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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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**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 consistently¹¹ 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

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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 constraints 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

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2 with T2D using adapted questions from the Centers for Disease Control and Prevention
3 (CDC) questionnaire³¹ conducted in April/ May 2015 in Muscat (Urban communities).
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5 Reporting of this study follows the guidelines for strengthening the reporting of
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7 observational studies in epidemiology (STROBE).³²
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10 All patients with T2D attending their routine diabetes clinics in 17 randomly selected
11 primary health care centres in Muscat were approached to take part in the study.
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13 Inclusion criteria were age >18 years and being followed up in a diabetes clinic for > 2
14 years and ability to provide informed consent. For illiterate participants, informed
15 consents were taken from their spouse, son, daughter or other close family member.
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17 Participants with type 1 diabetes, newly diagnosed (<6 months) or who had difficulty in
18 performing any physical activity, including history of myocardial infarction of <6
19 months and multiple organ failure, were excluded.
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29 **Data sources/ measurement**

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32 In addition to recording physiological data (BMI, medication, duration of diabetes,
33 blood pressure, lipid profile, and comorbidities coinciding with diabetes) from the
34 electronic health system, a multi-section questionnaire with a range of answers in closed
35 format was administered by a trained interviewer. The following information was
36 collected:
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44 *Socio-demographic data:* included gender, age, marital status, education, household
45 income, and work status
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49 *Perceptions on stage of change in physical activity:* Based on the trans-theoretical
50 theory of behaviour change,³³ subjects were asked to identify their perceived stage of
51 change in physical activity. Participants were to select “Maintenance stage” if they were
52 participating in moderate physical activity five or more times per week or in vigorous
53 activity three to five times per week longer than six consecutive months or select
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1 “Action stage” if less than six months. “Preparation stage” was selected by subjects who
2 were thinking about starting exercise such as walking in the near future, or doing
3 vigorous activity less than three times per week, or moderate activity less than five
4 times per week. Contemplation stage “getting ready” was selected by subjects who were
5 thinking about starting exercise or walk in the next six months. Subjects who were not
6 thinking about starting any PA in the near future selected pre-contemplation stage “not
7 ready”.

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18 *CDC questionnaire on barriers to leisure PA:*

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20 An English to Arabic translated CDC questionnaire “Barriers to Being Active” was
21 used in a study in Saudi Arabia¹⁴ with 21 questions on seven barriers (lack of time, lack
22 of social support, lack of energy, lack of willpower, fear of injury, lack of skill and lack
23 of resources). Permission to use the questionnaire was obtained from the lead author on
24 November 24, 2014
25 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2813614/figure/F0001/>). The
26 questionnaire was developed further to include two additional barrier categories, namely
27 religion and environment. These additional questions were included due to other similar
28 studies in neighbour countries with similar socio-economical characteristics.^{28 29}
29 Potential religious barriers considered questions on religious beliefs restricting PA,
30 accepted clothing for PA and religious perceptions on PA.^{14 25 26} Potential
31 environmental barriers included questions on extreme weather conditions, physical
32 activity in summer time and availability of appropriate environment for PA.^{16 25} A set of
33 three related questions (total of 27 questions) presented in random order within the
34 questionnaire represented one barrier category.

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54 A scoring system³¹ was used to indicate how likely each statement/question was
55 considered to be a barrier (very likely=3, somewhat likely=2, somewhat unlikely=1,
56 very unlikely=0). Scores of the three theme-related questions were added up to provide
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1 a total for each category of barriers. Possible scores for each barrier category ranged
2 from 0-9. A score of ≥ 5 was considered as an important significant barrier.³¹ The
3 questionnaire was pre-tested in Muscat by distributing to 25 randomly selected adult
4 patients with T2D from a population outside the sampled health centres. Amendments
5 were made to ensure translation to Arabic was appropriate and PA related definitions
6 were met. A copy of the used questionnaire can be found in online supplementary
7 material1.
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10 **Study size**

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

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

33 Descriptive statistics were expressed as percentages and mean (SD), median (quartiles)
34 to describe the study sample characteristics. Sum of scores from the three related
35 questions per category (range from 0-9) were expressed as median, the 25th, and 75th
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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/m² where 89% (n=271) had BMI >25kg/m² in which 50% (n=153) were obese (BMI>30 kg/m²) and 39% (n=118) were overweight (BMI>25-29.99 kg/m²). 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	Female	Total population
	130(43%)	175(57%)	n=305(100%)
Age (years)	(25 th ,50 th ,75 th) 51,60,66	(25 th ,50 th ,75 th) 49,56,63	(25 th ,50 th ,75 th) 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

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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

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2 older adults ($P=0.008$), unemployed ($P=0.007$), uneducated ($P=<0.001$), or individuals
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4 reporting in-active stages of PA ($P=<0.001$). Furthermore, “Lack of skills” was reported
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6 as a significant barrier more frequently by females ($P=0.003$), younger adults
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8 ($P=0.025$), unemployed ($P=0.004$) or uneducated ($P=0.01$). Additionally, “Lack of
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10 resources” was reported as a significant barrier more frequently by married adults
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12 ($P=0.026$) or with lower income ($P=0.005$). It is notable that the religious and
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14 environmental barriers had no significant associations with any of the studied factors
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16 (Table 2).
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Table 2: Factors influencing high barrier scores to leisure physical activity in adult population with type 2 diabetes

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	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	>=5	<5	>=5	<5	>=5	<5	>=5	<5	>=5	<5	>=5	<5	>=5	<5	>=5	<5	>=5
	243 (79.7)	62 (20.3)	216 (70.8)	89 (29.2)	249 (81.6)	56 (18.4)	166 (54.4)	139 (45.6)	227 (74.4)	78 (25.6)	239 (78.4)	66 (21.6)	212 (69.5)	93 (30.5)	292 (95.7)	13 (4.3)	269 (88.2)	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 χ^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 χ^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 χ^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 37	38	33	56	15	49	22	42	29	62	9	65	6	52	19	69	2	62	9

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4	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)
5	Corrected χ^2	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)	
6	(P-value)																		
7	Education:																		
8	Uneducated	132	17	99	50	129	20	81	68	96	53	107	42	105	44	140	9	133	16
9	149(48.9)	(88.6)	(11.4)	(66.4)	(33.6)	(86.6)	(13.4)	(54.4)	(45.6)	(64.4)	(35.6)	(71.8)	(28.2)	(70.5)	(29.5)	(94.0)	(6.0)	(89.3)	(10.7)
10	Educated-	111	45	117	39	120	36	85	71	131	25	132	24	107	49	152	4	136	20
11	156(51.1)	(71.2)	(28.8)	(75)	(25)	(76.9)	(23.1)	(54.5)	(45.5)	(84)	(16)	(84.6)	(15.4)	(68.6)	(31.4)	(97.4)	(2.6)	(87.2)	(12.8)
12	Corrected χ^2	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)	
13	(P-value)																		
14	Income:																		
15	<500	100	20	88	32	94	26	55	65	95	25	92	28	72	48	113	7	110	10
16	120(39.3)	(83.3)	(16.7)	(73.3)	(26.7)	(78.3)	(21.7)	(45.8)	(54.2)	(79.2)	(20.8)	(76.7)	(23.3)	(60)	(40)	(94.2)	(5.8)	(91.7)	(8.3)
17	>=500	143	42	128	57	155	30	111	74	132	53	147	38	140	45	179	6	159	26
18	185(60.7)	(77.3)	(22.7)	(69.2)	(30.8)	(83.8)	(16.2)	(60)	(40)	(71.4)	(28.6)	(79.5)	(20.5)	(75.7)	(24.3)	(96.8)	(3.2)	(85.9)	(14.1)
19	Corrected χ^2	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)	
20	(P-value)																		
21	Self-reported stages of PA:																		
22	Not active	169	38	148	59	170	37	102	105	141	66	157	50	146	61	198	9	179	28
23	207(67.9)	(81.6)	(18.4)	(71.5)	(28.5)	(82.1)	(17.9)	(49.3)	(50.7)	(68.1)	(31.9)	(75.8)	(24.2)	(70.5)	(29.5)	(95.7)	(4.3)	(86.5)	(13.5)
24	Active	74	24	68	30	79	19	64	34	86	12	82	16	66	32	94	4	90	8
25	98(32.1)	(75.5)	(24.5)	(69.4)	(30.6)	(80.6)	(19.4)	(65.3)	(34.7)	(87.8)	(12.2)	(83.7)	(16.3)	(67.3)	(32.7)	(95.9)	(4.1)	(91.8)	(8.2)
26	Corrected χ^2	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)	
27	(P-value)																		

* Significant at P<0.05

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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 USA³⁸ 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

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

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

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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 females¹⁴ 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 jeopardized 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

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

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

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

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10 The authors declare that they have no competing interests.
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18 corresponding author.
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21 **AUTHERS' CONTRIBUTION**

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24 TS is the principal investigator in charge of the project. SM, YA, EB, AC and ASA
25
26 have all been involved in designing the intervention and the evaluation. TS prepared the
27
28 initial draft of the manuscript and all other authors have contributed. All authors have
29
30 critically reviewed and approved the final version of the manuscript.
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45 **DATA SHARING STATEMENT** No additional data are available.
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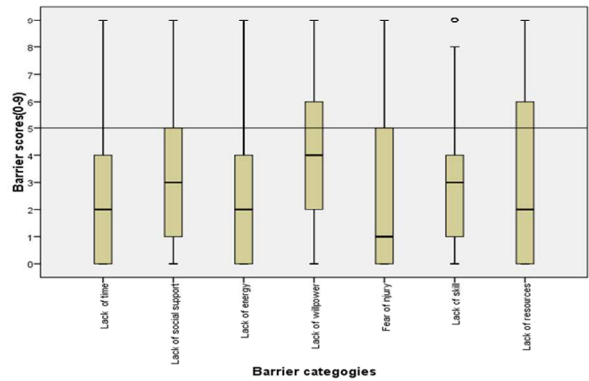
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Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (significant scores defined as ≥ 5)

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

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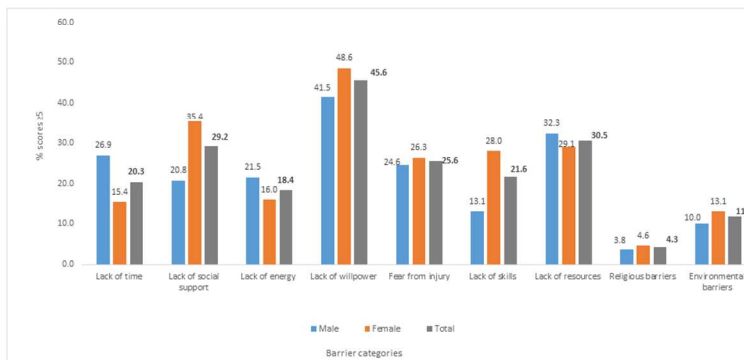


Box and Whisker plots for the reported barrier sum scores of 0-9 (significant scores defined as ≥ 5)

338x190mm (96 x 96 DPI)

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Percentage of reported barrier scores ≥ 5 by gender

338x190mm (96 x 96 DPI)

review only

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)
Title and abstract	1	1 & 2-3
Introduction		
Background/rationale	2	4
Objectives	3	5
Methods		
Study design	4	5
Setting	5	6
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Study size	10	8
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Descriptive data	14	8-9
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Discussion		
Key results	18	16-18
Limitations	19	19
Interpretation	20	19
Generalisability	21	19
Other information		
Funding	22	20

BMJ Open

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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-016946.R1
Article Type:	Research
Date Submitted by the Author:	20-Jun-2017
Complete List of Authors:	Alghafri, Thamra; Ministry of Health, Planning Alharthi, Saud; Ministry of Health, Medicine Al-Farsi, Yahya; Sultan Qaboos University College of Medicine and Health Science, FAMCO Bannerman, Elaine; Ninewells Hospital and Medical School., Centre for Public Health Nutrition Research, University of Dundee Craigie, Angela; Centre for Research into Cancer Prevention and Screening, Medical Research Institute, University of Dundee Anderson, Annie; Ninewells Hospital and Medical School, Centre for Public Health Nutrition Research, University of Dundee
Primary Subject Heading:	Diabetes and endocrinology
Secondary Subject Heading:	Sports and exercise medicine
Keywords:	Physical Activity, Type 2 diabetes, Primary health care, Barriers, Oman, General diabetes < DIABETES & ENDOCRINOLOGY, PUBLIC HEALTH, SPORTS MEDICINE

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Manuscripts

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

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

30 **FUNDING:** The Oman Ministry of Health funded this project.

31 **CONFLICTS OF INTEREST:** No competing interests.

32 **ABSTRACT**

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

38 **Design:** Cross-sectional study using an Arabic version of the “Barriers to Being Active”
39 27 item questionnaire, socio-demographic information and questions on perceived
40 stages of change in physical activity.

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

42 **Participants:** Individuals >18 years with type 2 diabetes, attending diabetes clinic for >
43 2 years and with no contraindications to performing physical activity.

44 **Primary and secondary outcome measures:**

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

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2 47 energy, willpower, skills, resources, religion and environment. On a scale of 0-9,
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4 48 barriers were considered important if scored ≥ 5 .

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8 49 **Results:** A total of 305 questionnaires were collected. Most (96%) reported at least one
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10 50 barrier to performing leisure time physical activity. Lack of willpower (44.4%), lack of
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12 51 resources (30.5%) and lack of social support (29.2%) were the most frequently reported
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14 52 barriers. Using chi-square test, lack of willpower was significantly different in
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16 53 individuals with low vs high income (54.2% vs 40%, $P=0.002$) and in those reporting
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18 54 inactive vs active stages of change for physical activity (50.7% vs 34.7%, $P=0.029$),
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20 55 lack of resources was significantly different in those with low vs high income (40% vs
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22 56 24.3%, $P=0.004$) and married vs unmarried (33.8% vs 18.5%, $P=0.018$). Lack of social
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24 57 support was significant in females vs males (35.4% vs 20.8%, $P=0.005$).

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28 58 **Conclusions:** These findings suggest that physical activity interventions should be cost
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30 59 neutral and target psycho-social factors including self-efficacy and social support.

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33 60 **Key words:** Physical Activity, Type 2 diabetes, Primary health care, Barriers, Oman

34 35 36 61 **ARTICLE SUMMARY**

37 38 62 **Strengths and limitations of this study**

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41 63 ▪ Barriers to performing leisure physical activity for adults with type 2 diabetes were
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43 64 investigated in Oman where prevalence of both diabetes and physical inactivity is
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45 65 high.
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47 66 ▪ Questions on possible barriers to performing physical activity linked to religion and
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49 67 environment were included.
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51 68 ▪ The tool used in this study was an English to Arabic language translated
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53 69 questionnaire that may have affected the validity of questions.
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55 70 ▪ The subjective nature of self-reports may have limited the accuracy of outcomes.
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71 INTRODUCTION

72 Oman is located in Southwest Asia on the Southeast coast of the Arabian Peninsula.
73 Similar to its neighbouring countries (United Arab Emirates, Saudi Arabia, Qatar,
74 Bahrain, and Kuwait), Oman has witnessed enormous economic advancement in recent
75 decades, along with significant increases in non-communicable diseases including a
76 rising prevalence of diabetes. Diabetes prevalence in Oman has increased from 8.3% in
77 1991 to 12.3% in 2008 and recent estimates are in the order of 14.8%, exceeding global
78 rates.^{1 2} The World Health Organization (WHO) has indicated that physical inactivity is
79 one of the top ten leading global causes of mortality and disability worldwide, and the
80 principal cause for approximately 27% of diabetes, and approximately 30% of ischemic
81 heart disease.³ In Oman, it has been reported that almost 70% of the population are
82 physically inactive (daily activity of ≤ 10 minutes).⁴ This raises concerns regarding the
83 impact these high levels of physical inactivity may be having on lifestyle related chronic
84 diseases including diabetes, on health care expenditures and overall population health.⁵

85 The protective effects of physical activity (PA) in the management of diabetes,
86 specifically type 2 diabetes (T2D), have been widely reported.^{6 7} WHO recommends at
87 least 150 minutes of moderate to vigorous physical activity or 75 minutes of vigorous
88 PA/week.⁸ However, over 60% of patients with diabetes in western countries do not
89 meet the recommended levels of PA.^{9 10} The Oman World Health Survey (OWHS)
90 2008, reported that in Oman, only 15% of patients with diabetes (98% of them with type
91 2 diabetes) met PA recommendations using the Global Physical Activity Questionnaire
92 (GPAQ).²

93 The importance of leisure time PA in meeting PA recommendations is consistently¹¹
94 associated with reduced mortality risks (20% to >37% risk reduction) and favourable
95 cardiovascular outcomes.¹² This relationship appears to have a dose-response effect
96 where the upper threshold for mortality benefit occurs at 3 to 5 times the leisure PA

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2 97 recommendations of 7.5-<15 MET h/wk.¹² No clear association is observed for
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4 98 occupational or travel physical activity.¹³
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7 99 Theoretical models underpinning effective interventions to promote personalized PA
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9 100 (contents, methods and approaches) should focus on benefits and ways to overcome
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11 101 barriers to PA.¹⁴ Literature to date mainly from western countries has reported a number
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13 102 of potential barriers to performing PA in adults with diabetes. These include lack of
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15 103 time,¹⁵⁻¹⁸ physical constrains including pain,¹⁹ lack of knowledge and limited facilities.²⁰
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18 104 Differences in reporting barriers to PA have been noted across genders, age groups,
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20 105 environments, cultures and disease status. Female gender, increasing age, unsafe
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22 106 neighbourhoods, being overweight and being a smoker increased the odds of reporting
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24 107 barriers to PA among migrant populations like African Americans, South Asian British
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26 108 and Mexican Americans.²¹⁻²³ In the Arab countries, modest evidence on barriers to PA
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28 109 in both the general population and in adults with T2D suggests that lack of time, co-
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30 110 existing diseases and adverse weather conditions^{14 24-29} are the main factors. Moreover,
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32 111 the climate in this region may be a drawback to meeting recommended levels of PA due
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34 112 to high temperatures during the day, particularly in the sandy/desert areas. During the
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36 113 summer months, these countries including Oman experience major heat waves (>40
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38 114 degrees celsius) and humidity levels that could reach 90%.
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42 115 The current study aimed to identify barriers to performing leisure-time PA in adults
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44 116 with T2D in Oman, and the distribution of barrier scores across different socio-
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46 117 demographic characteristics and perceived stages of change in PA.
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118 **METHODS**

119 **Study design, setting and participants**

120 This cross-sectional interview based study was part of a larger study that examined
121 correlates of physical activity and sitting time in adults with type 2 diabetes, and
122 barriers to leisure physical activity in the same population. Results regarding the PA
123 patterns of the population using the Global Physical Activity Questionnaire are
124 reported elsewhere.³⁰ This current paper identified barriers to performing leisure
125 physical activity expressed by Omani adults with T2D using adapted questions from the
126 Centers for Disease Control and Prevention (CDC) questionnaire³¹ conducted in April/
127 May 2015 in Muscat (Urban communities). Reporting of this study follows the
128 guidelines for strengthening the reporting of observational studies in epidemiology
129 (STROBE).³²

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

138 **Data sources/ measurement**

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

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2 142 range of answers in closed format was administered by a trained interviewer. The
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4 143 following information was collected:

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6 144 *Socio-demographic data:* included gender, age, marital status, education, household
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8 145 income, and employment.

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11 146 *Perceptions on stage of change in physical activity:* Based on the trans-theoretical
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13 147 theory of behaviour change,³³ subjects were asked to identify their perceived stage of
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15 148 change in physical activity. Participants were to select “Maintenance stage” if they were
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17 149 participating in moderate physical activity five or more times per week or in vigorous
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19 150 activity three to five times per week longer than six consecutive months or select
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21 151 “Action stage” if less than six months. “Preparation stage” was selected by subjects who
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23 152 were thinking about starting exercise such as walking in the near future, or doing
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25 153 vigorous activity less than three times per week, or moderate activity less than five
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27 154 times per week. Contemplation stage “getting ready” was selected by subjects who were
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29 155 thinking about starting exercise or walk in the next six months. Subjects who were not
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31 156 thinking about starting any PA in the near future selected pre-contemplation stage “not
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33 157 ready”.

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38 158 *CDC questionnaire on barriers to leisure PA:*

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41 159 An English to Arabic translated CDC questionnaire “Barriers to Being Active” was
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43 160 used in a study in Saudi Arabia¹⁴ with 21 questions on seven barriers (lack of time, lack
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45 161 of social support, lack of energy, lack of willpower, fear of injury, lack of skill and lack
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47 162 of resources). Permission to use the questionnaire was obtained from the lead author on
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49 163 November 24, 2014
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51 164 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2813614/figure/F0001/>). However, in
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53 165 that tool no statements on religion or environment as possible barriers to PA were
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55 166 included. To address this gap and to formulate robust items on these topics we
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167 undertook several procedures. Literature search was conducted to identify possible
168 content for the new items from similar studies in neighbour countries with similar socio-
169 economical characteristics.^{28 29} Potential religious barriers considered questions on
170 religious beliefs restricting PA, accepted clothing for PA and religious perceptions on
171 PA.^{14 25 26} Potential environmental barriers included questions on extreme weather
172 conditions, physical activity in summer time and availability of appropriate environment
173 for PA.^{16 25} Content and face validity of the questionnaire were assessed by our
174 investigatory team and draft questions were then discussed with a sample of patients
175 prior to field testing and adjustments were made to ease comprehension and ensure
176 translation to Arabic was appropriate.

177 A set of three related questions (total of 27 questions) presented in random order within
178 the questionnaire represented one barrier category. A scoring system³¹ was used to
179 indicate how likely each statement/item was considered to be a barrier (very likely=3,
180 somewhat likely=2, somewhat unlikely=1, very unlikely=0). Scores of the three theme-
181 related questions were added up to provide a total for each category of barriers. Possible
182 scores for each barrier category ranged from 0-9. A score of ≥ 5 was considered as an
183 important barrier to overcome.³¹ A copy of the used (Arabic) questionnaire can be found
184 in online supplementary material.

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

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

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193 **Study size**

194 Power analysis was performed to estimate the prevalence of meeting PA
195 recommendations in adult population with T2D in a parallel study conducted in the
196 same population.³⁶ We assumed that meeting PA recommendation is indirectly related
197 to reporting less barriers to PA³⁷ and used an estimated 15% prevalence of adequate PA
198 in patients with diabetes, as reported in the 2008 Oman World Health Survey
199 (OWHS).³⁸ Using 95% confidence limits, a response rate of 80%, and a precision of +/-
200 4%, and smallest expected frequency of 15%, the calculated sample size was ~300
201 participants across primary health centres in Muscat region, the capital of Oman.

202 **Training**

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

209 **Statistical methods**

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

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

227 **RESULTS**

228 **Socio-demographic**

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

237 **Physiological status**

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

242 taking anti-hypertensives (78%) and two-thirds of those using lipid lowering drugs
 243 (66%) had blood pressure (BP) readings and fasting serum cholesterol within target
 244 levels (BP<140/80 mmHg and fasting serum cholesterol of <5mmol/l).⁴⁰ Fifteen percent
 245 (n=45) were controlling their diabetes by diet alone versus 85% (n=260) on oral anti-
 246 hypoglycaemic medications, in which 25% (n=75) were additionally on insulin. Mean
 247 (SD) BMI was 31.0 (6.0) kg/m² where 89% (n=271) had BMI >25kg/m² in which 50%
 248 (n=153) were obese (BMI>30 kg/m²) and 39% (n=118) were overweight (BMI>25-
 249 29.99 kg/m²). Glycated haemoglobin HbA1c was >7% (>48 mmol/mol) in more than
 250 half of the population (58%) indicating poor diabetes control (Table 1).

251 Self-reported stages of PA

252 Only 17% (n=52) of participants considered themselves actively participating in regular
 253 moderate or vigorous PA (22% of males vs 13% of females). Of the remainder, the
 254 majority reported being “not ready” (37%), “getting ready” (31%) or in “preparation”
 255 (15%) (Table 1).

256 **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
	No	28 (9)	263
Current medication			
	Anti-HTN	217(71)	266
	Lipid lowering drugs	189(62)	267
	Oral-hypoglycaemic drugs	260(85)	268
	Oral-hypoglycaemic drugs with Insulin	75(25)	269
	Diet control	45(15)	270
			271
			272
Blood pressure (systolic/diastolic) mmHg**			
	Within target (<140/<80)	237(78)	274
	High (≥140/≥80)	68(22)	275
			276
Fasting lipid profile (mmol/l)**			
	Cholesterol within target (< 5.0)	201(66)	278
	Cholesterol high (≥5.0)	104(34)	279
			280
Body Mass Index (kg/m²)**			
	Healthy weight range (18.5-24.99)	34(11)	282
	Overweight (>25-29.99)	118(39)	283
	Obese (>30)	153(50)	284
			285
			286
HbA1c(%)**(>48 mmol/mol)			
	Normal ≤7%	127(42)	287
	High >7%	178(58)	288
			289
Self-reported stages of PA			
	Not ready (Pre-contemplation)	112(37)	290
	Getting ready(contemplation)	95(31)	291
	Preparation	46(15)	292
	Action	14(5)	293
	Maintenance	38(12)	294
			295
			296

*Reported hypertension

297 n, hyperlipidaemia, thyroid dysfunction or any other chronic condition coinciding with diabetes.

298 **Oman diabetes mellitus management guidelines (2015)⁴⁰

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.

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 INSERT FIGURE 1 ABOUT HERE

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2 307 _____
3 308 Categorizing barrier scores to <5 and ≥ 5 (significant barrier) highlighted that ‘lack of
4
5 309 willpower’ (n=139), ‘lack of resources’ (n=93) and ‘lack of social support’ (n=89) were
6
7 310 the most frequently reported ‘significant barriers’ to physical activity (Figure 2).
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9 311 Barriers found to be significant in both males and females were lack of willpower
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11 312 (41.5% m: 48.6% f) and lack of resources (32.3% m: 29.1% f). In addition, lack of time
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13 313 in males (26.9%) and lack of social support in females (35.4%) were also noteworthy
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15 314 (Table 2).
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20 315 _____
21 316 INSERT FIGURE 2 ABOUT HERE
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23 317 _____
24 318 Distributions of significant high barrier score (≥ 5) across the studied sociodemographic
25
26 319 factors and self-reported stages of change in PA differed among the nine barrier
27
28 320 categories: “Lack of time” was frequently highly scored by males, younger adults and
29
30 321 those who were married, employed or educated. Additionally, “Lack of social support”
31
32 322 was highly scored by females and “Lack of energy” by employed, or educated adults.
33
34 323 However, “Lack of willpower” was highly scored by individuals with lower income, or
35
36 324 at inactive stages of PA. Moreover, “Fear of injury” was highly scored by older adults,
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38 325 unemployed, uneducated, or individuals reporting in-active stages of PA. Furthermore,
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40 326 “Lack of skills” was highly scored by females, younger adults, and unemployed or
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42 327 uneducated. “Lack of resources” on the other hand, was frequently highly scored by
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44 328 married adults or with lower income. It is notable that the religious and environmental
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46 329 barriers had no significant different distributions across any of the studied factors (Table
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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 χ^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 χ^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 χ^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 χ^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

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Corrected χ^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 χ^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 χ^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

1 Factor analysis and reliability test results

2 Initially, the factorability of the 27 items/questions was examined. The Kaiser-Meyer-
3 Olkin (KMO) measure of sampling adequacy was 0.7, above the commonly
4 recommended value of 0.6. Bartlett's test of sphericity (test of at least one significant
5 correlation between 2 of the items studied) was also significant ($\chi^2(351) = 2600.175, p$
6 $< .05$).⁴¹ The communalities (proportion of item's variance explained by the extracted
7 factors) were all above 0.3, further confirming that each item shared some common
8 variance with other items. Given these overall indicators, factor analysis was regarded
9 to be suitable with all the 27 items/questions.

10 Principal components analysis (PCA) was used because the primary purpose was to
11 identify composite scores for the factors underlying the items/questions in the study
12 scale. Initial eigenvalues (statistical values used in deciding how many factors to extract
13 in the overall factor analysis where values of ≥ 1.0 are considered statistically sound)⁴²
14 indicated that the first eight factors (namely fear of injury, environmental barriers, lack
15 of willpower, lack of time/ lack of energy, lack of resources, religious barriers, lack of
16 skills/ lack of social support and lack of energy) explained 13.1%, 11.4%, and 9.2%,
17 9.0%, 7.2%, 5.1%, 4.3% and 3.8% of the variance respectively.

18 None of the 27 items/questions were eliminated because they all met a minimum criteria
19 of having a primary factor loading of 0.45 or above (magnitude of item-factor
20 relationship desirable at ≥ 0.3). Majority of the factor loadings within the study
21 items/questions were in the same direction of the barrier categories except for
22 items/questions related to lack of energy (Q3 & 17) and lack of social support (Q2 & 16)
23 which loaded up with lack of time (Q1, 8 & 15) and lack of skills (Q6 & 13)
24 respectively indicating cross contributions. McDonald's coefficient Omega was equal to
25 0.75 indicating moderate reliability of the scale.⁴²

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

30 **Table 3: KMO values, factor loadings, communalities and McDonald's coefficient**
 31 **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	

32 **DISCUSSION**

33 Despite evidence on the effectiveness of meeting PA levels in the management of T2D,
 34 and associated cardiovascular risk factors,⁶⁷ PA is poorly addressed in routine diabetes
 35 care.⁴³ Low PA levels in populations with T2D are consistently reported in western
 36 countries, for example, USA⁴⁴ as well as Arabic speaking countries namely Oman,

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2 37 Saudi Arabia and Lebanon.^{2 45 46} Addressing perceived barriers to performing
3
4 38 recommended PA levels in this population is crucial for planning effective PA
5
6 39 promoting interventions.
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9 40 Within a series of formative studies to inform a culturally congruent PA intervention in
10
11 41 diabetes care,⁴⁷ this study has looked at perceived barriers to performing leisure time
12
13 42 physical activity in an adult population with T2D attending primary care using an
14
15 43 adapted CDC questionnaire translated to Arabic language.¹⁴
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18 44 The current findings relating to willpower, resources and social support were also
19
20 45 reported as the top three barriers to PA in the Saudi population attending primary care
21
22 46 by AlQuaiz (2009).¹⁴ In the West, USA in particular, the strongest reported barriers to
23
24 47 physical activity among adults with T2D were pain (41%), followed by lack of
25
26 48 willpower (27%), and poor health (21%).⁴⁸
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30 49 In the current study, lack of willpower was significantly highly reported by individuals
31
32 50 with low income. This finding is difficult to interpret in the absence of true verifications
33
34 51 for the self-reported house hold income. However low income could be linked to
35
36 52 financial constrains which were reported to have negative influence on intention to
37
38 53 participate in leisure-time physical activity in adult population with T2D in Canada.⁴⁹
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40 54 Additionally in a study in USA, older individuals with low income who were found
41
42 55 hopeless and had low participation in social activities had less odds of engaging in PA.⁵⁰
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44 56 None the less, more evidence is needed to explain how income alters the willpower for
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46 57 performing leisure PA in Arabic speaking countries namely Oman. Comparably, Lack
47
48 58 of willpower was more likely to be reported by individuals at inactive stages of physical
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50 59 activity (pre-contemplation or contemplation stages of physical activity) than those in
51
52 60 active stages. Progressive stages of behavioural change according to the trans-
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54 61 theoretical model were direct correlates to PA in a review article by Trost (2002)⁵¹ and
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56 62 direct determinants in another by Van Stralen (2009).⁵² This finding supports the need
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2 63 for programs to help raise self-willpower/determination through stepped process of
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4 64 behaviour change from inactive (pre-contemplation) to active stages of PA (action and
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6 65 maintenance).⁵³ Interestingly, fear of injury was the only other reported barrier
7
8 66 significantly different between individuals at inactive vs active stages of change in PA.
9
10 67 This could be explained by possible physical constraints pertaining to older age⁵⁰ and
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12 68 existing comorbidities in the current study population triggering fear of injuries
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14 69 associated with PA.

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18 70 Limited resources including high cost and limited facilities for PA have been reported
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20 71 as significant barriers to PA across different cultures.^{20 22} In the current study, limited
21
22 72 resources were reported as significant by individuals who were married and those with
23
24 73 low income. Married individuals could have more financial commitments to their
25
26 74 families especially in the Gulf Cooperation Council countries where extended families
27
28 75 are common.⁵⁴ This may alter an individual's priorities for house-hold income
29
30 76 expenditure. Low income was similarly reported as a barrier in a Saudi population,
31
32 77 possibly due to the perceived high cost of utilising PA facilities.¹⁴ This may reflect a
33
34 78 narrow view on what constitutes PA and a misconception that expensive equipment is
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36 79 required. Hence, irrespective of culture, interventions promoting cost neutral PA such as
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38 80 walking in populations would be highly desirable to overcome this barrier.^{47 55}

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42 81 Lack of social support was frequently reported by females in this study. Meeting
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44 82 cultural norms and social expectations related to safety, security and conservative dress
45
46 83 mainly for females were reported as barriers to PA in South Asian (Pakistani and
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48 84 Indian) British populations^{18 21} and populations in Arabic counties such as Qatar.⁵⁶
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50 85 Evaluation of interventions to provide the necessary social support and networks to PA
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52 86 specifically for women with T2D, particularly in the countries of the Gulf Cooperation
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54 87 Council are required. Activities including group-based activities and buddying,⁵⁷⁻⁵⁹ are
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56 88 worth further investigation.
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2 89 Other reported barriers such as fear of injury and lack of skills varied across subgroups
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4 90 in particular, older, unemployed, and uneducated individuals. Older individuals with
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6 91 T2D are more vulnerable to have poor vision and osteoarthritic changes that may cause
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8 92 fall and injuries.⁶⁰ Moreover the negative influence of pain to PA in older population
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10 93 with T2D was reported in western countries,⁴⁸ and hence potential barriers to
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12 94 individuals' participation. Programs to promote PA should be individualized for type,
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14 95 frequency and intensity of PA and incorporate safety measures to prevent PA induced
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16 96 pain and injuries in older individuals.⁶¹

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20 97 Lack of time on the other hand, has been a highly cited barrier to PA in the general
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22 98 population as well as populations with diabetes.^{15-18 21 22 48 62} However, unlike the study
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24 99 by Alquaiz (2009), significant scores for lack of time in this study were higher in males
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26 100 compared to females¹⁴ along-with a lack of energy, which may be a reflection of the fact
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28 101 that more males than females were educated and employed. This perception of 'lack of
29
30 102 time', in addition to family and social commitments may jeopardized their time for PA
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32 103 especially if individuals were younger and married. This discussion highlights the
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34 104 importance of changing people's perceptions of PA but also consideration of
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36 105 opportunities in other PA domains namely work and travel that could enable individuals
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38 106 with less leisure time to increase overall PA and behaviour.

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42 107 Factors which are independent of an individual's decision-making, such as environment
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44 108 and religion had no significant associations in the current study despite the hot weather
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46 109 during data collection of this study in April/May. These null results, may be real or may
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48 110 be due to the wording of the questions and their interpretation. To address this gap in
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50 111 the literature, a qualitative exploration of possible environmental, including seasonal
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52 112 variations, and religious factors affecting PA performance may be warranted.

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56 113 Additionally, results of this study cannot be generalised across all regions in Oman.
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58 114 More information is required from rural Omani communities where perceptions on PA
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2 115 may be different. Despite the excellent scale reliability measures in the current data, the
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4 116 results cannot be generalized due to possible differences in scale quality across various
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6 117 data.⁴² Despite efforts to minimize potential bias due to the subjective nature of self-
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8 118 reports, accuracy of outcomes cannot be fully ensure.

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11 119 Finally, future attempts to explore barriers to PA should equally include work and travel
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13 120 domains to cater diversities in both PA behaviour and sedentary lifestyle across
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15 121 subgroups of adults with T2D.

122 **CONCLUSION**

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

131 **ETHICAL CONSIDERATION**

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

136 **COMPETING INTERESTS**

137 The authors declare that they have no competing interests.

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4
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6
7 140 corresponding author.
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9

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12
13 142 TS is the principal investigator in charge of the project. SM, YA, EB, AC and ASA
14
15 143 have all been involved in designing the intervention and the evaluation. TS prepared the
16
17 144 initial draft of the manuscript and all other authors have contributed. All authors have
18
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37

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24 341 **Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high**
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26 **scores defined as ≥ 5)**
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30 343 **Figure 2: Percentage of reported high barrier scores (≥ 5)**
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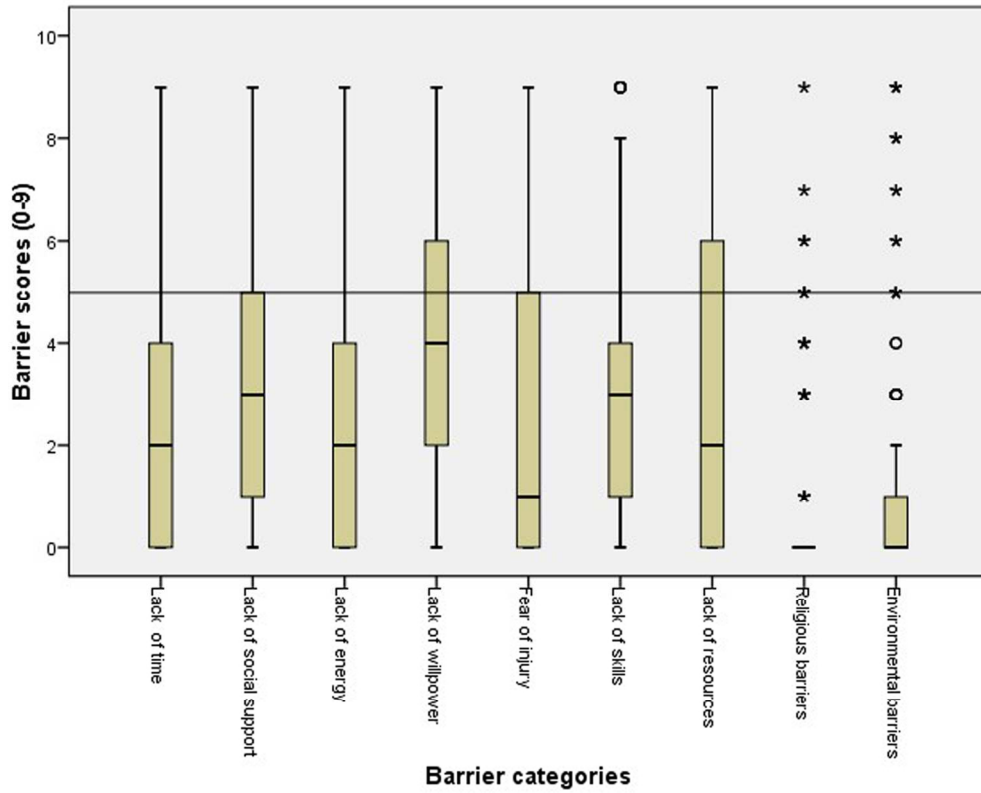


Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high scores defined as ≥ 5)

132x106mm (300 x 300 DPI)

For peer review only

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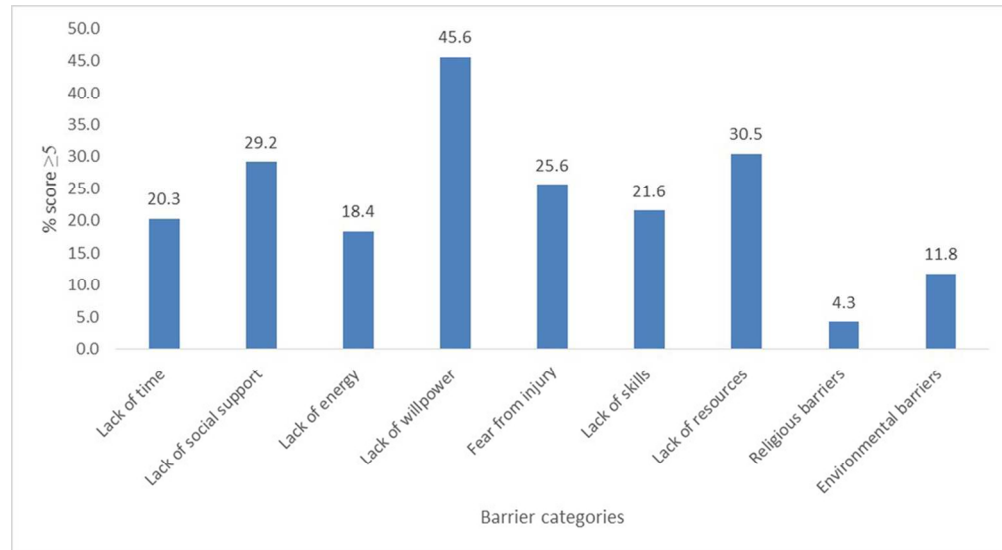


Figure 2: Percentage of reported high barrier scores (≥ 5)

96x53mm (300 x 300 DPI)

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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)
Title and abstract	1	1 & 2-3
Introduction		
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Objectives	3	5
Methods		
Study design	4	5
Setting	5	6
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Data sources/ measurement	8	6
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Descriptive data	14	8-9
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Discussion		
Key results	18	16-18
Limitations	19	19
Interpretation	20	19
Generalisability	21	19
Other information		
Funding	22	20

BMJ Open

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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Secondary Subject Heading:	Sports and exercise medicine
Keywords:	Physical Activity, Type 2 diabetes, Primary health care, Barriers, Oman, General diabetes < DIABETES & ENDOCRINOLOGY, PUBLIC HEALTH, SPORTS MEDICINE

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Manuscripts

1 **Perceived barriers to leisure time physical activity in adults with type 2 diabetes**
2 **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.

FUNDING: The Oman Ministry of Health funded this project.

CONFLICTS OF INTEREST: No competing interests.

peer review only

33 **ABSTRACT**

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

39 **Design:** Cross-sectional study using an Arabic version of the “Barriers to Being Active”
40 27 item questionnaire.

41 **Setting:** Seventeen primary health centres randomly selected in Muscat.

42 **Participants:** Individuals >18 years with type 2 diabetes, attending diabetes clinic for >
43 2 years and with no contraindications to performing physical activity.

44 **Primary and secondary outcome measures:**

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

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

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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

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

86 The protective effects of physical activity (PA) in the management of diabetes,
87 specifically type 2 diabetes (T2D), have been widely reported.^{6 7} WHO recommends at
88 least 150 minutes of moderate to vigorous physical activity or 75 minutes of vigorous
89 PA/week.⁸ However, over 60% of patients with diabetes in western countries do not
90 meet the recommended levels of PA.^{9 10} The Oman World Health Survey (OWHS)
91 2008, reported that in Oman, only 15% of patients with diabetes (98% of them with type
92 2 diabetes) met PA recommendations using the Global Physical Activity Questionnaire
93 (GPAQ).²

94 The importance of leisure time PA in meeting PA recommendations is consistently¹¹
95 associated with reduced mortality risks (20% to >37% risk reduction) and favourable
96 cardiovascular outcomes.¹² This relationship appears to have a dose-response effect
97 where the upper threshold for mortality benefit occurs at 3 to 5 times the leisure PA
98 recommendations of 7.5-<15 MET h/wk.¹² No clear association is observed for
99 occupational or travel physical activity.¹³

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

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

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

119 **METHODS**

120 **Study design, setting and participants**

121 This cross-sectional interview based study was part of a larger study that examined
122 correlates of physical activity and sitting time in adults with type 2 diabetes, and
123 barriers to leisure physical activity in the same population. Results regarding the PA
124 patterns of the population using the Global Physical Activity Questionnaire are
125 reported elsewhere.³⁰ This current paper identified barriers to performing leisure
126 physical activity expressed by Omani adults with T2D using adapted questions from the
127 Centers for Disease Control and Prevention (CDC) questionnaire³¹ conducted in April/
128 May 2015 in Muscat (Urban communities). Reporting of this study follows the
129 guidelines for strengthening the reporting of observational studies in epidemiology
130 (STROBE).³²

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

139 **Data sources/ measurement**

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

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

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

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

159 *CDC questionnaire on barriers to leisure PA:*

160 An English to Arabic translated CDC questionnaire “Barriers to Being Active” was
161 used in a study in Saudi Arabia¹⁴ with 21 questions on seven barriers (lack of time, lack
162 of social support, lack of energy, lack of willpower, fear of injury, lack of skill and lack
163 of resources). Permission to use the questionnaire was obtained from the lead author on
164 November 24, 2014
165 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2813614/figure/F0001/>). However, in
166 that tool no statements on religion or environment as possible barriers to PA were
167 included. To address this gap and to formulate robust items on these topics we
168 undertook several procedures. Literature search was conducted to identify possible
169 content for the new items from similar studies in neighbour countries with similar socio-
170 economical characteristics.^{28 29} Potential religious barriers considered questions on
171 religious beliefs restricting PA, accepted clothing for PA and religious perceptions on
172 PA.^{14 25 26} Potential environmental barriers included questions on extreme weather
173 conditions, physical activity in summer time and availability of appropriate environment
174 for PA.^{16 25} Content and face validity of the questionnaire were assessed by our
175 investigatory team and draft questions were then discussed with a sample of patients
176 prior to field testing and adjustments were made to ease comprehension and ensure
177 translation to Arabic was appropriate.

178 A set of three related questions (total of 27 questions) presented in random order within
179 the questionnaire represented one barrier category. A scoring system³¹ was used to
180 indicate how likely each statement/item was considered to be a barrier (very likely=3,
181 somewhat likely=2, somewhat unlikely=1, very unlikely=0). Scores of the three theme-

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

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

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

194 **Study size**

195 Power analysis was performed to estimate the prevalence of meeting PA
196 recommendations in adult population with T2D in a parallel study conducted in the
197 same population.³⁶ We assumed that meeting PA recommendation is at least in part
198 facilitated by reporting fewer barriers to PA³⁷ and used an estimated 15% prevalence of
199 adequate PA in patients with diabetes, as reported in the 2008 Oman World Health
200 Survey (OWHS).³⁸ Using 95% confidence limits, a response rate of 80%, and a
201 precision of +/-4%, and smallest expected frequency of 15%, the calculated sample size
202 was ~300 participants across primary health centres in Muscat region, the capital of
203 Oman.

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204 **Training**

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

211 **Statistical methods**

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

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2 228 “maintenance” stages of PA. Corrected P-values (Yate’s continuity) were reported for
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4 229 high barrier scores against the studied independent variables.

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6 230 Factor analysis namely principal components analysis (PCA) was performed to identify
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8 231 composite scores for the components underlying the items/questions in the study scale.
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10 232 Eigenvalues values of ≥ 1.0 were used to determine the number of components in the
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12 233 overall factor analysis which are considered statistically sound.³⁹ Furthermore, factor
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14 234 loading matrix was examined using Oblimin rotation⁴⁰ where correlations between the
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16 235 extracted components were obtained.
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20 21 236 **RESULTS**

22 23 24 237 **Socio-demographic**

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27 238 Out of 312 patients approached, 305 (98%) completed the questionnaire. Slightly more
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29 239 females were represented in this sample (57.4%) than males. The population was
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31 240 slightly older with mean (SD) age of 57(10.8) years. Additionally, more than two-thirds
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33 241 being married (78.8%) and just about half unable to read or write (48.9%). More than a
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35 242 third of the study population (39.3%) reported household income of <500 OR (less than
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37 243 national average)⁴¹ and the majority (77%) reported unemployment (including
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39 244 retirement). More males than females were educated (70% vs 37%) and employed (45%
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41 vs 7%) (Table 1).
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45 246 **Physiological status**

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47 247 Median (LQ, UQ) duration of diabetes in this population was 6.0 (4.0, 10.0) years. The
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49 248 majority of the participants had hypertension (n=217, 71%) or/and hyperlipidaemia
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51 249 (n=189, 62%) coinciding with their diabetes. All of them were using anti-hypertensive
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53 250 or/and lipid lowering medications as appropriate. More than three-quarters of those
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55 251 taking anti-hypertensives (78%) and two-thirds of those using lipid lowering drugs
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252 (66%) had blood pressure (BP) readings and fasting serum cholesterol within target
 253 levels (BP<140/80 mmHg and fasting serum cholesterol of <5mmol/l).⁴² Fifteen percent
 254 (n=45) were controlling their diabetes by diet alone versus 85% (n=260) on oral anti-
 255 hypoglycaemic medications, in which 25% (n=75) were additionally on insulin. Mean
 256 (SD) BMI was 31.0 (6.0) kg/m² where 89% (n=271) had BMI >25kg/m² in which 50%
 257 (n=153) were obese (BMI>30 kg/m²) and 39% (n=118) were overweight (BMI>25-
 258 29.99 kg/m²). Glycated haemoglobin HbA1c was >7% (>48 mmol/mol) in more than
 259 half of the population (58%) indicating poor diabetes control (Table 1).

260 Self-reported stages of PA

261 Only 17% (n=52) of participants considered themselves actively participating in regular
 262 moderate or vigorous PA (22% of males vs 13% of females). Of the remainder, the
 263 majority reported being “not ready” (37%), “getting ready” (31%) or in “preparation”
 264 (15%) (Table 1).

265 **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)	269
No		28 (9)	270
Current medication			
Anti-HTN		217(71)	273
Lipid lowering drugs		189(62)	274
Oral-hypoglycaemic drugs		260(85)	275
Oral-hypoglycaemic drugs with Insulin		75(25)	276
Diet control		45(15)	278
Blood pressure (systolic/diastolic) mmHg**			
Within target (<140/<80)		237(78)	281
High (≥140/≥80)		68(22)	282
Fasting lipid profile (mmol/l)**			
Cholesterol within target (< 5.0)		201(66)	285
Cholesterol high (≥5.0)		104(34)	286
Body Mass Index (kg/m ²)**			
Healthy weight range (18.5-24.99)		34(11)	289
Overweight (>25-29.99)		118(39)	290
Obese (>30)		153(50)	291
HbA1c(%)**(>48 mmol/mol)			
Normal ≤7%		127(42)	294
High >7%		178(58)	295
Self-reported stages of PA			
Not ready (Pre-contemplation)		112(37)	297
Getting ready(contemplation)		95(31)	298
Preparation		46(15)	299
Action		14(5)	300
Maintenance		38(12)	301
			302
			303

*Reported hypertension, hyperlipidaemia, thyroid dysfunction or any other chronic condition coinciding with diabetes.
**Oman

304 diabetes mellitus management guidelines (2015)⁴²

305 CDC questionnaire on barriers to leisure PA

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

311

312 INSERT FIGURE 1 ABOUT HERE

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314 Categorizing barrier scores to <5 and ≥ 5 (significant barrier) highlighted that 'lack of
 315 willpower' (n=139), 'lack of resources' (n=93) and 'lack of social support' (n=89) were
 316 the most frequently reported 'significant barriers' to physical activity (Figure 2).
 317 Barriers found to be significant in both males and females were lack of willpower
 318 (41.5% m: 48.6% f) and lack of resources (32.3% m: 29.1% f). In addition, lack of time
 319 in males (26.9%) and lack of social support in females (35.4%) were also noteworthy
 320 (Table 2).

321 _____
 322 INSERT FIGURE 2 ABOUT HERE
 323 _____

324 Correlations between the sum scores of the nine studied barriers showed several weak
 325 ($R < 0.500$) but significant (P-value < 0.050) associations. Positive correlations of > 0.400
 326 were noted among lack of energy with lack of time; lack of skill with lack of social

	Lack of	Lack of social	Lack of energy	Lack of willpower	Fear of injury	Lack of	Lack of resources	Religious barriers	Environmental barriers
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327 support; and lack of skills with lack of willpower (Table 2). Interestingly, no significant
 328 correlations were seen within the religious and environmental barriers except for one
 329 weak significant positive correlation between lack of resources and environmental
 330 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

331 **Table 2: Correlations between sum scores of barrier categories**

332 *P-value <0.050

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334 Distributions of significant high barrier score (≥ 5) across the studied sociodemographic
 335 factors and self-reported stages of change in PA differed among the nine barrier
 336 categories: “Lack of time” was frequently highly scored by males, younger adults and
 337 those who were married, employed or educated. Additionally, “Lack of social support”
 338 was highly scored by females and “Lack of energy” by employed, or educated adults.
 339 However, “Lack of willpower” was highly scored by individuals with lower income, or
 340 at inactive stages of PA. Moreover, “Fear of injury” was highly scored by older adults,
 341 unemployed, uneducated, or individuals reporting in-active stages of PA. Furthermore,
 342 “Lack of skills” was highly scored by females, younger adults, and unemployed or
 343 uneducated. “Lack of resources” on the other hand, was frequently highly scored by
 344 married adults or with lower income. It is notable that the religious and environmental
 345 barriers had no significant different distributions across any of the studied factors (Table
 346 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 χ^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 χ^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 χ^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 χ^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 χ^2	13.2	2.3	4.1	0.0	14.2	6.6	0.1	1.5	0.1

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(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 χ^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 χ^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

For peer review only

1 Factor analysis and reliability test results

2 Initially, the factorability of the 27 items/questions was examined. The Kaiser-Meyer-
3 Olkin (KMO) measure of sampling adequacy was 0.711, above the commonly
4 recommended value of 0.600. Bartlett's test of sphericity (test of at least one significant
5 correlation between 2 of the items studied) was also significant ($\chi^2(351) = 2600.175, p$
6 $< .05$).⁴³ The communalities (proportion of item's variance explained by the extracted
7 factors) were all above 0.300, further confirming that each item shared some common
8 variance with other items. Given these overall indicators, factor analysis was regarded
9 to be suitable with all the 27 items/questions.

10 PCA indicated that the first eight components (1-8) with eigenvalues of ≥ 1 , namely lack
11 of resources, fear of injury, lack of time/ lack of energy, environmental barriers,
12 religious barriers, lack of willpower/skills, lack of skills/ social support and lack of
13 energy/social support, explained 13.1%, 11.4%, and 9.2%, 9.0%, 7.2%, 5.1%, 4.3% and
14 3.8% of the variance respectively.

15 None of the 27 items were eliminated because they all met a minimum criteria of having
16 a primary factor loading (how much a factor explains a variable) of 0.4 or above.

17 Solutions for the eight components were examined using Oblimin rotation of the factor
18 loading matrix. The factor loading matrix for this final solution is presented in Table 4.

19 All factor loadings were in the same direction of the barrier categories used in the
20 current study where a set of three items instructed a barrier category except for
21 items/questions related to lack of skills (Q20), lack of social support (Q16) and lack of
22 energy (Q10) which loaded up with lack of willpower (Q18, 11& 4), lack of skills (Q6
23 & 13) and lack of social support (Q9) respectively indicating cross contributions.

24 Component correlation matrix, presented (Table 5), shows weak correlations between
25 the extracted eight components < 0.200 except for the negative correlation of 0.201

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

28 McDonald's coefficient Omega was equal to 0.750 indicating moderate reliability of the
29 27 items/questions scale.³⁹

30 **Table 4: The extracted components and factor loadings based on a principal**
31 **components analysis with Oblimin rotation for the 27 items/questions used in the**
32 **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	

44 DISCUSSION

45 Despite evidence on the effectiveness of meeting PA levels in the management of T2D,
 46 and associated cardiovascular risk factors,^{6 7} PA is poorly addressed in routine diabetes
 47 care.⁴⁴ Low PA levels in populations with T2D are consistently reported in western
 48 countries, for example, USA⁴⁵ as well as Arabic speaking countries namely Oman,
 49 Saudi Arabia and Lebanon.^{2 46 47} Addressing perceived barriers to performing
 50 recommended PA levels in this population is crucial for planning effective PA
 51 promoting interventions.

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

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

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

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67 be depressed had had low participation in social activities had less odds of engaging in
68 PA.⁵¹ None the less, more evidence is needed to explain how income alters the
69 willpower for performing leisure PA in Arabic speaking countries namely Oman.
70 Comparably, lack of willpower was more likely to be reported by individuals at inactive
71 stages of physical activity (pre-contemplation or contemplation stages of physical
72 activity) than those in active stages. Progressive stages of behavioural change according
73 to the trans-theoretical model were direct correlates to PA in a review article by Trost
74 (2002)⁵² and direct determinants in another by Van Stralen (2009).⁵³ This finding
75 supports the need for programs to help raise self-willpower/determination through
76 stepped process of behaviour change from inactive (pre-contemplation) to active stages
77 of PA (action and maintenance).⁵⁴ Interestingly, fear of injury was the only other
78 reported barrier significantly different between individuals at inactive vs active stages of
79 change in PA. This could be explained by possible physical constraints pertaining to
80 older age⁵¹ and existing comorbidities in the current study population triggering fear of
81 injuries associated with PA.

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

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2 93 Lack of social support was frequently reported by females in this study. Meeting
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4 94 cultural norms and social expectations related to safety, security and conservative dress
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6 95 mainly for females were reported as barriers to PA in South Asian (Pakistani and
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8 96 Indian) British populations^{18 21} and populations in Arabic counties such as Qatar.⁵⁷
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10 97 Evaluation of interventions to provide the necessary social support and networks to PA
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12 98 specifically for women with T2D, particularly in the countries of the Gulf Cooperation
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14 99 Council are warranted. Activities including group-based activities and buddying,⁵⁸⁻⁶⁰
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16 100 are worth further investigation.
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20 101 Other reported barriers such as fear of injury and lack of skills varied across subgroups
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22 102 in particular, older, unemployed, and uneducated individuals. Older individuals with
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24 103 T2D are more vulnerable to have poor vision and osteoarthritic changes that may cause
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26 104 fall and injuries.⁶¹ Moreover the negative influence of pain to PA in older population
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28 105 with T2D was reported in western countries,⁴⁹ and hence potential barriers to
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30 106 individuals' participation. These results suggest that programs to promote PA should be
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32 107 individualized for type, frequency and intensity of PA and incorporate safety measures
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34 108 to prevent PA induced pain and injuries in older individuals.⁶²
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38 109 Lack of time on the other hand, has been a highly cited barrier to PA in the general
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40 110 population as well as populations with diabetes.^{15-18 21 22 49 63} However, unlike the study
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42 111 by Alquaiz (2009), significant scores for lack of time in this study were higher in males
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44 112 compared to females¹⁴ along-with a lack of energy, which may be a reflection of the fact
45
46 113 that more males than females were educated and employed. This perception of 'lack of
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48 114 time', in addition to family and social commitments may jeopardized their time for PA
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50 115 especially if individuals were younger and married. This discussion highlights the
51
52 116 importance of changing people's perceptions of PA but also consideration of
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54 117 opportunities in other PA domains namely work and travel that could enable individuals
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56 118 with less leisure time to increase overall PA and behaviour.
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2 119 Factors which are independent of an individual's decision-making, such as environment
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4 120 and religion had no significant associations in the current study despite the hot weather
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6 121 during data collection of this study in April/May. These null results, may be real or may
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8 122 be due to the wording of the questions and their interpretation. To address this gap in
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10 123 the literature, a qualitative exploration of possible environmental, including seasonal
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12 124 variations, and religious factors affecting PA performance may be warranted.

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15 125 Additionally, results of this study cannot be generalised across all regions in Oman.
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17 126 More information is required from rural Omani communities where perceptions on PA
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19 127 may be different. Despite the excellent scale reliability measures in the current data, the
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21 128 results cannot be generalized due to possible differences in scale quality across various
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23 129 data.³⁹ Despite efforts to minimize potential bias due to the subjective nature of self-
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25 130 reports, accuracy of outcomes cannot be fully ensure. Moreover, due to the cross-
26
27 131 sectional design of this study, causal inferences cannot be drawn.

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31 132 Finally, future attempts to explore barriers to PA should equally include work and travel
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33 133 domains to cater for diversities in both PA behaviour and sedentary lifestyle across
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35 134 subgroups of adults with T2D.

36 37 38 39 135 **CONCLUSION**

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42 136 This study identified lack of willpower, low resources and low social support
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44 137 (especially in females) as the most common barriers to performing leisure PA. Overall,
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46 138 the findings suggest that the design of physical activity interventions should consider a)
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48 139 the inclusion of individuals' readiness to change b) options for PA resources and social
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50 140 support c) approaches aimed at increasing individuals' understanding of what
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52 141 constitutes PA and d) methods that are flexible and tailored to the specific needs of
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54 142 subgroups of adults with T2D.
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2 143 **ETHICAL CONSIDERATION**
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5 144 Ethical approval was obtained from the Regional Research Committee in Muscat, Oman
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7 145 Ministry of Health. All eligible participants provided informed consent prior to data
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9 146 collection. For illiterate individuals, consents to participate in this study were provided
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11 147 by their accompanying support member (spouse, son or daughter).
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15 148 **COMPETING INTERESTS**
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18 149 The authors declare that they have no competing interests.
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23
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26 152 corresponding author.
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30 153 **AUTHORS' CONTRIBUTION**
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33 154 TS is the principal investigator in charge of the project. SM, YA, EB, AC and ASA
34
35 155 have all been involved in designing the intervention and the evaluation. TS prepared the
36
37 156 initial draft of the manuscript and all other authors have contributed. All authors have
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39 157 critically reviewed and approved the final version of the manuscript.
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355 **Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high**
356 **scores defined as ≥ 5)**

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

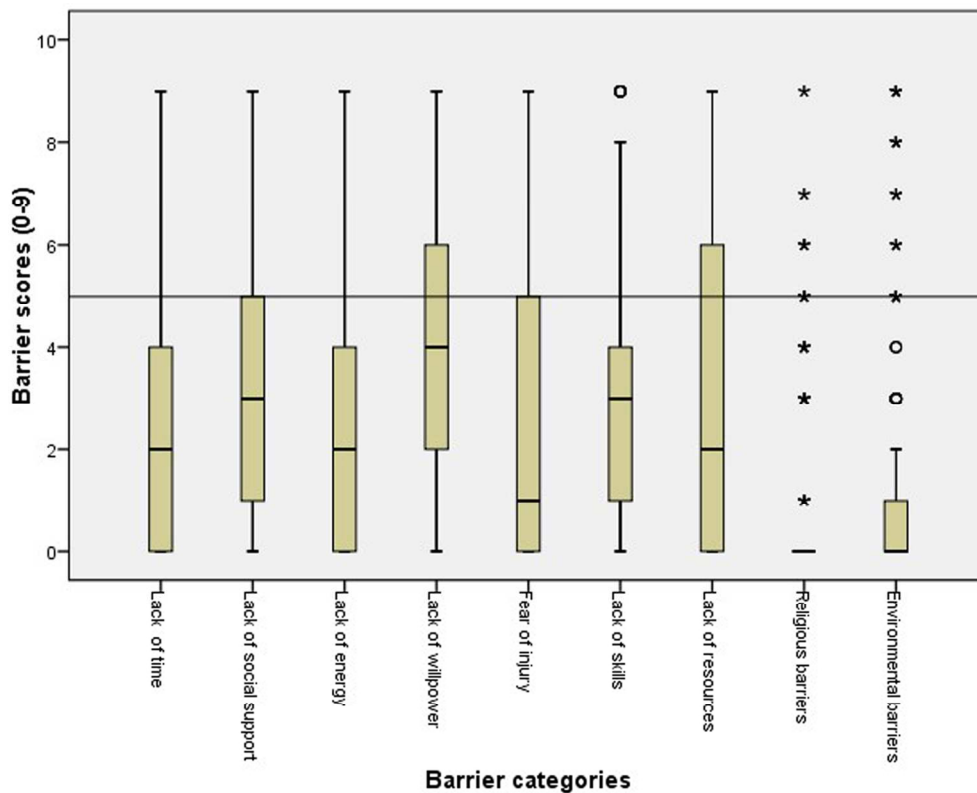


Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high scores defined as ≥ 5)

132x106mm (300 x 300 DPI)

For peer review only

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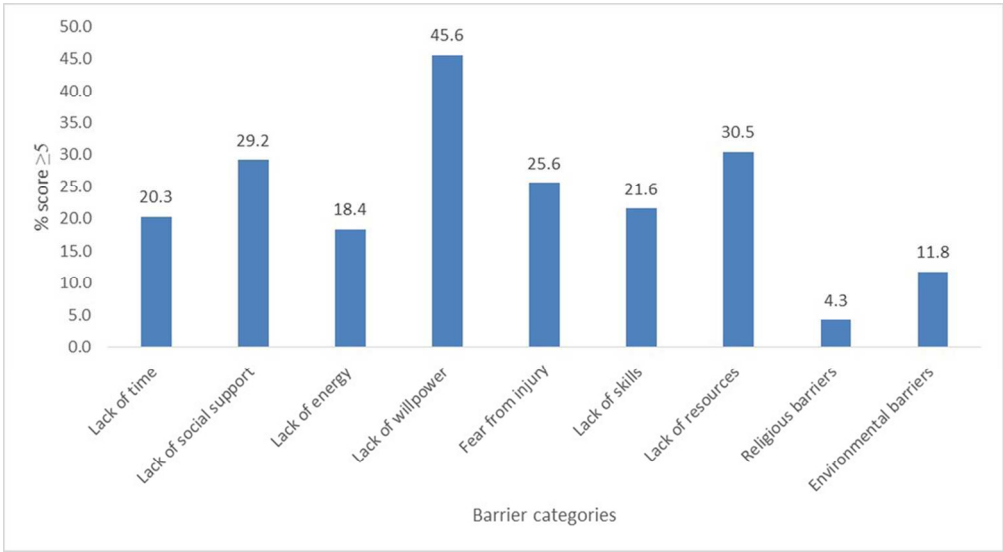


Figure 2: Percentage of reported high barrier scores (≥ 5)

96x53mm (300 x 300 DPI)

review only

من فضلك أجب عن الأسئلة التالية				
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لا أبداً	نادراً	نعم أحياناً	نعم غالباً	
				١ يومي مشغول جداً لذلك لا أستطيع أن أجعل لي وقت خاص بالتمارين ضمن جدولتي اليومي
				٢ لا أحد من أفراد عائلتي أو أصدقائي يفضلون ممارسة الرياضة لذلك فأني 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 خطراً على
				٦ لا أمارس الرياضة كثيراً 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 والأسرة
				٩ أشعر بالخجل من منظري وأنا أمارس الرياضة مع الآخرين
				١٠ أنا لا أحصل على القدر المكافئ من النوم فلا أستطيع الاستيقاظ مبكراً أو البقاء في الليل لممارسة الرياضة
				١١ من الأسهل علي إيجاد عذر لعدم ممارسه الرياضه من الخروج لعمل شئ آخر
				١٢ أنا أعرف أناس كثيرين أدوا 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 علي 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 العطله للراحة وليس للرياضة
				١٨ أريد ان أمارس المزيد ولكن يبدو أنني لا أستطيع أن استمر على شئ معين
				١٩ أخاف ان أؤذي 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 مجتمعا
				٢٥ النشاط البدني في الصيف غير مناسب لي
				٢٦ أخلاقيات الدينيه لا تسمح لي بممارسه النشاط البدني
				٢٧ البيئه المحيطة 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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1 **Perceived barriers to leisure time physical activity in adults with type 2 diabetes**
2 **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.

33 **ABSTRACT**

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

39 **Design:** Cross-sectional study using an Arabic version of the “Barriers to Being Active”
40 27 item questionnaire.

41 **Setting:** Seventeen primary health centres randomly selected in Muscat.

42 **Participants:** Individuals >18 years with type 2 diabetes, attending diabetes clinic for >
43 2 years and with no contraindications to performing physical activity.

44 **Primary and secondary outcome measures:**

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

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

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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

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

85 The protective effects of physical activity (PA) in the management of diabetes,
86 specifically type 2 diabetes (T2D), have been widely reported.^{6 7} WHO recommends at
87 least 150 minutes of moderate to vigorous physical activity or 75 minutes of vigorous
88 PA/week.⁸ However, over 60% of patients with diabetes in western countries do not
89 meet the recommended levels of PA.^{9 10} The Oman World Health Survey (OWHS)
90 2008, reported that in Oman, only 15% of patients with diabetes (98% of them with type
91 2 diabetes) met PA recommendations using the Global Physical Activity Questionnaire
92 (GPAQ).²

93 The importance of leisure time PA in meeting PA recommendations is consistently¹¹
94 associated with reduced mortality risks (20% to >37% risk reduction) and favourable
95 cardiovascular outcomes.¹² This relationship appears to have a dose-response effect
96 where the upper threshold for mortality benefit occurs at 3 to 5 times the leisure PA
97 recommendations of 7.5-<15 MET h/wk.¹² No clear association is observed for
98 occupational or travel physical activity.¹³

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

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

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

118 **METHODS**

119 **Study design, setting and participants**

120 This cross-sectional interview based study was part of a larger study that examined
121 correlates of physical activity and sitting time in adults with type 2 diabetes, and
122 barriers to leisure physical activity in the same population. Results regarding the PA
123 patterns of the population using the Global Physical Activity Questionnaire are
124 reported elsewhere.³⁰ This current paper identified barriers to performing leisure
125 physical activity expressed by Omani adults with T2D using adapted questions from the
126 Centers for Disease Control and Prevention (CDC) questionnaire³¹ conducted in April/
127 May 2015 in Muscat (Urban communities). Reporting of this study follows the
128 guidelines for strengthening the reporting of observational studies in epidemiology
129 (STROBE).³²

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

138 **Data sources/ measurement**

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

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

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

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

158 *CDC questionnaire on barriers to leisure PA:*

159 An English to Arabic translated CDC questionnaire “Barriers to Being Active” was
160 used in a study in Saudi Arabia¹⁴ with 21 questions on seven barriers (lack of time, lack
161 of social support, lack of energy, lack of willpower, fear of injury, lack of skill and lack
162 of resources). Permission to use the questionnaire was obtained from the lead author on
163 November 24, 2014
164 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2813614/figure/F0001/>). However, in
165 that tool no statements on religion or environment as possible barriers to PA were
166 included. To address this gap and to formulate robust items on these topics we
167 undertook several procedures. Literature search was conducted to identify possible
168 content for the new items from similar studies in neighbour countries with similar socio-
169 economical characteristics.^{28 29} Potential religious barriers considered questions on
170 religious beliefs restricting PA, accepted clothing for PA and religious perceptions on
171 PA.^{14 25 26} Potential environmental barriers included questions on extreme weather
172 conditions, physical activity in summer time and availability of appropriate environment
173 for PA.^{16 25} Content and face validity of the questionnaire were assessed by our
174 investigatory team and draft questions were then discussed with a sample of patients
175 prior to field testing and adjustments were made to ease comprehension and ensure
176 translation to Arabic was appropriate.

177 A set of three related questions (total of 27 questions) presented in random order within
178 the questionnaire represented one barrier category. A scoring system³¹ was used to
179 indicate how likely each statement/item was considered to be a barrier (very likely=3,
180 somewhat likely=2, somewhat unlikely=1, very unlikely=0). Scores of the three theme-

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

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

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

193 **Study size**

194 Power analysis was performed to estimate the prevalence of meeting PA
195 recommendations in adult population with T2D in a parallel study conducted in the
196 same population.³⁶ We assumed that meeting PA recommendation is at least in part
197 facilitated by reporting fewer barriers to PA³⁷ and used an estimated 15% prevalence of
198 adequate PA in patients with diabetes, as reported in the 2008 Oman World Health
199 Survey (OWHS).³⁸ Using 95% confidence limits, a response rate of 80%, and a
200 precision of +/-4%, and smallest expected frequency of 15%, the calculated sample size
201 was ~300 participants across primary health centres in Muscat region, the capital of
202 Oman.

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203 Training

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

210 Statistical methods

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

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2 227 “maintenance” stages of PA. Corrected P-values (Yate’s continuity) were reported for
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4 228 high barrier scores against the studied independent variables.

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6 229 Principal components analysis (PCA) was performed to identify composite scores for
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8 230 the components underlying the items/questions in the study scale. A nine factor solution
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10 231 was used to investigate the contributions of the 27 item/questions to the nine barrier
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12 232 categories.³⁹ Furthermore, factor loading matrix was examined using Oblimin rotation⁴⁰
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15 233 where correlations between the extracted components were obtained.

18 19 234 **RESULTS**

20 21 235 **Socio-demographic**

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23 236 Out of 312 patients approached, 305 (98%) completed the questionnaire. Slightly more
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25 237 females were represented in this sample (57.4%) than males. The population was
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27 238 slightly older with mean (SD) age of 57(10.8) years. Additionally, more than two-thirds
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29 239 being married (78.8%) and just about half unable to read or write (48.9%). More than a
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31 240 third of the study population (39.3%) reported household income of <500 OR (less than
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33 241 national average)⁴¹ and the majority (77%) reported unemployment (including
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35 242 retirement). More males than females were educated (70% vs 37%) and employed (45%
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37 243 vs 7%) (Table 1).

38 39 244 **Physiological status**

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41 245 Median (LQ, UQ) duration of diabetes in this population was 6.0 (4.0, 10.0) years. The
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43 246 majority of the participants had hypertension (n=217, 71%) or/and hyperlipidaemia
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45 247 (n=189, 62%) coinciding with their diabetes. All of them were using anti-hypertensive
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47 248 or/and lipid lowering medications as appropriate. More than three-quarters of those
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49 249 taking anti-hypertensives (78%) and two-thirds of those using lipid lowering drugs
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51 250 (66%) had blood pressure (BP) readings and fasting serum cholesterol within target
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251 levels (BP<140/80 mmHg and fasting serum cholesterol of <5mmol/l).⁴² Fifteen percent
 252 (n=45) were controlling their diabetes by diet alone versus 85% (n=260) on oral anti-
 253 hypoglycaemic medications, in which 25% (n=75) were additionally on insulin. Mean
 254 (SD) BMI was 31.0 (6.0) kg/m² where 89% (n=271) had BMI >25kg/m² in which 50%
 255 (n=153) were obese (BMI>30 kg/m²) and 39% (n=118) were overweight (BMI>25-
 256 29.99 kg/m²). Glycated haemoglobin HbA1c was >7% (>48 mmol/mol) in more than
 257 half of the population (58%) indicating poor diabetes control (Table 1).

258 Self-reported stages of PA

259 Only 17% (n=52) of participants considered themselves actively participating in regular
 260 moderate or vigorous PA (22% of males vs 13% of females). Of the remainder, the
 261 majority reported being “not ready” (37%), “getting ready” (31%) or in “preparation”
 262 (15%) (Table 1).

263 **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**			
	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)			
	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
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*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

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309 7 (lack of social support and skills), and component 8 (lack of social support and
310 energy).

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

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

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INSERT FIGURE 1 ABOUT HERE

322 Categorizing barrier scores to <5 and ≥ 5 (significant barrier) highlighted that 'lack of
323 willpower' (n=139), 'lack of resources' (n=93) and 'lack of social support' (n=89) were
324 the most frequently reported 'significant barriers' to physical activity (Figure 2).
325 Barriers found to be significant in both males and females were lack of willpower
326 (41.5% m: 48.6% f) and lack of resources (32.3% m: 29.1% f). In addition, lack of time
327 in males (26.9%) and lack of social support in females (35.4%) were also noteworthy
328 (Table 2).

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INSERT FIGURE 2 ABOUT HERE

332 Correlations between the sum scores of the nine studied barriers were generally weak
333 ($R < 0.200$). Positive and significant correlations of >0.300 were noted among lack of
334 energy with lack of time; lack of skill with lack of social support; lack of energy and
335 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

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

339 **Table 2: Correlations between sum scores of barrier categories**

340 *P-value <0.050

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

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2 353 barriers had no significant different distributions across any of the studied factors (Table
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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 χ^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 χ^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 χ^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 χ^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 χ^2	13.2	2.3	4.1	0.0	14.2	6.6	0.1	1.5	0.1

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(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 χ^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 χ^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

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1 DISCUSSION

2 Despite evidence on the effectiveness of meeting PA levels in the management of T2D,
3 and associated cardiovascular risk factors,^{6 7} PA is poorly addressed in routine diabetes
4 care.⁴³ Low PA levels in populations with T2D are consistently reported in western
5 countries, for example, USA⁴⁴ as well as Arabic speaking countries namely Oman,
6 Saudi Arabia and Lebanon.^{2 45 46} Addressing perceived barriers to performing
7 recommended PA levels in this population is crucial for planning effective PA
8 promoting interventions.

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

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

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

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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 age⁵⁰ 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

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2 52 Indian) British populations^{18 21} and populations in Arabic countries such as Qatar.⁵⁶
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4 53 Evaluation of interventions to provide the necessary social support and networks to PA
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6 54 specifically for women with T2D, particularly in the countries of the Gulf Cooperation
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8 55 Council are warranted. Activities including group-based activities and buddying,⁵⁷⁻⁵⁹
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10 56 are worth further investigation.
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13 57 Other reported barriers such as fear of injury and lack of skills varied across subgroups
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15 58 in particular, older, unemployed, and uneducated individuals. Older individuals with
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17 59 T2D are more vulnerable to have poor vision and osteoarthritic changes that may cause
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19 60 fall and injuries.⁶⁰ Moreover the negative influence of pain to PA in older population
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21 61 with T2D was reported in western countries,⁴⁸ and hence potential barriers to
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23 62 individuals' participation. These results suggest that programs to promote PA should be
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25 63 individualized for type, frequency and intensity of PA and incorporate safety measures
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27 64 to prevent PA induced pain and injuries in older individuals.⁶¹
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31 65 Lack of time on the other hand, has been a highly cited barrier to PA in the general
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33 66 population as well as populations with diabetes.^{15-18 21 22 48 62} However, unlike the study
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35 67 by Alquaiz (2009), significant scores for lack of time in this study were higher in males
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37 68 compared to females¹⁴ along-with a lack of energy, which may be a reflection of the fact
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39 69 that more males than females were educated and employed. This perception of 'lack of
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41 70 time', in addition to family and social commitments may jeopardized their time for PA
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43 71 especially if individuals were younger and married. This discussion highlights the
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45 72 importance of changing people's perceptions of PA but also consideration of
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47 73 opportunities in other PA domains namely work and travel that could enable individuals
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49 74 with less leisure time to increase overall PA and behaviour.
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54 75 Factors which are independent of an individual's decision-making, such as environment
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56 76 and religion had no significant associations in the current study despite the hot weather
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58 77 during data collection of this study in April/May. These null results, may be real or may
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2 78 be due to the wording of the questions and their interpretation. To address these gaps in
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4 79 the literature, a qualitative exploration of possible environmental, including seasonal
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6 80 variations, and religious factors affecting PA performance may be warranted.
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9 81 Moreover, PCA showed cross contribution of items/questions within lack of willpower,
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11 82 time, energy and skills indicating doubtful responses. Similarly inputs from questions
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13 83 on lack of social support and lack of skills and energy were mixed. Future
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15 84 questionnaires on barriers to performing PA, especially in the Arabic speaking
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17 85 countries, should consider more specific questions.
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20 86 Additionally, results of this study cannot be generalised across all regions in Oman.
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22 87 More information is required from rural Omani communities where perceptions on PA
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24 88 may be different. Despite the excellent scale reliability measures in the current data, the
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26 89 results cannot be generalized due to possible differences in scale quality across various
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28 90 data.³⁹ Despite efforts to minimize potential bias due to the subjective nature of self-
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30 91 reports, accuracy of outcomes cannot be fully ensure. Moreover, due to the cross-
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32 92 sectional design of this study, causal inferences cannot be drawn.
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36 93 Finally, future attempts to explore barriers to PA should equally include work and travel
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38 94 domains to cater for diversities in both PA behaviour and sedentary lifestyle across
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40 95 subgroups of adults with T2D.
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43 44 96 **CONCLUSION**

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47 97 This study identified lack of willpower, low resources and low social support
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49 98 (especially in females) as the most common barriers to performing leisure PA. The
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51 99 current findings can be used to inform the design of physical activity interventions for
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53 100 testing in clinical trials. The specific areas which might be usefully included to address
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55 101 barriers to performing PA are a) assessment of individuals' readiness to change b) low
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57 102 cost options for PA resources and social support c) approaches aimed at increasing
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2 103 individuals' understanding of what constitutes PA and d) methods that are flexible and
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4 104 tailored to the specific needs of subgroups of adults with T2D. In addition, approaches
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6 105 that enhance self-efficacy (and will power) and social support should be included.
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9 106 **ETHICAL CONSIDERATION**

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12 107 Ethical approval was obtained from the Regional Research Committee in Muscat, Oman
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14 108 Ministry of Health. All eligible participants provided informed consent prior to data
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16 109 collection. For illiterate individuals, consents to participate in this study were provided
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18 110 by their accompanying support member (spouse, son or daughter).
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21 111 **COMPETING INTERESTS**

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25 112 The authors declare that they have no competing interests.
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34 115 corresponding author.
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37 116 **AUTHORS' CONTRIBUTION**

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40 117 TS is the principal investigator in charge of the project. SM, YA, EB, AC and ASA
41
42 118 have all been involved in designing the intervention and the evaluation. TS prepared the
43
44 119 initial draft of the manuscript and all other authors have contributed. All authors have
45
46 120 critically reviewed and approved the final version of the manuscript.
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53 315 **Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high**
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55 316 **scores defined as ≥ 5)**

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58 317 **Figure 2: Percentage of reported high barrier scores (≥ 5)**

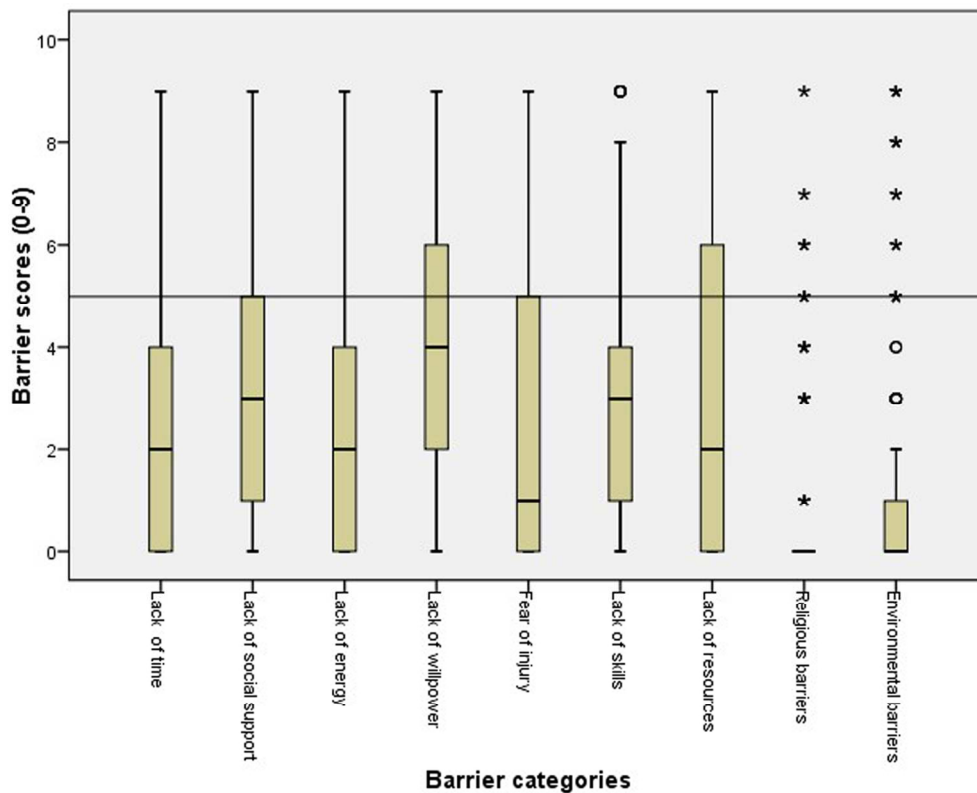


Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high scores defined as ≥ 5)

132x106mm (300 x 300 DPI)

For peer review only

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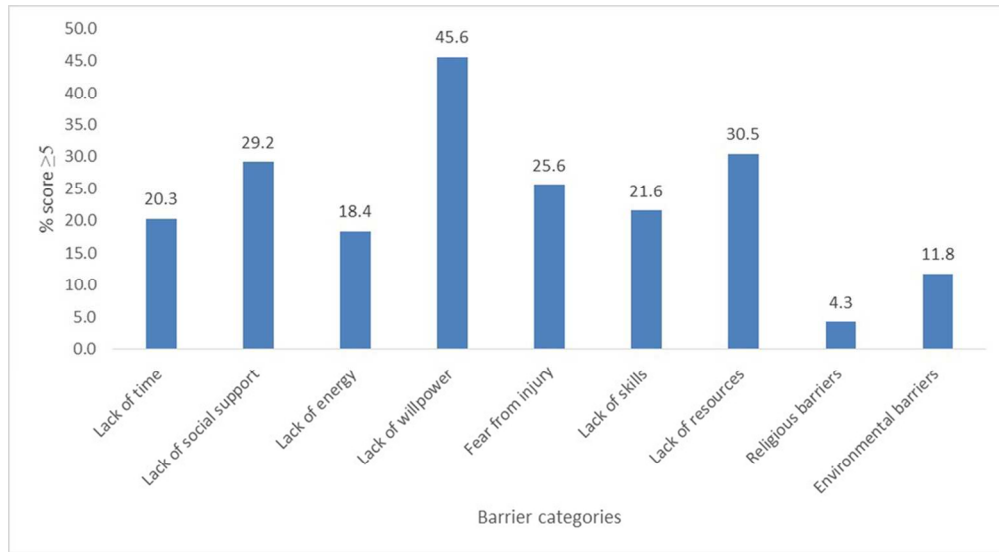


Figure 2: Percentage of reported high barrier scores (≥ 5)

96x53mm (300 x 300 DPI)

review only

من فضلك أجب عن الأسئلة التالية				
٠	١	٢	٣	
لا	نادراً	نعم أحياناً	نعم غالباً	
أبداً				
				١ يومي مشغول جداً لذلك لا أستطيع أن أجعل لي وقت خاص بالتمارين ضمن جدولتي اليومي
				٢ لا أحد من أفراد عائلتي أو أصدقائي يفضلون ممارسة الرياضة لذلك فأني 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 خطراً على
				٦ لا أمارس الرياضة كثيراً 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 والأسرة
				٩ أشعر بالخجل من منظري وأنا أمارس الرياضة مع الآخرين
				١٠ أنا لا أحصل على القدر المكافئ من النوم فلا أستطيع الاستيقاظ مبكراً أو البقاء في الليل لممارسة الرياضة
				١١ من الأسهل علي إيجاد عذر لعدم ممارسه الرياضه من الخروج لعمل شئ آخر
				١٢ أنا أعرف أناس كثيرين أدوا 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 يبدو أنني لا أستطيع أن استمر على شئ معين
				١٩ أخاف ان أؤذي 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 مجتمعا
				٢٥ النشاط البدني في الصيف غير مناسب لي
				٢٦ أخلاقيات 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 ($\chi^2(351) = 2600.175, p < .05$).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

0.201 and -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)
Title and abstract	1	1 & 2-3
Introduction		
Background/rationale	2	4
Objectives	3	5
Methods		
Study design	4	5
Setting	5	6
Participants	6	6
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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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1 **Perceived barriers to leisure time physical activity in adults with type 2 diabetes**
2 **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.

33 **ABSTRACT**

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

39 **Design:** Cross-sectional study using an Arabic version of the “Barriers to Being Active”
40 27 item questionnaire.

41 **Setting:** Seventeen primary health centres randomly selected in Muscat.

42 **Participants:** Individuals >18 years with type 2 diabetes, attending diabetes clinic for >
43 2 years and with no contraindications to performing physical activity.

44 **Primary and secondary outcome measures:**

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

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

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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

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

85 The protective effects of physical activity (PA) in the management of diabetes,
86 specifically type 2 diabetes (T2D), have been widely reported.^{6 7} WHO recommends at
87 least 150 minutes of moderate to vigorous physical activity or 75 minutes of vigorous
88 PA/week.⁸ However, over 60% of patients with diabetes in western countries do not
89 meet the recommended levels of PA.^{9 10} The Oman World Health Survey (OWHS)
90 2008, reported that in Oman, only 15% of patients with diabetes (98% of them with type
91 2 diabetes) met PA recommendations using the Global Physical Activity Questionnaire
92 (GPAQ).²

93 The importance of leisure time PA in meeting PA recommendations is consistently¹¹
94 associated with reduced mortality risks (20% to >37% risk reduction) and favourable
95 cardiovascular outcomes.¹² This relationship appears to have a dose-response effect
96 where the upper threshold for mortality benefit occurs at 3 to 5 times the leisure PA
97 recommendations of 7.5-<15 MET h/wk.¹² No clear association is observed for
98 occupational or travel physical activity.¹³

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

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

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

118 **METHODS**

119 **Study design, setting and participants**

120 This cross-sectional interview based study was part of a larger study that examined
121 correlates of physical activity and sitting time in adults with type 2 diabetes, and
122 barriers to leisure physical activity in the same population. Results regarding the PA
123 patterns of the population using the Global Physical Activity Questionnaire are
124 reported elsewhere.³⁰ This current paper identified barriers to performing leisure
125 physical activity expressed by Omani adults with T2D using adapted questions from the
126 Centers for Disease Control and Prevention (CDC) questionnaire³¹ conducted in April/
127 May 2015 in Muscat (Urban communities). Reporting of this study follows the
128 guidelines for strengthening the reporting of observational studies in epidemiology
129 (STROBE).³²

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

138 **Data sources/ measurement**

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

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

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

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

158 *CDC questionnaire on barriers to leisure PA:*

159 An English to Arabic translated CDC questionnaire “Barriers to Being Active” was
160 used in a study in Saudi Arabia¹⁴ with 21 questions on seven barriers (lack of time, lack
161 of social support, lack of energy, lack of willpower, fear of injury, lack of skill and lack
162 of resources). Permission to use the questionnaire was obtained from the lead author on
163 November 24, 2014
164 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2813614/figure/F0001/>). However, in
165 that tool no statements on religion or environment as possible barriers to PA were
166 included. To address this gap and to formulate robust items on these topics we
167 undertook several procedures. Literature search was conducted to identify possible
168 content for the new items from similar studies in neighbour countries with similar socio-
169 economical characteristics.^{28 29} Potential religious barriers considered questions on
170 religious beliefs restricting PA, accepted clothing for PA and religious perceptions on
171 PA.^{14 25 26} Potential environmental barriers included questions on extreme weather
172 conditions, physical activity in summer time and availability of appropriate environment
173 for PA.^{16 25} Content and face validity of the questionnaire were assessed by our
174 investigatory team and draft questions were then discussed with a sample of patients
175 prior to field testing and adjustments were made to ease comprehension and ensure
176 translation to Arabic was appropriate.

177 A set of three related questions (total of 27 questions) presented in random order within
178 the questionnaire represented one barrier category. A scoring system³¹ was used to
179 indicate how likely each statement/item was considered to be a barrier (very likely=3,
180 somewhat likely=2, somewhat unlikely=1, very unlikely=0). Scores of the three theme-

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

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

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

193 **Study size**

194 Power analysis was performed to estimate the prevalence of meeting PA
195 recommendations in adult population with T2D in a parallel study conducted in the
196 same population.³⁰ We assumed that meeting PA recommendation is at least in part
197 facilitated by reporting fewer barriers to PA³⁶ and used an estimated 15% prevalence of
198 adequate PA in patients with diabetes, as reported in the 2008 Oman World Health
199 Survey (OWHS).³⁷ Using 95% confidence limits, a response rate of 80%, and a
200 precision of +/-4%, and smallest expected frequency of 15%, the calculated sample size
201 was ~300 participants across primary health centres in Muscat region, the capital of
202 Oman.

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203 **Training**

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

210 **Statistical methods**

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

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2 227 “maintenance” stages of PA. Corrected P-values (Yate’s continuity) were reported for
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4 228 high barrier scores against the studied independent variables.

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6 229 Principal components analysis (PCA) was performed to identify composite scores for
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8 230 the components underlying the items/questions in the study scale. A nine factor solution
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10 231 was used to investigate the contributions of the 27 item/questions to the nine barrier
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12 232 categories.³⁸ Furthermore, factor loading matrix was examined using Oblimin rotation³⁹
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15 233 where correlations between the extracted components were obtained.

16 17 18 19 234 **RESULTS**

20 21 22 235 **Socio-demographic**

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24 236 Out of 312 patients approached, 305 (98%) completed the questionnaire. Slightly more
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26 237 females were represented in this sample (57.4%) than males. The population was
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28 238 slightly older with mean (SD) age of 57(10.8) years. Additionally, more than two-thirds
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30 239 being married (78.8%) and just about half unable to read or write (48.9%). More than a
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32 240 third of the study population (39.3%) reported household income of <500 OR (less than
33
34 241 national average)⁴⁰ and the majority (77%) reported unemployment (including
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36 242 retirement). More males than females were educated (70% vs 37%) and employed (45%
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38 243 vs 7%) (Table 1).

39 40 41 42 244 **Physiological status**

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44 245 Median (LQ, UQ) duration of diabetes in this population was 6.0 (4.0, 10.0) years. The
45
46 246 majority of the participants had hypertension (n=217, 71%) or/and hyperlipidaemia
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48 247 (n=189, 62%) coinciding with their diabetes. All of them were using anti-hypertensive
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50 248 or/and lipid lowering medications as appropriate. More than three-quarters of those
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52 249 taking anti-hypertensives (78%) and two-thirds of those using lipid lowering drugs
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54 250 (66%) had blood pressure (BP) readings and fasting serum cholesterol within target
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251 levels (BP<140/80 mmHg and fasting serum cholesterol of <5mmol/l).⁴¹ Fifteen percent
 252 (n=45) were controlling their diabetes by diet alone versus 85% (n=260) on oral anti-
 253 hypoglycaemic medications, in which 25% (n=75) were additionally on insulin. Mean
 254 (SD) BMI was 31.0 (6.0) kg/m² where 89% (n=271) had BMI >25kg/m² in which 50%
 255 (n=153) were obese (BMI>30 kg/m²) and 39% (n=118) were overweight (BMI>25-
 256 29.99 kg/m²). Glycated haemoglobin HbA1c was >7% (>48 mmol/mol) in more than
 257 half of the population (58%) indicating poor diabetes control (Table 1).

258 Self-reported stages of PA

259 Only 17% (n=52) of participants considered themselves actively participating in regular
 260 moderate or vigorous PA (22% of males vs 13% of females). Of the remainder, the
 261 majority reported being “not ready” (37%), “getting ready” (31%) or in “preparation”
 262 (15%) (Table 1).

263 **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)	274
Blood pressure (systolic/diastolic) mmHg**			
	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)			
	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)	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

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309 7 (lack of social support and skills), and component 8 (lack of social support and
310 energy).

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

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

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INSERT FIGURE 1 ABOUT HERE

322 Categorizing barrier scores to <5 and ≥ 5 (significant barrier) highlighted that 'lack of
323 willpower' (n=139), 'lack of resources' (n=93) and 'lack of social support' (n=89) were
324 the most frequently reported 'significant barriers' to physical activity (Figure 2).
325 Barriers found to be significant in both males and females were lack of willpower
326 (41.5% m: 48.6% f) and lack of resources (32.3% m: 29.1% f). In addition, lack of time
327 in males (26.9%) and lack of social support in females (35.4%) were also noteworthy
328 (Table 2).

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INSERT FIGURE 2 ABOUT HERE

332 Correlations between the sum scores of the nine studied barriers were generally weak
333 ($R < 0.200$). Positive and significant correlations of >0.300 were noted among lack of
334 energy with lack of time; lack of skill with lack of social support; lack of energy and
335 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

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

339 **Table 2: Correlations between sum scores of barrier categories**

340 *P-value <0.050

341
 342 Distributions of significant high barrier score (≥ 5) across the studied sociodemographic
 343 factors and self-reported stages of change in PA differed among the nine barrier
 344 categories: “Lack of time” was frequently highly scored by males, younger adults and
 345 those who were married, employed or educated. Additionally, “Lack of social support”
 346 was highly scored by females and “Lack of energy” by employed, or educated adults.
 347 However, “Lack of willpower” was highly scored by individuals with lower income, or
 348 at inactive stages of PA. Moreover, “Fear of injury” was highly scored by older adults,
 349 unemployed, uneducated, or individuals reporting in-active stages of PA. Furthermore,
 350 “Lack of skills” was highly scored by females, younger adults, and unemployed or
 351 uneducated. “Lack of resources” on the other hand, was frequently highly scored by
 352 married adults or with lower income. It is notable that the religious and environmental

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2 353 barriers had no significant different distributions across any of the studied factors (Table
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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 χ^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 χ^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 χ^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 χ^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 χ^2	13.2	2.3	4.1	0.0	14.2	6.6	0.1	1.5	0.1

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(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 χ^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 χ^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

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1 DISCUSSION

2 Despite evidence on the effectiveness of meeting PA levels in the management of T2D,
3 and associated cardiovascular risk factors,^{6 7} PA is poorly addressed in routine diabetes
4 care.⁴² Low PA levels in populations with T2D are consistently reported in western
5 countries, for example, USA⁴³ as well as Arabic speaking countries namely Oman,
6 Saudi Arabia and Lebanon.^{2 44 45} Addressing perceived barriers to performing
7 recommended PA levels in this population is crucial for planning effective PA
8 promoting interventions.

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

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

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

1
2 26 of willpower was more likely to be reported by individuals at inactive stages of physical
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4 27 activity (pre-contemplation or contemplation stages of physical activity) than those in
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6 28 active stages. Progressive stages of behavioural change according to the trans-
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8 29 theoretical model were direct correlates to PA in a review article by Trost (2002)⁵⁰ and
9
10 30 direct determinants in another by Van Stralen (2009).⁵¹ This finding supports the need
11
12 31 for programs to help raise self-willpower/determination through stepped process of
13
14 32 behaviour change from inactive (pre-contemplation) to active stages of PA (action and
15
16 33 maintenance).⁵² Interestingly, fear of injury was the only other reported barrier
17
18 34 significantly different between individuals at inactive vs active stages of change in PA.
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20 35 This could be explained by possible physical constraints pertaining to older age⁴⁹ and
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22 36 existing comorbidities in the current study population triggering fear of injuries
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24 37 associated with PA.
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29 38 Limited resources including high cost and limited facilities for PA have been reported
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31 39 as significant barriers to PA across different cultures.^{20 22} In the current study, limited
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33 40 resources were reported as significant by individuals who were married and those with
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35 41 low income. Married individuals could have more financial commitments to their
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37 42 families especially in the Gulf Cooperation Council countries where extended families
38
39 43 are common.⁵³ This may alter an individual's priorities for house-hold income
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41 44 expenditure. Low income was similarly reported as a barrier in a Saudi population,
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43 45 possibly due to the perceived high cost of utilising PA facilities.¹⁴ This may reflect a
44
45 46 narrow view on what constitutes PA and a misconception that expensive equipment is
46
47 47 required. Hence, irrespective of culture, interventions promoting cost neutral PA such as
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49 48 walking in populations would be highly desirable to overcome this barrier.^{46 54}
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54 49 Lack of social support was frequently reported by females in this study. Meeting
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56 50 cultural norms and social expectations related to safety, security and conservative dress
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58 51 mainly for females were reported as barriers to PA in South Asian (Pakistani and
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2 52 Indian) British populations^{18 21} and populations in Arabic countries such as Qatar.⁵⁵
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4 53 Evaluation of interventions to provide the necessary social support and networks to PA
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6 54 specifically for women with T2D, particularly in the countries of the Gulf Cooperation
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8 55 Council are warranted. Activities including group-based activities and buddying,⁵⁶⁻⁵⁸
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10 56 are worth further investigation.
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13 57 Other reported barriers such as fear of injury and lack of skills varied across subgroups
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15 58 in particular, older, unemployed, and uneducated individuals. Older individuals with
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17 59 T2D are more vulnerable to have poor vision and osteoarthritic changes that may cause
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19 60 fall and injuries.⁵⁹ Moreover the negative influence of pain to PA in older population
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21 61 with T2D was reported in western countries,⁴⁷ and hence potential barriers to
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23 62 individuals' participation. These results suggest that programs to promote PA should be
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25 63 individualized for type, frequency and intensity of PA and incorporate safety measures
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27 64 to prevent PA induced pain and injuries in older individuals.⁶⁰
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31 65 Lack of time on the other hand, has been a highly cited barrier to PA in the general
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33 66 population as well as populations with diabetes.^{15-18 21 22 47 61} However, unlike the study
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35 67 by Alquaiz (2009), significant scores for lack of time in this study were higher in males
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37 68 compared to females¹⁴ along-with a lack of energy, which may be a reflection of the fact
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39 69 that more males than females were educated and employed. This perception of 'lack of
40
41 70 time', in addition to family and social commitments may jeopardized their time for PA
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43 71 especially if individuals were younger and married. This discussion highlights the
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45 72 importance of changing people's perceptions of PA but also consideration of
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47 73 opportunities in other PA domains namely work and travel that could enable individuals
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49 74 with less leisure time to increase overall PA and behaviour.
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54 75 Factors which are independent of an individual's decision-making, such as environment
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56 76 and religion had no significant associations in the current study despite the hot weather
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58 77 during data collection of this study in April/May. These null results, may be real or may
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2 78 be due to the wording of the questions and their interpretation. To address these gaps in
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4 79 the literature, a qualitative exploration of possible environmental, including seasonal
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6 80 variations, and religious factors affecting PA performance may be warranted.
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9 81 Moreover, PCA showed cross contribution of items/questions within lack of willpower,
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11 82 time, energy and skills indicating doubtful responses. Similarly inputs from questions
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13 83 on lack of social support and lack of skills and energy were mixed. Future
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15 84 questionnaires on barriers to performing PA, especially in the Arabic speaking
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17 85 countries, should consider more specific questions.
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20 86 Additionally, results of this study cannot be generalised across all regions in Oman.
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22 87 More information is required from rural Omani communities where perceptions on PA
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24 88 may be different. Despite the excellent scale reliability measures in the current data, the
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26 89 results cannot be generalized due to possible differences in scale quality across various
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28 90 data.³⁸ Moreover, due to the cross-sectional design of this study, causal inferences
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30 91 cannot be drawn.
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34 92 Finally, future attempts to explore barriers to PA should equally include work and travel
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36 93 domains to cater for diversities in both PA behaviour and sedentary lifestyle across
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38 94 subgroups of adults with T2D.
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40 41 42 95 **CONCLUSION** 43

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45 96 This study identified lack of willpower, low resources and low social support
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47 97 (especially in females) as the most common barriers to performing leisure PA. The
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49 98 current findings can be used to inform the design of physical activity interventions for
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51 99 testing in clinical trials. The specific areas which might be usefully included to address
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53 100 barriers to performing PA are a) assessment of individuals' readiness to change b) low
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55 101 cost options for PA resources and social support c) approaches aimed at increasing
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57 102 individuals' understanding of what constitutes PA and d) methods that are flexible and
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2 103 tailored to the specific needs of subgroups of adults with T2D. In addition, approaches
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4 104 that enhance self-efficacy (and will power) and social support should be included.
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7 105 **ETHICAL CONSIDERATION**
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10 106 Ethical approval was obtained from the Regional Research Committee in Muscat, Oman
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12 107 Ministry of Health. All eligible participants provided informed consent prior to data
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14 108 collection. For illiterate individuals, consents to participate in this study were provided
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16 109 by their accompanying support member (spouse, son or daughter).
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20 110 **COMPETING INTERESTS**
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23 111 The authors declare that they have no competing interests.
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31 114 corresponding author.
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35 115 **AUTHORS' CONTRIBUTION**
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38 116 TS is the principal investigator in charge of the project. SM, YA, EB, AC and ASA
39
40 117 have all been involved in designing the intervention and the evaluation. TS prepared the
41
42 118 initial draft of the manuscript and all other authors have contributed. All authors have
43
44 119 critically reviewed and approved the final version of the manuscript.
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312 **Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high**
313 **scores defined as ≥ 5)**

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

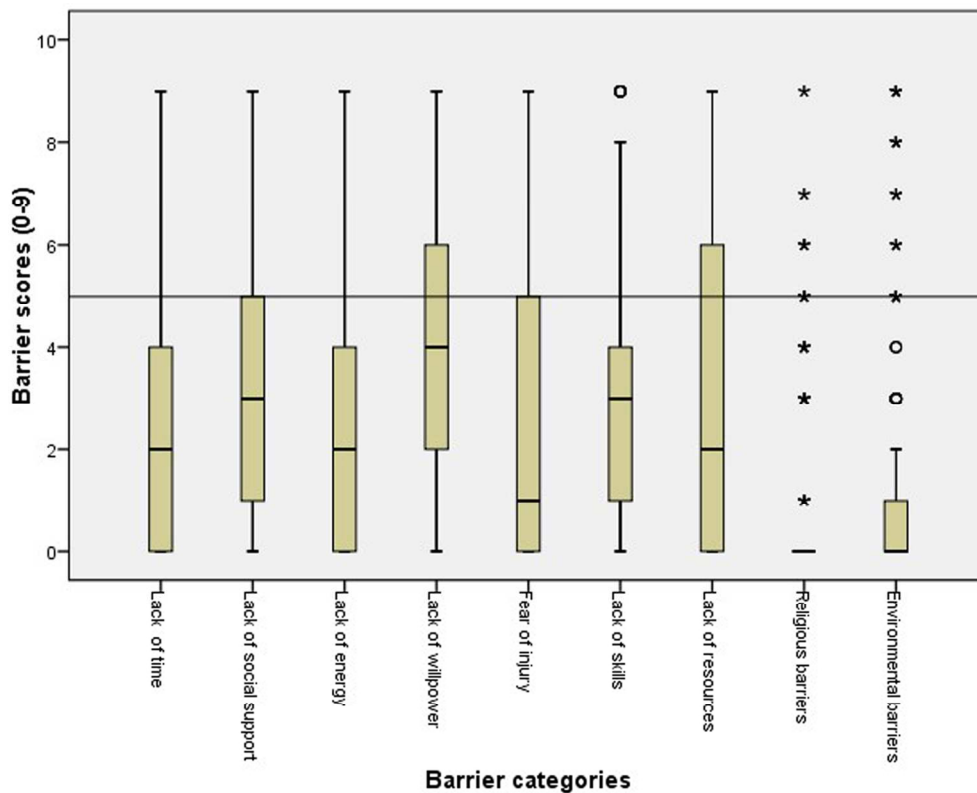


Figure 1: Box and Whisker plots for the reported barrier sum scores of 0-9 (high scores defined as ≥ 5)

132x106mm (300 x 300 DPI)

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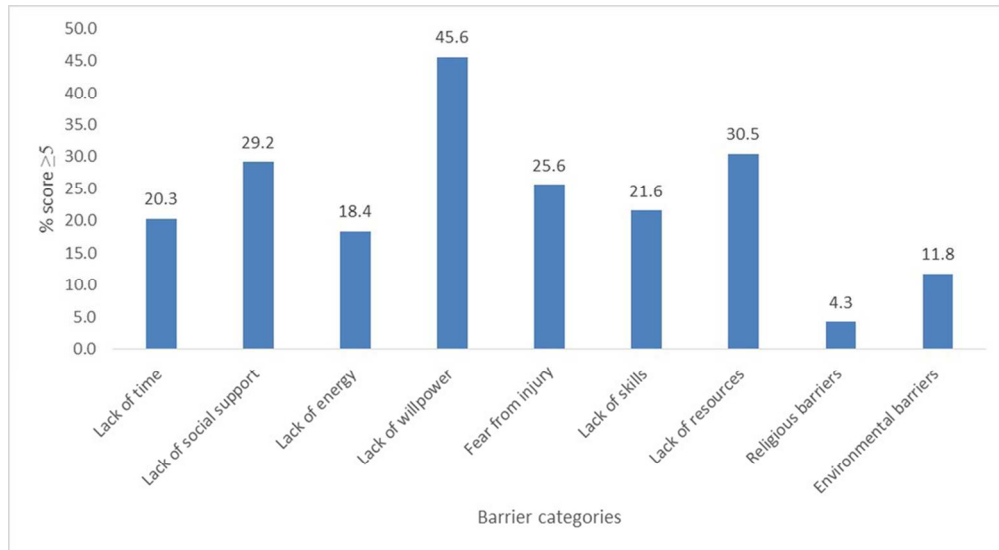


Figure 2: Percentage of reported high barrier scores (≥ 5)

96x53mm (300 x 300 DPI)

review only

من فضلك أجب عن الأسئلة التالية				
٠	١	٢	٣	
لا	نادراً	نعم أحياناً	نعم غالباً	
أبداً				
				١ يومي مشغول جداً لذلك لا أستطيع أن أجعل لي وقت خاص بالتمارين ضمن جدولتي اليومي
				٢ لا أحد من أفراد عائلتي أو أصدقائي يفضلون ممارسة الرياضة لذلك فأني 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 خطراً على
				٦ لا أمارس الرياضة كثيراً 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 والأسرة
				٩ أشعر بالخجل من منظري وأنا أمارس الرياضة مع الآخرين
				١٠ أنا لا أحصل على القدر المكافئ من النوم فلا أستطيع الاستيقاظ مبكراً أو البقاء في الليل لممارسة الرياضة
				١١ من الأسهل علي إيجاد عذر لعدم ممارسه الرياضه من الخروج لعمل شئ آخر
				١٢ أنا أعرف أناس كثيرين أدوا 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 يبدو أنني لا أستطيع أن استمر على شئ معين
				١٩ أخاف ان أؤذي 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 مجتمعا
				٢٥ النشاط البدني في الصيف غير مناسب لي
				٢٦ أخلاقيات 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 ($\chi^2(351) = 2600.175, p < .05$).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

0.201 and -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

3	Q9							.819	
4	Q10	.383						.622	
5	Q14								.802
6	Q7								.765
7	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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