include exercise.				
16. My usual social activities with family or friends do not include physical activity				
17. I'm too tired during the week and I need the weekend to catch up on my rest.				
18. I want to get more exercise, but I just can't seem to make myself stick to anything.				
19. I'm afraid I might injure myself or have a heart attack.				
20. I'm not good enough at any physical activity to make it fun.				
21. If we had exercise facilities and showers at work, then I would be more likely to exercise.				
22. my religious believes are not supportive for PA				
23.extreme hot weather is an obstacle				
24.sports cloths are not culturally appropriate				
25.PA in the summer times is not convenient to me				
26.My religious thoughts are against performing PA				
27.the environment around be is not supportive for PA				

Factor analysis and reliability test results

Initially, the factorability of the 27 items/questions was examined. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.711, above the commonly recommended value of 0.600. Bartlett's test of sphericity (test of at least one significant correlation between 2 of the items studied) was also significant (χ_2 (351) = 2600.175, p < .05).[1] The communalities (proportion of item's variance explained by the extracted factors) were all above 0.300, further confirming that each item shared some common variance with other items. Given these overall indicators, factor analysis was regarded to be suitable with all the 27 items/questions.

PCA for 9 components solution namely lack of willpower/time/energy and skills, fear of injury, lack of time/ lack of energy, environmental barriers, religious barriers, lack of willpower, lack of skills/ social support and lack of resources, explained 13.1%, 11.4%, and 9.2%, 9.0%, 7.2%, 5.1%, 4.3%, 3.8% and 3.6% of the variance respectively.

None of the 27 items were eliminated because they all met a minimum criteria of having a primary factor loading (how much a factor explains a variable) of 0.4 or above. Solutions for the nine components were examined using Oblimin rotation of the factor loading matrix. The factor loading matrix for this final solution is presented in Table 1. All factor loadings were in the same direction of the barrier categories used in the current study where a set of three items instructed a barrier category mainly component 2, 4, 5, 6, and 9 representing fear from injury, environmental barriers, religious barriers, lack of willpower, and lack of resources respectively. However, cross contributions were evident in four out of the nine extracted components namely component 1 (lack of willpower, time, energy and skills), component 3(lack of time and energy), component 7 (lack of social support and skills), and component 8 (lack of social support and energy). Component correlation matrix, presented in table 2, shows week correlations between the extracted nine components <0.200 except for the correlations of

0.201and -0.204 between component 6 (lack of willpower) with 7 (combination of lack of skills and social support) and 2 (fear of injury) with 9 (lack of resources) respectively.

McDonald's coefficient Omega was equal to 0.750 indicating moderate reliability of the 27 items/questions scale.[2]

Table 1: The extracted components and factor loadings based on a principal components analysis with Oblimin rotation for the 27 items/questions used in the current study (N = 305)

Items/ questions	Extracted components (1-9)*								
	1	2	3	4	5	6	7	8	9
Q4	.503					-.502			
Q19		.879							
Q12		.801							
Q5		.791							
Q1			.745						
Q15			.743						
Q17			.721						
Q3	.351		.604						
Q8	-.423		.468						
Q24				.922					
Q26				.909					
Q22				.839					
Q25					.899				
Q23					.871				
Q27					.777				
Q20						-.788			
Q11									
Q18						-.748			
Q16							-.789		
Q13							-.712		
Q6	.470						-.538		
Q2							-.390		

Q9								.819	
Q10	.383							.622	
Q14									.802
Q7									.765
Q21									.761

*1=lack of willpower/energy/time/skills, 2=fear of injury, 3=lack of time/ lack of energy, 4=environmental barriers, 5=religious barriers, 6=lack of willpower, 7=lack of skills/ social support, 8=lack of energy/social support and 9=lack of resources.

Table 2: Component correlation matrix

Extracted components*	1	2	3	4	5	6	7	8	9
1	1.000	-.008	.017	.028	-.046	-.151	-.049	.020	.149
2	-.008	1.000	-.099	-.023	.025	-.028	-.199	.000	-.204
3	.017	-.099	1.000	.063	-.117	-.127	-.043	.145	.009
4	.028	-.023	.063	1.000	.014	.004	-.016	.051	.019
5	-.046	.025	-.117	.014	1.000	.062	-.014	-.034	-.021
6	-.151	-.028	-.127	.004	.062	1.000	.207	-.153	-.125
7	-.049	-.199	-.043	-.016	-.014	.207	1.000	-.134	-.009
8	.020	.000	.145	.051	-.034	-.153	-.134	1.000	.014
9	.149	-.204	.009	.019	-.021	-.125	-.009	.014	1.000

*1=lack of willpower/energy/time/skills, 2=fear of injury, 3=lack of time/ lack of energy, 4=environmental barriers, 5=religious barriers, 6=lack of willpower, 7=lack of skills/ social support, 8=lack of energy/social support and 9=lack of resources.

Further Factor analysis and reliability tests were conducted on the studied barrier subscales (3 questions per barrier). Table 3 provide factor loadings and McDonald's coefficient Omega for all the nine subscales used in the current study indicating excellent sub-scale quality.

Table 3: Factor loadings and McDonald's coefficient Omega for the study subscales

Barrier categories	Items/questions	factor loadings	Omega
Lack of time	Q15	0.826	0.900
	Q1	0.798	
	Q8	0.618	
Lack of social support	Q16	0.734	0.900
	Q2	0.680	
	Q9	0.534	
Lack of energy	Q3	0.755	0.900
	Q17	0.720	
	Q10	0.581	
Lack of willpower	Q18	0.837	0.900
	Q4	0.746	
	Q11	0.691	

Fear of injury	Q19	0.904	0.900
	Q12	0.823	
	Q5	0.803	
Lack of skills	Q6	0.840	0.900
	Q13	0.646	
	Q20	0.560	
Lack of resources	Q7	0.837	0.900
	Q21	0.831	
	Q14	0.754	
Religious barriers	Q25	0.905	0.900
	Q23	0.872	
	Q27	0.786	
Environmental barriers	Q24	0.924	0.900
	Q26	0.913	
	Q22	0.847	

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Page number (where information can be found in the manuscript)
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Perceived barriers to leisure time physical activity in adults with type 2 diabetes attending primary health care in Oman: a cross-sectional survey

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TRANSPARENCY DECLARATION: This manuscript is an honest, accurate, and transparent account of the study being reported. There are no important aspects of the study that are omitted; and any possible discrepancies from the study are explained.

TECHNICAL APPENDIX: Data generated from this study is not available for public use. However it is available from the corresponding author on reasonable request and approvals from Oman Ministry of Health.

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CONFLICTS OF INTEREST: No competing interests.

ABSTRACT

Objectives: Physical activity is fundamental in diabetes management for good metabolic control. This study aimed to identify barriers to performing leisure time physical activity and explore differences based on gender, age, marital status, employment, education, income and perceived stages of change in physical activity in adults with type 2 diabetes in Oman.

Design: Cross-sectional study using an Arabic version of the "Barriers to Being Active" 27 item questionnaire.

Setting: Seventeen primary health centres randomly selected in Muscat.

Participants: Individuals >18 years with type 2 diabetes, attending diabetes clinic for > 2 years and with no contraindications to performing physical activity.

Primary and secondary outcome measures:

Participants were asked to rate how far different factors influenced their physical activity, under the following categories: fear of injury, lack of time, social support, energy, willpower, skills, resources, religion and environment. On a scale of 0-9, barriers were considered important if scored ≥5.

Results: A total of 305 questionnaires were collected. Most (96%) reported at least one barrier to performing leisure time physical activity. Lack of willpower (44.4%), lack of resources (30.5%) and lack of social support (29.2%) were the most frequently reported barriers. Using chi-square test, lack of willpower was significantly different in individuals with low vs high income (54.2% vs 40%, *P*=0.002) and in those reporting inactive vs active stages of change for physical activity (50.7% vs 34.7%, *P*=0.029), lack of resources was significantly different in those with low vs high income (40% vs

24.3%, *P*=0.004) and married vs unmarried (33.8% vs 18.5%, *P*=0.018). Lack of social support was significant in females vs males (35.4% vs 20.8%, *P*=0.005).

Conclusions: The findings can inform the design on physical activity intervention studies by testing the impact of strategies which incorporate ways to address reported barriers including approaches that enhance self-efficacy and social support.

Key words: Physical Activity, Type 2 diabetes, Primary health care, Barriers, Oman

ARTICLE SUMMARY

Strengths and limitations of this study

- Barriers to performing leisure physical activity for adults with type 2 diabetes were investigated in Oman where prevalence of both diabetes and physical inactivity is high.
- Questions on possible barriers to performing physical activity linked to religion and environment were included.
- The tool used in this study was an English to Arabic language translated questionnaire that may have affected the validity of questions.

INTRODUCTION

Oman is located in Southwest Asia on the Southeast coast of the Arabian Peninsula. Similar to its neighbouring countries (United Arab Emirates, Saudi Arabia, Qatar, Bahrain, and Kuwait), Oman has witnessed enormous economic advancement in recent decades, along with significant increases in non-communicable diseases including a rising prevalence of diabetes. Diabetes prevalence in Oman has increased from 8.3% in 1991 to 12.3% in 2008 and recent estimates are in the order of 14.8%, exceeding global rates.[1 2] The World Health Organization (WHO) has indicated that physical inactivity is one of the top ten leading global causes of mortality and disability worldwide, and the principal cause for approximately 27% of diabetes, and approximately 30% of ischemic

heart disease.[3] In Oman, it has been reported that almost 70% of the population are physically inactive (daily activity of ≤10 minutes).[4] This raises concerns regarding the impact these high levels of physical inactivity may be having on lifestyle related chronic diseases including diabetes, on health care expenditures and overall population health.[5]

The protective effects of physical activity (PA) in the management of diabetes, specifically type 2 diabetes (T2D), have been widely reported.[6 7] WHO recommends at least 150 minutes of moderate to vigorous physical activity or 75 minutes of vigorous PA/week.[8] However, over 60% of patients with diabetes in western countries do not meet the recommended levels of PA.[9 10] The Oman World Health Survey (OWHS) 2008, reported that in Oman, only 15% of patients with diabetes (98% of them with type 2 diabetes) met PA recommendations using the Global Physical Activity Questionnaire (GPAQ).[2]

The importance of leisure time PA in meeting PA recommendations is consistently[11] associated with reduced mortality risks (20% to >37% risk reduction) and favourable cardiovascular outcomes.[12] This relationship appears to have a dose-response effect where the upper threshold for mortality benefit occurs at 3 to 5 times the leisure PA recommendations of 7.5-<15 MET h/wk.[12] No clear association is observed for occupational or travel physical activity.[13]

Theoretical models underpinning effective interventions to promote personalized PA (contents, methods and approaches) should focus on benefits and ways to overcome barriers to PA.[14] Literature to date mainly from western countries has reported a number of potential barriers to performing PA in adults with diabetes. These include lack of time,[15-18] physical constrains including pain,[19] lack of knowledge and limited facilities.[20] Differences in reporting barriers to PA have been noted across genders, age groups, environments, cultures and disease status. Female gender, increasing age, unsafe neighbourhoods, being overweight and being a smoker increased the odds of reporting

barriers to PA among migrant populations like African Americans, South Asian British and Mexican Americans.[21-23] In the Arab countries, modest evidence on barriers to PA in both the general population and in adults with T2D suggests that lack of time, co-existing diseases and adverse weather conditions[14 24-29] are the main factors. Moreover, the climate in this region may be a drawback to meeting recommended levels of PA due to high temperatures during the day, particularly in the sandy/desert areas. During the summer months, these countries including Oman experience major heat waves (>40 degrees celsius) and humidity levels that could reach 90%.

The current study aimed to identify barriers to performing leisure-time PA in adults with T2D in Oman, and the distribution of barrier scores across different socio-demographic characteristics and perceived stages of change in PA.

METHODS

Study design, setting and participants

This cross-sectional interview based study was part of a larger study that examined correlates of physical activity and sitting time in adults with type 2 diabetes, and barriers to leisure physical activity in the same population. Results regarding the PA patterns of the population using the Global Physical Activity Questionnaire are reported elsewhere.[30] This current paper identified barriers to performing leisure physical activity expressed by Omani adults with T2D using adapted questions from the Centers for Disease Control and Prevention (CDC) questionnaire[31] conducted in April/ May 2015 in Muscat (Urban communities). Reporting of this study follows the guidelines for strengthening the reporting of observational studies in epidemiology (STROBE).[32]

All patients with T2D attending their routine diabetes clinics in 17 randomly selected primary health care centres in Muscat were approached to take part in the study. Inclusion criteria were age >18 years and being followed up in a diabetes clinic for >2 years and ability to provide informed consent. For illiterate participants, informed consents were taken from their spouse, son, daughter or other close family member. Participants with type 1 diabetes, newly diagnosed (<6 months) or who had difficulty in performing any physical activity, including history of myocardial infarction of <6 months and multiple organ failure, were excluded.

Data sources/ measurement

In addition to recording physiological data [Body Mass Index (BMI), medication, duration of diabetes, blood pressure (BP), lipid profile, and comorbidities coinciding with diabetes] from the electronic health system, a multi-section questionnaire with a range of answers in closed format was administered by a trained interviewer. The following information was collected:

Socio-demographic data: included gender, age, marital status, education, household income, and employment.

Perceptions on stage of change in physical activity: Based on the trans-theoretical theory of behaviour change,[33] subjects were asked to identify their perceived stage of change in physical activity. Participants were to select "Maintenance stage" if they were participating in moderate physical activity five or more times per week or in vigorous activity three to five times per week longer than six consecutive months or select "Action stage" if less than six months. "Preparation stage" was selected by subjects who were thinking about starting exercise such as walking in the near future, or doing vigorous activity less than three times per week, or moderate activity less than five times per week. Contemplation stage "getting ready" was selected by subjects who were

thinking about starting exercise or walk in the next six months. Subjects who were not thinking about starting any PA in the near future selected pre-contemplation stage "not ready".

CDC questionnaire on barriers to leisure PA:

An English to Arabic translated CDC questionnaire "Barriers to Being Active" was used in a study in Saudi Arabia[14] with 21 questions on seven barriers (lack of time, lack of social support, lack of energy, lack of willpower, fear of injury, lack of skill and lack of resources). Permission to use the questionnaire was obtained from the lead author on November 24, 2014 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2813614/figure/F0001/). However, in that tool no statements on religion or environment as possible barriers to PA were included. To address this gap and to formulate robust items on these topics we undertook several procedures. Literature search was conducted to identify possible content for the new items from similar studies in neighbour countries with similar socio-economical characteristics.[28 29] Potential religious barriers considered questions on religious beliefs restricting PA, accepted clothing for PA and religious perceptions on PA.[14 25 26] Potential environmental barriers included questions on extreme weather conditions, physical activity in summer time and availability of appropriate environment for PA.[16 25] Content and face validity of the questionnaire were assessed by our investigatory team and draft questions were then discussed with a sample of patients prior to field testing and adjustments were made to ease comprehension and ensure translation to Arabic was appropriate.

A set of three related questions (total of 27 questions) presented in random order within the questionnaire represented one barrier category. A scoring system[31] was used to indicate how likely each statement/item was considered to be a barrier (very likely=3, somewhat likely=2, somewhat unlikely=1, very unlikely=0). Scores of the three theme-

related questions were added up to provide a total for each category of barriers. Possible scores for each barrier category ranged from 0-9. A score of ≥ 5 was considered as an important barrier to overcome.[31] A copy of the used (Arabic & English) questionnaire can be found in online supplementary material (1&2).

To ensure common understanding and acceptability, an interview recording was undertaken in Muscat in 25 randomly selected adult with type 2 diabetes (population of interest) outside the sampled health centres of the study. Results were discussed and reviewed by the investigation team and an independent statistician.

Based on the data from the current study, the scale quality (27 item study questionnaire) including internal consistency reliability measures were investigated through the use of factor analysis using SPSS v22 and supported by McDonald's coefficient omega using the free and open source R. [34 35]

Study size

Power analysis was performed to estimate the prevalence of meeting PA recommendations in adult population with T2D in a parallel study conducted in the same population.[30] We assumed that meeting PA recommendation is at least in part facilitated by reporting fewer barriers to PA[36] and used an estimated 15% prevalence of adequate PA in patients with diabetes, as reported in the 2008 Oman World Health Survey (OWHS).[37] Using 95% confidence limits, a response rate of 80%, and a precision of +/-4%, and smallest expected frequency of 15%, the calculated sample size was ~300 participants across primary health centres in Muscat region, the capital of Oman.

Training

A multidisciplinary team of two nurses, one senior dietician, one medical orderly and two doctors were recruited for data collection. A one day training on administration of the questionnaire was delivered by the national focal point on PA in Oman Ministry of Health. Data entry, cross-checking and cleaning was done through Epi Info™ 7 by an independent personnel. Entered data was transferred to SPSS v22 for analysis and subsequent results.

Statistical methods

Descriptive statistics were expressed as percentages and mean (SD), median (quartiles) to describe the study sample characteristics. Sum of scores from the three related questions per category (range from 0-9) were expressed as median (LQ, UQ). Correlations between the sum of scores of the nine barrier categories were tested. Furthermore, data were dichotomised to scores <5 and ≥ 5 to determine the highly reported barriers as advised in the CDC questionnaire and practised in a study in Saudi Arabia.[31] Chi-square analysis was carried out to identify the distribution of the high barrier scores (≥5) across the independent sociodemographic factors including gender (male vs female); age (to ensure sufficient power and adequate numbers for further statistical analysis the population was divided by the mean age ≤57 vs < 57 years); marital status (currently unmarried vs married); education (those unable to read or write ("uneducated") vs. those having attended primary school or beyond ("educated"); household income (<500 vs ≥500 Omani rials - 'OR'); and employment (unemployed, including those retired vs employed). Self-reported stage of change in PA was expressed as one of two categories: inactive if reporting "pre-contemplation" or "contemplation" and potentially active if reporting being at "preparation", "action", or

"maintenance" stages of PA. Corrected P-values (Yate's continuity) were reported for high barrier scores against the studied independent variables.

Principal components analysis (PCA) was performed to identify composite scores for the components underlying the items/questions in the study scale. A nine factor solution was used to investigate the contributions of the 27 item/questions to the nine barrier categories.[38] Furthermore, factor loading matrix was examined using Oblimin rotation [39] where correlations between the extracted components were obtained.

RESULTS

Socio-demographic

Out of 312 patients approached, 305 (98%) completed the questionnaire. Slightly more females were represented in this sample (57.4%) than males. The population was slightly older with mean (SD) age of 57(10.8) years. Additionally, more than two-thirds being married (78.8%) and just about half unable to read or write (48.9%). More than a third of the study population (39.3%) reported household income of <500 OR (less than national average) [40] and the majority (77%) reported unemployment (including retirement). More males than females were educated (70% vs 37%) and employed (45% vs 7%) (Table 1).

Physiological status

Median (LQ, UQ) duration of diabetes in this population was 6.0 (4.0, 10.0) years. The majority of the participants had hypertension (n=217, 71%) or/and hyperlipidaemia (n=189, 62%) coinciding with their diabetes. All of them were using anti-hypertensive or/and lipid lowering medications as appropriate. More than three-quarters of those taking anti-hypertensives (78%) and two-thirds of those using lipid lowering drugs (66%) had blood pressure (BP) readings and fasting serum cholesterol within target

levels (BP<140/80 mmHg and fasting serum cholesterol of <5mmol/l).[41] Fifteen percent (n=45) were controlling their diabetes by diet alone versus 85% (n=260) on oral anti-hypoglycaemic medications, in which 25% (n=75) were additionally on insulin. Mean (SD) BMI was 31.0 (6.0) kg/m^2 where 89% (n=271) had BMI >25kg/m^2 in which 50% (n=153) were obese (BMI>30 kg/m^2) and 39% (n=118) were overweight (BMI>25-29.99 kg/m^2). Glycated haemoglobin HbA1c was >7% (>48 mmol/mol) in more than half of the population (58%) indicating poor diabetes control (Table 1).

Self-reported stages of PA

Only 17% (n=52) of participants considered themselves actively participating in regular moderate or vigorous PA (22% of males vs 13% of females). Of the remainder, the majority reported being "not ready" (37%), "getting ready" (31%) or in "preparation" (15%) (Table 1).

Table 1: Selected participants characteristics

Population characteristics	Total population n=305(100%)
Gender	
Male	130(42.6)
Female	175(57.4)
Age (years)	
≤57	155(51)
>57	150(49)
Marital status	
Currently unmarried	65(21)
Currently married	240(79)
Education	
Not educated	149(49)
Educated	156(51)
Income	
<500 OR	120(39)
≥500 OR	185(61)
Employment	
Not employed	234(77)
Employed	71(23)
Physiological	
Duration of diabetes (years)	Median (LQ, UQ)

	6(4, 10)	
Self-reported comorbidities*		
Yes	277(91)	265
No	28 (9)	266
Current medication		
Anti-HTN	217(71)	269
Lipid lowering drugs	189(62)	270
Oral-hypoglycaemic drugs	260(85)	271
Oral-hypoglycaemic drugs with Insulin	75(25)	272
Diet control	45(15)	273
Blood pressure (systolic/diastolic) mmHg**		274
Within target (<140/<80)	237(78)	277
High (≥140/≥80)	68(22)	278
Fasting lipid profile (mmol/l)**		
Cholesterol within target (< 5.0)	201(66)	281
Cholesterol high (≥5.0)	104(34)	282
Body Mass Index (kg/m2)**		
Healthy weight range (18.5-24.99)	34(11)	285
Overweight (>25-29.99)	118(39)	286
Obese (>30)	153(50)	287
HbA1c(%)**(>48 mmol/mol)		288
Normal ≤7%	127(42)	290
High >7%	178(58)	291
Self-reported stages of PA		
Not ready (Pre-contemplation)	112(37)	293
Getting ready(contemplation)	95(31)	294
Preparation	46(15)	295
Action	14(5)	296
Maintenance	38(12)	297
		298
		299

*Reported hypertension, hyperlipidaemia, thyroid dysfunction or any other chronic condition coinciding with diabetes. **Oman diabetes mellitus management guidelines (2015)[41]

300 **CDC questionnaire on barriers to leisure PA**

301 For the 27 items/questions scale, McDonald's coefficient Omega was equal to 0.750
302 indicating moderate reliability of the scale.[38] Further, PCA analysis with 9 components
303 solution generally supported the previous found subscales (three questions per barrier
304 category) in barriers to performing PA mainly component 2, 4, 5, 6, and 9 representing
305 fear from injury, environmental barriers, religious barriers, lack of willpower, and lack
306 of resources respectively (see supplementary materials 3). However, cross contributions
307 were evident in four out of the nine extracted components namely component 1 (lack of
308 willpower, time, energy and skills), component 3 (lack of time and energy), component

7 (lack of social support and skills), and component 8 (lack of social support and energy).

Each of the subscales for the nine studied barriers had good reliability [McDonald's coefficient Omega was equal to 0.900]. Based on this, further results are presented using sum scores.

The majority of the population, 97.7% (n=298), reported at least one barrier to performing leisure physical activity median (LQ, UQ) was 6 (4, 7). Population distributions were not normal across all reported barrier categories. Median sum scores were all <5 as illustrated in (Figure 1). Except for reporting lack of willpower and lack of resources, 75% of sum scores of other reported barriers were ≤ 5.

INSERT FIGURE 1 ABOUT HERE

Categorizing barrier scores to <5 and ≥5 (significant barrier) highlighted that 'lack of willpower' (n=139), 'lack of resources' (n=93) and 'lack of social support' (n=89) were the most frequently reported 'significant barriers' to physical activity (Figure 2). Barriers found to be significant in both males and females were lack of willpower (41.5% m: 48.6% f) and lack of resources (32.3% m: 29.1% f). In addition, lack of time in males (26.9%) and lack of social support in females (35.4%) were also noteworthy (Table 2).

INSERT FIGURE 2 ABOUT HERE

Correlations between the sum scores of the nine studied barriers were generally weak (R<0.200). Positive and significant correlations of >0.300 were noted among lack of energy with lack of time; lack of skill with lack of social support; lack of energy and lack of willpower; lack of skills with lack of willpower; and fear of injury with lack of

	Lack of time	Lack of social support	Lack of energy	Lack of willpower	Fear of injury	Lack of skill	Lack of resources	Religious barriers	Environmental barriers
Lack of time	1.000	.134*	.464*	.118*	-.116*	.035	.013	-.092	.013
Lack of social support	.134*	1.000	.125*	.288*	.262*	.430*	.083	.011	.039
Lack of energy	.464*	.125*	1.000	.306*	-.013	.178*	.171*	-.070	.099
Lack of willpower	.118*	.288*	.306*	1.000	.058	.497*	.260*	-.112	.053
Fear of injury	-.116*	.262*	-.013	.058	1.000	.338*	-.218*	.032	-.090
Lack of skill	.035	.430*	.178*	.497*	.338*	1.000	.182*	-.052	.005
Lack of resources	.013	.083	.171*	.260*	-.218*	.182*	1.000	.038	.281*
Religious barriers	-.092	.011	-.070	-.112	.032	-.052	.038	1.000	.007
Environmental barriers	.013	.039	.099	.053	-.090	.005	.281*	.007	1.000

skills (Table 2). Interestingly, no significant correlations were seen within the religious and environmental barriers except for one weak significant positive correlation between lack of resources and environmental barriers.

Table 2: Correlations between sum scores of barrier categories

*P-value <0.050

Distributions of significant high barrier score (≥5) across the studied sociodemographic factors and self-reported stages of change in PA differed among the nine barrier categories: "Lack of time" was frequently highly scored by males, younger adults and those who were married, employed or educated. Additionally, "Lack of social support" was highly scored by females and "Lack of energy" by employed, or educated adults. However, "Lack of willpower" was highly scored by individuals with lower income, or at inactive stages of PA. Moreover, "Fear of injury" was highly scored by older adults, unemployed, uneducated, or individuals reporting in-active stages of PA. Furthermore, "Lack of skills" was highly scored by females, younger adults, and unemployed or uneducated. "Lack of resources" on the other hand, was frequently highly scored by married adults or with lower income. It is notable that the religious and environmental

barriers had no significant different distributions across any of the studied factors (Table 3).

Table 3: Distribution of high barrier scores (≥5) to leisure physical activity in adult population with type 2 diabetes across sociodemographic variables and self-reported stages of change in physical activity (n=305).

(%) Scores ≥ 5	Lack of time	Lack of social support	Lack of energy	Lack of willpower	Fear of injury	Lack of skills	Lack of resources	Religious barriers	Environmental barriers
Gender:									
Male	26.6	20.8	21.5	41.5	24.6	13.1	32.3	3.8	10.0
Female	15.4	35.4	16.0	48.6	26.3	28.0	29.1	4.6	13.1
Corrected x^2	5.4	7.1	1.2	1.2	0.04	8.9	0.2	0.001	0.4
(P-value)	(0.020)*	(0.008)*	(0.278)	(0.270)	(0.843)	(0.003)*	(0.640)	(0.981)	(0.508)
Age:									
<=57	27.7	26.5	21.3	45.8	18.7	16.1	33.5	4.5	12.3
>57	12.7	32.0	15.3	45.3	32.7	27.3	27.3	4.0	11.3
Corrected x^2	9.7	0.9	1.4	0.0	7.1	5.0	1.1	0.00	0.0
(P-value)	(0.002)*	(0.347)	(0.232)	(1.000)	(0.008)*	(0.025)*	(0.292)	(1.000)	(0.942)
Marital status:									
Unmarried	10.8	35.4	16.9	43.1	30.8	24.6	18.5	7.7	13.8
Married	22.9	27.5	18.8	46.3	24.2	20.8	33.8	3.3	11.3
Corrected x^2	3.9	1.2	0.0	0.1	0.9	0.2	4.9	1.4	0.1
(P-value)	(0.047)*	(0.277)	(0.875)	(0.753)	(0.356)	(0.626)	(0.026)*	(0.231)	(0.720)
Employment:									
Un-employed	12.4	31.6	14.5	47.0	29.5	25.6	31.6	4.7	11.5
Employed	46.5	21.1	31.0	40.8	12.7	8.5	26.8	2.8	12.7
Corrected x^2	37.0	2.4	8.8	0.6	7.2	8.5	0.4	0.1	0.0
(P-value)	(<0.001)*	(0.120)	(0.003)*	(0.437)	(0.007)*	(0.004)*	(0.527)	(0.740)	(0.960)
Education:									
Un-educated	11.4	33.6	13.4	45.6	35.6	28.2	29.5	6.0	10.7
Educated	28.8	25.0	23.1	45.5	16.0	15.4	31.4	2.6	12.8
Corrected x^2	13.2	2.3	4.1	0.0	14.2	6.6	0.1	1.5	0.1

(P-value)	(<0.001)*	(0.129)	(0.042)*	(1.0)	(<0.001)*	(0.010)*	(0.816)	(0.162)	(0.700)
Income:									
<500	16.7	26.7	21.7	54.2	20.8	23.3	40.0	5.8	8.3
>=500	22.7	30.8	16.2	40.0	28.6	20.5	24.3	3.2	14.1
Corrected x^2	1.3	0.4	1.1	5.3	1.9	0.2	7.7	0.6	1.8
(P-value)	(0.257)	(0.516)	(0.294)	(0.021)*	(0.163)	(0.663)	(0.005)*	(0.422)	(0.183)
Self-reported stages of PA:									
Not active	18.4	28.5	17.9	50.7	31.9	24.2	29.5	4.3	13.5
Active	24.5	30.6	19.4	34.7	12.2	16.3	32.7	4.1	8.2
Corrected x^2	1.2	0.1	0.0	6.2	12.5	2.0	0.2	0.00	1.4
(P-value)	(0.276)	(0.808)	(0.873)	(0.012)*	(<0.001)*	(0.161)	(0.667)	(1.0)	(0.244)

* Significant at P<0.050

DISCUSSION

Despite evidence on the effectiveness of meeting PA levels in the management of T2D, and associated cardiovascular risk factors, [6 7] PA is poorly addressed in routine diabetes care.[42] Low PA levels in populations with T2D are consistently reported in western countries, for example, USA[43] as well as Arabic speaking countries namely Oman, Saudi Arabia and Lebanon.[2 44 45] Addressing perceived barriers to performing recommended PA levels in this population is crucial for planning effective PA promoting interventions.

Within a series of formative studies to inform a culturally congruent PA intervention in diabetes care,[46] this study has looked at perceived barriers to performing leisure time physical activity in an adult population with T2D attending primary care using an adapted CDC questionnaire translated to Arabic language.[14]

The current findings relating to willpower, resources and social support were also reported as the top three barriers to PA in the Saudi population attending primary care by AlQuaiz (2009).[14] In the West, USA in particular, the strongest reported barriers to physical activity among adults with T2D were pain (41%), followed by lack of willpower (27%), and poor health (21%).[47]

In the current study, lack of willpower was significantly highly reported by individuals from low income households. This finding is similar to a Canadian study which reported a negative association between financial position and on intention to participate in leisure-time physical activity in adult population with T2D in Canada.[48] Additionally in a study in USA, older individuals with low income who were found to be depressed had low participation in social activities and less odds of engaging in PA.[49] None the less, more evidence is needed to explain how income alters the willpower for performing leisure PA in Arabic speaking countries namely Oman. Comparably, lack

of willpower was more likely to be reported by individuals at inactive stages of physical activity (pre-contemplation or contemplation stages of physical activity) than those in active stages. Progressive stages of behavioural change according to the trans-theoretical model were direct correlates to PA in a review article by Trost (2002)[50] and direct determinants in another by Van Stralen (2009).[51] This finding supports the need for programs to help raise self-willpower/determination through stepped process of behaviour change from inactive (pre-contemplation) to active stages of PA (action and maintenance).[52] Interestingly, fear of injury was the only other reported barrier significantly different between individuals at inactive vs active stages of change in PA. This could be explained by possible physical constraints pertaining to older age[49] and existing comorbidities in the current study population triggering fear of injuries associated with PA.

Limited resources including high cost and limited facilities for PA have been reported as significant barriers to PA across different cultures.[20 22] In the current study, limited resources were reported as significant by individuals who were married and those with low income. Married individuals could have more financial commitments to their families especially in the Gulf Cooperation Council countries where extended families are common.[53] This may alter an individual's priorities for house-hold income expenditure. Low income was similarly reported as a barrier in a Saudi population, possibly due to the perceived high cost of utilising PA facilities.[14] This may reflect a narrow view on what constitutes PA and a misconception that expensive equipment is required. Hence, irrespective of culture, interventions promoting cost neutral PA such as walking in populations would be highly desirable to overcome this barrier.[46 54]

Lack of social support was frequently reported by females in this study. Meeting cultural norms and social expectations related to safety, security and conservative dress mainly for females were reported as barriers to PA in South Asian (Pakistani and

Indian) British populations[18 21] and populations in Arabic counties such as Qatar.[55] Evaluation of interventions to provide the necessary social support and networks to PA specifically for women with T2D, particularly in the countries of the Gulf Cooperation Council are warranted. Activities including group-based activities and buddying,[56-58] are worth further investigation.

Other reported barriers such as fear of injury and lack of skills varied across subgroups in particular, older, unemployed, and uneducated individuals. Older individuals with T2D are more vulnerable to have poor vision and osteoarthritic changes that may cause fall and injuries.[59] Moreover the negative influence of pain to PA in older population with T2D was reported in western countries,[47] and hence potential barriers to individuals' participation. These results suggest that programs to promote PA should be individualized for type, frequency and intensity of PA and incorporate safety measures to prevent PA induced pain and injuries in older individuals.[60]

Lack of time on the other hand, has been a highly cited barrier to PA in the general population as well as populations with diabetes.[15-18 21 22 47 61] However, unlike the study by Alquaiz (2009), significant scores for lack of time in this study were higher in males compared to females[14] along-with a lack of energy, which may be a reflection of the fact that more males than females were educated and employed. This perception of 'lack of time', in addition to family and social commitments may jeopardized their time for PA especially if individuals were younger and married. This discussion highlights the importance of changing people's perceptions of PA but also consideration of opportunities in other PA domains namely work and travel that could enable individuals with less leisure time to increase overall PA and behaviour.

Factors which are independent of an individual's decision-making, such as environment and religion had no significant associations in the current study despite the hot weather during data collection of this study in April/May. These null results, may be real or may

be due to the wording of the questions and their interpretation. To address these gaps in the literature, a qualitative exploration of possible environmental, including seasonal variations, and religious factors affecting PA performance may be warranted.

Moreover, PCA showed cross contribution of items/questions within lack of willpower, time, energy and skills indicating doubtful responses. Similarly inputs from questions on lack of social support and lack of skills and energy were mixed. Future questionnaires on barriers to performing PA, especially in the Arabic speaking countries, should consider more specific questions.

Additionally, results of this study cannot be generalised across all regions in Oman. More information is required from rural Omani communities where perceptions on PA may be different. Despite the excellent scale reliability measures in the current data, the results cannot be generalized due to possible differences in scale quality across various data.[38] Moreover, due to the cross-sectional design of this study, causal inferences cannot be drawn.

Finally, future attempts to explore barriers to PA should equally include work and travel domains to cater for diversities in both PA behaviour and sedentary lifestyle across subgroups of adults with T2D.

CONCLUSION

This study identified lack of willpower, low resources and low social support (especially in females) as the most common barriers to performing leisure PA. The current findings can be used to inform the design of physical activity interventions for testing in clinical trials. The specific areas which might be usefully included to address barriers to performing PA are a) assessment of individuals' readiness to change b) low cost options for PA resources and social support c) approaches aimed at increasing individuals' understanding of what constitutes PA and d) methods that are flexible and

tailored to the specific needs of subgroups of adults with T2D. In addition, approaches that enhance self-efficacy (and will power) and social support should be included.

ETHICAL CONSIDERATION

Ethical approval was obtained from the Regional Research Committee in Muscat, Oman Ministry of Health. All eligible participants provided informed consent prior to data collection. For illiterate individuals, consents to participate in this study were provided by their accompanying support member (spouse, son or daughter).

COMPETING INTERESTS

The authors declare that they have no competing interests.

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AUTHORS' CONTRIBUTION

TS is the principal investigator in charge of the project. SM, YA, EB, AC and ASA have all been involved in designing the intervention and the evaluation. TS prepared the initial draft of the manuscript and all other authors have contributed. All authors have critically reviewed and approved the final version of the manuscript.

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Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high scores defined as ≥5)

Figure 2: Percentage of reported high barrier scores (≥5)

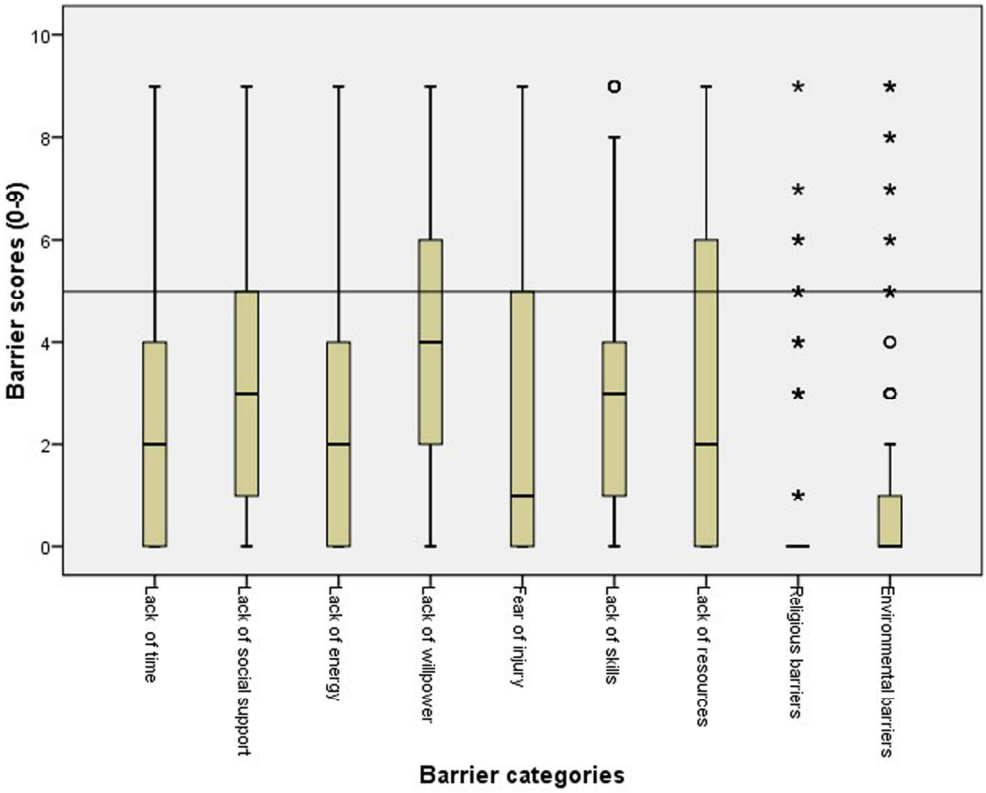

Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high scores defined as ≥5)

132x106mm (300 x 300 DPI)

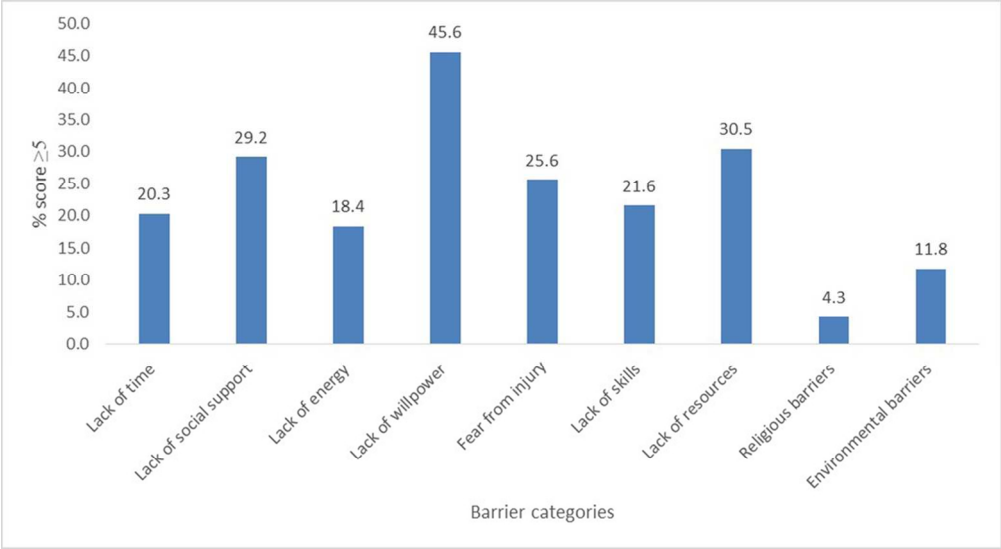

Figure 2: Percentage of reported high barrier scores (≥5)

96x53mm (300 x 300 DPI)

من فضلك أجب عن الأسئلة التالية					
		٣ نعم غالباً	٢ نعم أحياناً	١ لا نادراً	٠ لا أبداً
١	يومي مشغول جداً لذلك لا أستطيع أن أجعل لي وقت خاص بالتمارين ضمن جدولي اليومي				
٢	لا أحد من أفراد عائلتي أو أصدقائي يفضلون ممارسة الرياضة لذلك فأنى لا أجد فرصة لممارستها				
٣	أكون متعب جداً بعد العمل فلا أستطيع ممارسة الرياضة				
٤	كنت أفكر في زيادة التمارين الرياضية لكن لا يبدو أنني أستطيع البدء بذلك				
٥	أنني كبير في السن لذا فممارسة الرياضة تشكل خطرا على				
٦	لا أمارس الرياضة كثيرا وذلك لأنني لم أتعلم مهارات إي نوع من أنواع الرياضة				
٧	المسابح، المسارات، الدراجات ..... الخ غير متوفرة للاستخدام بالنسبة لي				
٨	ممارسة الرياضة تأخذ الكثير من وقت التزامات أخرى مثل وقت العمل والاسرة				
٩	أشعر بالخجل من منظري وأنا أمارس الرياضة مع الاخرين				
١٠	أنا لا أحصل على القدر المكافئ من النوم فلا أستطيع الاستيقاظ مبكراً أو البقاء في الليل لممارسة الرياضة				
١١	من الأسهل علي ايجاد عذر لعدم ممارسه الرياضه من الخروج لعمل شئ آخر				
١٢	أنا أعرف أناس كثيرين أذوا أنفسهم من كثرة ممارسة الرياضة				
١٣	أنا أرى أنه لا يمكن تعلم أي رياضه جديدة في مثل سني				
١٤	أن ممارسة الرياضة أمر مكلف جداً فيجب على شراء أدوات رياضيه أو أخذ دروس رياضيه				
١٥	وقت فراغي أثناء اليوم ضيق جداً لا يكفي لأداء التمارين الرياضية				
١٦	نشاطاتي الاجتماعية المعتادة مع العائلة والأصدقاء لا تتضمن أي نشاط رياضي				
١٧	أنا متعبة جداً خلال أيام الأسبوع واحتاج أيام العطلة للراحة وليس للرياضة				
١٨	أريد ان أمارس المزيد ولكن يبدوا أنني لا أستطيع أن استمر على شيء معين				
١٩	أخاف ان أوذى نفسي او أصاب بأزمه قلبيه				
٢٠	ليس لدي القدرة الكافية لتحويل ممارسة الرياضة لمتعه				
٢١	لو كانت هناك أجهزه رياضية وغرف للاستحمام في موقع العمل لكان من الأرجح ان أقوم بالتمارين الرياضية				
٢٢	معتقداتي الدينيه لا تسمح لي بممارسه النشاط البدني				
٢٣	الطقس (الحراو البرد الشديدين) لا يسمح لي بممارسه النشاط البدني				
٢٤	الملابس الرياضيه غير لا تتناسب مع مجتمعنا				
٢٥	النشاط البدني في الصيف غير مناسب لي				
٢٦	أخلاقياتي الدينيه لا تسمح لي بممارسه النشاط البدني				
٢٧	البيئه المحيطه لا يسمح لي بممارسه النشاط البدني				

How likely are you to say?	Very likely 3	Somewhat likely 2	Somewhat unlikely 1	Very unlikely 0
1. My day is so busy now, I just don't think I can make the time to include physical activity in my regular schedule.				
2. None of my family members or friends like to do anything active, so I don't have a chance to exercise.				
3. I'm just too tired after work to get any exercise.				
4. I've been thinking about getting more exercise, but I just can't seem to get started				
5. I'm getting older so exercise can be risky.				
6. I don't get enough exercise because I have never learned the skills for any sport.				
7. I don't have access to jogging trails, swimming pools, bike paths, etc.				
8. Physical activity takes too much time away from other commitments—time, work, family, etc.				
9. I'm embarrassed about how I will look when I exercise with others.				
10. I don't get enough sleep as it is. I just couldn't get up early or stay up late to get some exercise.				
11. It's easier for me to find excuses not to exercise than to go out to do something.				
12. I know of too many people who have hurt themselves by overdoing it with exercise.				
13. I really can't see me learning a new sport at my age.				
14. It's just too expensive. You have to take a class or join a club or buy the right equipment.				
15. My free times during the day are too short to include exercise.				
16. My usual social activities with family or friends do not include physical activity				
17. I'm too tired during the week and I need the weekend to catch up on my rest.				
18. I want to get more exercise, but I just can't seem to make myself stick to anything.				
19. I'm afraid I might injure myself or have a heart attack.				
20. I'm not good enough at any physical activity to make it fun.				
21. If we had exercise facilities and showers at work, then I would be more likely to exercise.				
22. my religious believes are not supportive for PA				
23.extreme hot weather is an obstacle				
24.sports cloths are not culturally appropriate				
25.PA in the summer times is not convenient to me				
26.My religious thoughts are against performing PA				
27.the environment around be is not supportive for PA				

Factor analysis and reliability test results

Initially, the factorability of the 27 items/questions was examined. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.711, above the commonly recommended value of 0.600. Bartlett's test of sphericity (test of at least one significant correlation between 2 of the items studied) was also significant (χ_2 (351) = 2600.175, p < .05).[1] The communalities (proportion of item's variance explained by the extracted factors) were all above 0.300, further confirming that each item shared some common variance with other items. Given these overall indicators, factor analysis was regarded to be suitable with all the 27 items/questions.

PCA for 9 components solution namely lack of willpower/time/energy and skills, fear of injury, lack of time/ lack of energy, environmental barriers, religious barriers, lack of willpower, lack of skills/ social support and lack of resources, explained 13.1%, 11.4%, and 9.2%, 9.0%, 7.2%, 5.1%, 4.3%, 3.8% and 3.6% of the variance respectively.

None of the 27 items were eliminated because they all met a minimum criteria of having a primary factor loading (how much a factor explains a variable) of 0.4 or above. Solutions for the nine components were examined using Oblimin rotation of the factor loading matrix. The factor loading matrix for this final solution is presented in Table 1. All factor loadings were in the same direction of the barrier categories used in the current study where a set of three items instructed a barrier category mainly component 2, 4, 5, 6, and 9 representing fear from injury, environmental barriers, religious barriers, lack of willpower, and lack of resources respectively. However, cross contributions were evident in four out of the nine extracted components namely component 1 (lack of willpower, time, energy and skills), component 3(lack of time and energy), component 7 (lack of social support and skills), and component 8 (lack of social support and energy). Component correlation matrix, presented in table 2, shows weak correlations between the extracted nine components <0.200 except for the correlations of

0.201and -0.204 between component 6 (lack of willpower) with 7 (combination of lack of skills and social support) and 2 (fear of injury) with 9 (lack of resources) respectively.

McDonald's coefficient Omega was equal to 0.750 indicating moderate reliability of the 27 items/questions scale.[2]

Table 1: The extracted components and factor loadings based on a principal components analysis with Oblimin rotation for the 27 items/questions used in the current study (N = 305)

Items/ questions	Extracted components (1-9)*								
	1	2	3	4	5	6	7	8	9
Q4	.503					-.502			
Q19		.879							
Q12		.801							
Q5		.791							
Q1			.745						
Q15			.743						
Q17			.721						
Q3	.351		.604						
Q8	-.423		.468						
Q24				.922					
Q26				.909					
Q22				.839					
Q25					.899				
Q23					.871				
Q27					.777				
Q20						-.788			
Q11									
Q18						-.748			
Q16							-.789		
Q13							-.712		
Q6	.470						-.538		
Q2							-.390		

Q9								.819	
Q10	.383							.622	
Q14									.802
Q7									.765
Q21									.761

*1=lack of willpower/energy/time/skills, 2=fear of injury, 3=lack of time/ lack of energy, 4=environmental barriers, 5=religious barriers, 6=lack of willpower, 7=lack of skills/ social support, 8=lack of energy/social support and 9=lack of resources.

Table 2: Component correlation matrix

Extracted components*	1	2	3	4	5	6	7	8	9
1	1.000	-.008	.017	.028	-.046	-.151	-.049	.020	.149
2	-.008	1.000	-.099	-.023	.025	-.028	-.199	.000	-.204
3	.017	-.099	1.000	.063	-.117	-.127	-.043	.145	.009
4	.028	-.023	.063	1.000	.014	.004	-.016	.051	.019
5	-.046	.025	-.117	.014	1.000	.062	-.014	-.034	-.021
6	-.151	-.028	-.127	.004	.062	1.000	.207	-.153	-.125
7	-.049	-.199	-.043	-.016	-.014	.207	1.000	-.134	-.009
8	.020	.000	.145	.051	-.034	-.153	-.134	1.000	.014
9	.149	-.204	.009	.019	-.021	-.125	-.009	.014	1.000

*1=lack of willpower/energy/time/skills, 2=fear of injury, 3=lack of time/ lack of energy, 4=environmental barriers, 5=religious barriers, 6=lack of willpower, 7=lack of skills/ social support, 8=lack of energy/social support and 9=lack of resources.

Further Factor analysis and reliability tests were conducted on the studied barrier subscales (3 questions per barrier). Table 3 provide factor loadings and McDonald's coefficient Omega for all the nine subscales used in the current study indicating excellent sub-scale quality.

Table 3: Factor loadings and McDonald's coefficient Omega for the study subscales

Barrier categories	Items/questions	factor loadings	Omega
Lack of time	Q15	0.826	0.900
	Q1	0.798	
	Q8	0.618	
Lack of social support	Q16	0.734	0.900
	Q2	0.680	
	Q9	0.534	
Lack of energy	Q3	0.755	0.900
	Q17	0.720	
	Q10	0.581	
Lack of willpower	Q18	0.837	0.900
	Q4	0.746	
	Q11	0.691	

Fear of injury	Q19	0.904	0.900
	Q12	0.823	
	Q5	0.803	
Lack of skills	Q6	0.840	0.900
	Q13	0.646	
	Q20	0.560	
Lack of resources	Q7	0.837	0.900
	Q21	0.831	
	Q14	0.754	
Religious barriers	Q25	0.905	0.900
	Q23	0.872	
	Q27	0.786	
Environmental barriers	Q24	0.924	0.900
	Q26	0.913	
	Q22	0.847	

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STROBE Statement—checklist of items that should be included in reports of observational studies

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