

# Descriptive Epidemiology of Sitting Time in Omani Men and Women: A Known Risk Factor for Non-Communicable Diseases

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## ABSTRACT

**Objectives:** Sedentary behaviors (too much sitting as distinct from too little exercise) are associated with increased risk of non-communicable diseases. Identifying the prevalence and sociodemographic correlates of sitting time can inform public health policy and prevention strategies. **Methods:** A population-based national survey was carried out among Omani adults in 2008 (n = 2 977) using the Global Physical Activity Questionnaire, which included a measure of total sitting time. Bivariate and regression analyses examined the associations of total sitting time with sociodemographic correlates (gender, age, education, work status, marital status, place of residence, and wealth). **Results:** The proportion who sat for  $\geq 7$  hours/day was significantly higher in older than in younger adults (men: 22.0% vs. 14.6%,  $p < 0.010$ ; women: 26.9% vs. 15.2%,  $p < 0.001$ , respectively). The odds ratio (OR) for prolonged sitting was half for men who were not working compared to those who were ( $p < 0.050$ ). For younger women, the OR for sitting  $\geq 7$  hours/day was nearly a third for educated women compared to least educated ( $p = 0.035$ ). For older women, the OR for prolonged sitting was more than double for married women compared to unmarried ( $p < 0.001$ ). **Conclusions:** One in five Omani adults was identified as sitting for prolonged periods, at levels understood to have deleterious health consequences. Higher-risk groups include older adults and working men. With sitting time identified as a key behavioral risk to be targeted for the prevention of non-communicable diseases, further research is needed to understand the factors associated with domain-specific sitting time in order to guide prevention programs and broader public health approaches.

The Sultanate of Oman is a high-income oil-producing country located on the southeast corner of the Arabian Peninsula. Rapid socioeconomic development has resulted in dramatic demographic and epidemiological transitions. Urgent public health action is required to address the alarming increase in the prevalence of type 2 diabetes, cardiovascular disease, obesity, and their risk factors in Oman and neighboring countries.<sup>1,2</sup> Promoting physical activity and better quality dietary intake are key interventions being promoted by public health experts to address this growing concern.<sup>3-5</sup>

Sedentary behaviors, defined as any waking behavior characterized by an energy expenditure  $\leq 1.5$  metabolic equivalents (METs) while in a sitting or reclining posture must be addressed.<sup>6,7</sup> High levels of sedentary behavior are associated

with all-cause mortality and in premature mortality due to cardiovascular disease and risk of diabetes, obesity, and some cancers.<sup>8,9</sup> Mortality risk increases significantly when total daily sitting time exceeds seven hours.<sup>10,11</sup> High level of moderate physical activity appears to attenuate, but not eliminate, the risk of high sitting time.<sup>12</sup> Reducing sedentary behavior is now identified as an additional strategy to address these diseases.<sup>13,14</sup>

Country-specific evidence on sedentary behavior is needed to identify target groups and develop interventions.<sup>8</sup> This need is especially the case for countries of the Arabian Peninsula.<sup>15</sup> Limited evidence is available on sedentary behavior in the region.

A recent review identified only one study reporting the prevalence of prolonged sitting among the adult population from the Arabian Peninsula;

a sub-national study in Oman reported that half of the adult population sit  $\geq 3$  hours/day.<sup>16</sup> It also reported a significant association of sitting time with the metabolic syndrome.<sup>16</sup>

We report a descriptive epidemiological analysis of high sitting time from a large population-based survey of Omani adults, reporting sociodemographic and other correlates that may help to identify higher-risk subgroups.

## METHODS

The Oman World Health Survey is a cross-sectional household survey of adults living in Oman conducted in 2008. It followed the World Health Organization (WHO) World Health Survey methodology.<sup>17</sup> The Arabic version of the instrument was adapted using the local Arabic dialect. A multistage sampling design was used where a random sample of 1700 houses was selected from 191 census clusters in Oman, and an individual was randomly selected in each selected household from all eligible household members. A high proportion of those selected completed the household interview (4717 nationals and non-nationals, response rate 86.3%).<sup>18</sup> Omani participants with complete data for all key variables were included in the present analyses.

The findings of the Oman World Health Survey 2008 were published by the Ministry of Health in 2012. Data preparation and analyses for this study was conducted in 2016 after ethical approval to carry out secondary analysis was granted by the Ministry of Health Research Committee.

The adapted Arabic version of the World Health Survey instrument was used to collect data for demographic variables (gender, age, education, work status, marital status, place of residence, and wealth). Physical activity behavior and sitting time were measured using the Global Physical Activity Questionnaire (GPAQ), a validated tool developed by the WHO to estimate physical activity levels in diverse countries around the world.<sup>19–21</sup> Although not validated for Arab populations, both the long and short form have been used in numerous studies conducted in the Arabian Gulf.<sup>15</sup> Demographic and behavioral data were collected using face-to-face household and individual interviews. Questionnaires were reviewed for quality prior to data entry into the SPSS statistical software (SPSS Statistics Inc., Chicago, USA) version 9.0.

The independent variables included gender, age (18–40 and  $> 40$  years), educational attainment (illiterate, less than secondary education, and secondary and above), marital status (married, not married), work status (employed, unemployed), wealth (quintiles), and place of residence (urban, rural). Principle components analysis based on household assets was carried out to classify participants into wealth quintiles.<sup>18</sup> Place of residence followed the government definition; participants living in an area with a population of at least 2500 with access to basic services such as public education and electricity/telephone networks were classified as urban.<sup>22</sup>

Physical activity and sitting time were scored as per the GPAQ protocol.<sup>23</sup> Physically active individuals were those who engaged in at least 150 minutes of moderate physical activity per week. Inclusion and categorization of variables were based on bivariate and regression analysis to ensure that there was sufficient power for the regression models and adequate numbers in all categories.

The dependent variable was total sitting time based on the single item in the GPAQ instrument: ‘Over the past 7 days, how much time did you spend sitting or reclining on a typical day?’. Responses reported as hours and/or minutes per day. The distribution of sitting time as well as the natural logarithm were non-normal, therefore, a categorical variable ( $< 7$  hours/day vs.  $\geq 7$  hours/day) was developed guided by the recent evidence of increased risk  $> 7$  hours/day of sitting time.<sup>10,11</sup>

Data were analysed using the STATA 11 software (StataCorp. 2009. Stata Statistical Software: Release 11. College Station, TX: StataCorp LP.). Bivariate analysis and logistic regression using the sociodemographic variables and physical activity were carried out to examine the prevalence of prolonged sitting in Oman and to determine the independent associations of correlates with sitting time.

All models were weighted to the Omani population in 2008. Models (without weighting) were tested for gender and age interactions. Due to multiple interactions, regression analysis was carried out segregated by gender and age. Goodness of fit tests were carried out to determine how well data fitted the models. Results were reported as odds ratios (OR) with 95% confidence intervals (CI) and statistically significant at  $p \leq 0.050$ .

**Table 1:** Mean and median sitting times for Omani men and women by sociodemographic attributes and physical activity status.

Demographic indicators	Men			Women			n = 2977	Total	
	n	Mean (SD)	Median (25 <sup>th</sup> and 75 <sup>th</sup> )	n	Mean (SD)	Median (25 <sup>th</sup> and 75 <sup>th</sup> )		Mean (SD)	Median (25 <sup>th</sup> and 75 <sup>th</sup> )
<b>Gender</b>									
Men							1 490	243 (212)	120, 300
Women							1 487	265 (227)	120, 360
<b>Residence</b>									
Rural	700	253 (218)	120, 300	684	271 (237)	120, 360	1 384	262 (228)	120, 360
Urban	790	234 (210)	120, 300	803	263 (223)	120, 360	1 593	252 (217)	120, 300
<b>Age</b>									
18–39 years	919	221 (171)	120, 300	944	231 (181)	120, 300	1 863	226 (176)	120, 300
≥ 40 years	571	279 (261)	120, 360	543	314 (272)	120, 420	1 114	298 (268)	120, 390
<b>Marital status</b>									
Married	594	245 (197)	120, 300	597	299 (254)	120, 390	1 191	274 (231)	120, 360
Not married	896	242 (221)	120, 300	890	239 (200)	90, 300	1 786	241 (211)	120, 300
<b>Education</b>									
Illiterate	317	310 (322)	120, 360	527	313 (281)	120, 480	844	312 (294)	120, 420
Less than secondary	504	250 (198)	120, 300	496	240 (199)	120, 300	1 000	245 (199)	120, 300
Secondary and above	669	216 (161)	120, 300	464	242 (181)	120, 300	1 133	227 (170)	120, 300
<b>Wealth status (quintile)</b>									
1 (lowest)	384	280 (271)	120, 390	412	268 (249)	90, 360	796	273 (259)	120, 360
2	396	250 (225)	120, 300	407	281 (250)	120, 360	803	267 (239)	120, 300
3	297	236 (181)	120, 300	295	257 (202)	120, 360	592	247 (193)	120, 330
4	231	241 (189)	120, 300	245	247 (193)	120, 360	476	244 (191)	120, 320
5	182	219 (191)	120, 240	128	274 (237)	120, 360	310	243 (213)	120, 300
<b>Work status</b>									
Employed	782	210 (165)	120, 240	112	193 (165)	60, 120	894	207 (165)	120, 240
Unemployed	708	281 (250)	120, 360	1 375	273 (231)	120, 360	2 083	276 (237)	120, 360
<b>Meeting PA requirements</b>									
Inactive	715	274 (255)		919	287 (254)	120, 360	1 634	281 (254)	120, 360
Active	775	217 (162)		568	235 (178)	120, 300	1 343	225 (170)	120, 300
<b>Total</b>								<b>255 (220)</b>	<b>120, 300</b>

\*Weighted to the Omani population, 2008. PA: physical activity; SD: standard deviation.

## RESULTS

Participants who had complete information on sociodemographic variables, physical activity, and sitting time (n = 2 977, 49.9% women) were included in this study. The interquartile range (IQR) for daily sitting time was similar between men and women (men: 120, 300; women: 120, 360 minutes/day). Those who were older, married, less educated, unemployed, and not physically active had higher mean sitting times than their counterparts [Table 1]. One in five adults was found sitting for ≥ 7 hours/day (men: 17.4%, women: 20.0%). The proportion sitting for ≥ 7 hours/day was significantly higher in men and women age ≥ 40 years compared to

< 40 years, men: 22.0% and 14.6%, respectively ( $p < 0.001$ ), and women: 26.9% and 15.2%, respectively ( $p < 0.001$ ).

Logistic regression analyses using variables identified as significant in bivariate analysis were carried out. The models for men included education, wealth status, work status, and physical activity levels. Women's models included marital status, education, work status, and physical activity levels. Due to numerous gender and age interactions, analyses were conducted for men and women in two age groups (< 40 years, ≥ 40 years).

The  $p$ -values for the Hosmer–Lemeshow tests indicated that the models were all good fit

**Table 2:** Findings of the analyses examining correlates of sitting for  $\geq 7$  hours/day among Omani men and women.

Demographic indicators	< 40 years			$\geq 40$ years		
	n <sup>a</sup>	Odds ratio (95% CI) <sup>b</sup>	p-value	n	Odds ratio (95% CI) <sup>b</sup>	p-value
<b>Men</b>						
<i>Education</i>						
Illiterate	19	Ref		298	Ref	
Less than secondary	298	0.89 (0.19–4.24)	0.893	206	0.66 (0.34–1.28)	0.224
Secondary and above	602	1.00 (0.21–4.74)	0.999	67	1.41 (0.42–4.78)	0.579
<i>p</i> -for-trend			0.737			0.972
<i>Wealth status (quintile)</i>						
1 (lowest)	187	Ref		197	Ref	
2	266	1.42 (0.67–4.24)	0.359	130	1.60 (0.68–3.77)	0.284
3	188	2.65 (1.15–6.08)	0.022	109	0.87 (0.38–1.99)	0.381
4	149	1.05 (0.45–2.46)	0.911	82	1.13 (0.51–2.52)	0.509
5	129	1.50 (0.63–3.60)	0.363	53	2.28 (0.75–6.91)	0.751
<i>p</i> -for-trend			0.838			0.319
<i>Work status</i>						
Employed	526	Ref		256	Ref	
Unemployed	393	0.59 (0.36–0.97)	0.038	315	0.47 (0.25–0.90)	0.022
<i>Meeting PA requirements</i>						
Inactive	370	Ref		144	Ref	
Active	549	1.60 (0.94–2.72)	0.082	242	2.31 (1.25–4.26)	0.007
<b>Women</b>						
<i>Marital status</i>						
Married	363	Ref		234	Ref	
Not Married	581	0.88 (0.51–1.51)	0.648	309	2.59 (1.52–4.40)	<0.001
<i>Education</i>						
Illiterate	110	Ref		417	Ref	
Less than secondary	379	0.58 (0.21–1.60)	0.294	117	1.28 (0.67–2.46)	0.459
Secondary and above	455	0.35 (0.13–0.93)	0.035	9	1.36 (0.08–21.93)	0.827
<i>p</i> -for-trend			0.028			0.064
<i>Work status</i>						
Employed	99	Ref		13	Ref	
Unemployed	845	0.59 (0.24–1.45)	0.254	530	0.13 (0.01–1.27)	0.079
<i>Meeting PA requirements</i>						
Inactive	547	Ref		372	Ref	
Active	397	1.01 (0.60–1.68)	0.980	171	2.12 (1.23–3.66)	0.007

<sup>a</sup>n in sample (unweighted). <sup>b</sup>Weighted to the Omani population 2008. p-value using weighted logistic regression.

PA: physical activity; CI: confidence interval.

(p-values ranged between 0.647 to 0.991). For men, working status was significantly associated with  $\geq 7$  hours/day of sitting time [Table 2]. The OR for prolonged sitting was half for men who were unemployed compared to those who were employed; 0.59 (95% CI 0.36–0.97,  $p = 0.038$ ) for men < 40 years old and 0.47 (95% CI 0.25–0.90,  $p = 0.022$ ) for men  $\geq 40$  years. The OR was more than double for active men age  $\geq 40$  years compared to inactive; 2.31 (95% CI 1.25–4.26,  $p = 0.007$ ); an association not seen in men age < 40 years. Education, marital status, and physical activity were

significantly associated with sitting  $\geq 7$  hours/day in the women's models but differed by age cohorts.

For women < 40 years old, the OR for sitting  $\geq 7$  hours/day was nearly a third for educated women compared to least educated, 0.35 (95% CI 0.13–0.93,  $p = 0.035$ ). For women age  $\geq 40$  years, the OR for prolonged sitting was more than double for married women compared to the unmarried 2.59 (95% CI 1.52–4.40,  $p < 0.001$ ). In addition, the OR was more than double for physically active older women compared to their inactive counterparts 2.12 (95% CI 1.23–3.66,  $p = 0.007$ ).

## DISCUSSION

This is the first descriptive epidemiological study of sedentary behavior for a national population not only for Oman but for any of the oil-producing countries of the Arabian Peninsula. The prevalence of prolonged sitting time ( $\geq 7$  hours/day) was significantly higher in men and women age  $\geq 40$  years compared to their younger cohorts. Education, marital status, working status, and physical activity levels were associated with prolonged sitting time but varied by gender and age.

Higher daily sitting times are associated with greater risk of all-cause mortality.<sup>10,11</sup> A threshold of  $\geq 7$  hours/day has been proposed as a basis for public health recommendations.<sup>10</sup> However, few studies used this cut-point making comparisons difficult. In this study, one in five Omani adults reported high sitting times. Similar proportions were seen in some parts of southern Europe (i.e., Hungary, Portugal, and Romania), the lowest in the continent; prevalences were much higher ( $\geq 30\%$ ) in countries in north western Europe.<sup>24</sup>

Although this study does not identify domain-specific sitting, it establishes a basis for monitoring sitting time trends in the region. Further research using objective measurements (such as accelerometers) and tools that assess sitting time across domains (e.g. occupational, transport, and leisure-time) are warranted.<sup>25,26</sup> Given the changing trends in occupational, leisure activity, and motorization, research should focus on prolonged occupational sitting, sitting in cars, and screen use (TV, smart phones, and computers) during leisure.<sup>15</sup>

Higher prevalence of more-prolonged sitting among older adults contrasts with findings from Sur, a city 150 km from the national capital (Muscat), which reported age having a negative association among women.<sup>27</sup> Similar to the findings for gender, this trend is not consistently reported globally.<sup>24,28-30</sup> The variations by age and gender for sitting time in Oman could be due to various factors including occupational patterns, leisure time activities as well as cultural characteristics.<sup>28,29,31</sup> It is possible, for example, that men and women of different age groups living in agricultural areas of the northern coast and southern tip of the country have differing activity patterns compared to the maritime communities of eastern Oman, the more nomadic communities of the desert region and the modernized parts of the capital city. Further research is required to better understand

the age and gender relationships. Given the higher levels of inactivity among women and the differing associations of activity with the correlates according to gender, public health interventions should be targeted specifically to men and women.<sup>15,32,33</sup>

The higher odds of sitting time for men who are employed compared to unemployed indicates the importance of understanding the labor market. A multi-county review reported a similar finding with overall leisure sitting time,<sup>30</sup> a common measure of sedentary behavior. Due to the high dependency on non-nationals, particularly in the unskilled labor market, it is likely Omani men are increasingly being employed in sedentary occupations. Thus, the Omani working population is a key group that could be targeted for the reduction of sedentary behavior. Further research to examine occupational sitting would be useful for the development of appropriate interventions.

Among the other sociodemographic correlates examined, only higher educational attainment showed a significant association with prolonged sitting in younger women. Globally, results are mixed; the Eurobarometer study reported a positive association<sup>24</sup> as seen among men in Sur, Oman.<sup>27</sup> The International Prevalence Study reported broadly similar findings for 15 of the 20 countries.<sup>30</sup> Further examination of the relationships of educational attainment and other indicators of socioeconomic position with domain-specific sedentary behavior would better identify possible high risk groups for targeting interventions.

Numerous studies have explored the association of sedentary behavior with physical activity. Many report higher sedentary behavior being associated with less physical activity,<sup>24,28,30</sup> however, others detect no association or a positive association, higher sedentary behavior associated with higher physical activity.<sup>30</sup> The positive association seen among older adults in this study warrants further examination. Domain-specific studies for both physical activity and sedentary behavior would help better assess their relationship.

This study was a population-based national survey of Omani adults that followed a standard protocol and the data was weighted to the Omani population. However, four key limitations were identified. First, although the instrument is widely used in the region, it has not been validated for an Arab population. Second, given the error associated with self-reported

measures and the one-item sitting time measure, it is possible that the reported sitting time is over- or underestimated. Objective measures would be useful to better understand sedentary behavior in this population. Third, dividing educational attainment into only two categories may have resulted in potentially biased findings. It is possible that more educated adults have better health literacy than their less educated counterparts. A larger sample would have been helpful to ensure adequate numbers in all categories to allow a more thorough exploration of the associations of education and behavior. Finally, the associations reported do not denote causality owing to the cross-sectional nature of the study.

## CONCLUSIONS

Prolonged time spent in sedentary behavior is an emerging public health concern, particularly since the rates of type 2 diabetes, cardiovascular disease, and obesity are escalating in the countries of the Arabian Peninsula. These findings provide the first national-level evidence on the prevalence and correlates of this behavior in Omani adults. One in five Omani adults sit for seven or more hours every day, and preventive approaches focusing on older adults and working men may have public health benefit. However, further research is needed to understand domain-specific sitting time and to further identify high risk groups, in order to guide decision-makers in developing the most relevant preventive approaches.

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