

# Prevalence of Risk Factors of Non-Communicable Diseases in Oman: STEPS Survey 2017

Adhra Al-Mawali (✉ [adhra.almawali@gmail.com](mailto:adhra.almawali@gmail.com))

Ministry of Health Oman <https://orcid.org/0000-0002-5344-4591>

Sathish Kumar Jayapal

Ministry of Health Oman

Magdi Morsi

Ministry of Health Oman

Waleed Al-Shekaili

Ministry of Health Oman

Avinash Daniel Pinto

Ministry of Health Oman

Hilal Al-Kharusi

Ministry of Health Oman

Ayaman Al-Harrasi

Ministry of Health Oman

Zainab Al-Balushi

Ministry of Health Oman

John Idikula

Ministry of Health Oman

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## Research article

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# Abstract

**Background** Non-Communicable Diseases (NCD) represent a major public health issue and currently are the cause of 71% of deaths globally and 72% deaths in Oman. Hence, there is a need for comprehensive, up-to-date and internationally comparable data on NCD risk factors in order to evaluate the effectiveness of ongoing public health policies and to develop further NCD prevention and control interventions. The aim of the study was to provide evidence-based, up-to-date, extensive, and reliable baseline data on the behavioural and biological risk factors of NCDs in the Sultanate of Oman.

**Methods** A cross-sectional community-based survey designed to be nationally representative of the Sultanate of Oman was conducted based on the WHO STEPwise approach to Surveillance (STEPS). Multi-stage stratified random sampling according to geographical distribution selected a total of 9053 households (Omani nationals and non-Omani residents). Cluster sampling was used and symmetric equal number of blocks were chosen in each governorate with 823 households chosen from each governorate and one eligible adult selected from each household randomly. The survey used demographic and behavioural information questionnaires along with physical and biochemical measurements among adults aged 18 years and above.

**Results** The prevalence of behavioural risk factors such as tobacco use was 9%, alcohol consumption was 2%, insufficient fruit or vegetable intake was 61%, and insufficient physical activity was 39%. The prevalence of biological risk factors such as overweight and obesity was 66%, raised blood pressure was 33%, raised blood glucose was 16%, and raised blood cholesterol was 36%. The prevalence of multiple risk factors was also determined and 95% of the population were found to have more than one risk factor. Three or more risk factors were found among 33% of population aged 18-69 years and 45% of the population aged 45 years.

**Conclusions** These findings are important to support the formulation and implementation of NCD-related policies and action plans that improve health status and prevent mortality due to NCDs in the Sultanate of Oman.

## Background

Non-Communicable Diseases (NCDs) represent a major public health and broader societal problem, causing 71% (around 41 million) of deaths worldwide every year leading to high costs in health expenditures, absenteeism and loss of years of productive life. (1) The 4 sub-groups of NCDs that account for over 80% of all premature NCD deaths are cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes. Worldwide, NCDs deaths are projected to increase by 17% by 2025 (2) with an estimated cumulative loss of output of \$47 trillion between 2011 and 2030 (3). The World Health Organization (WHO) estimated that there will be 2.4 million deaths from NCDs in the high, middle and low-income countries of the WHO Eastern Mediterranean Region by 2025 (4). It is therefore unsurprising

that several NCD-related indicators had been included in the final list of Sustainable Development Goals (SDG) indicators adopted by the United Nations General Assembly in July 2017 (5).

In the Sultanate of Oman, NCDs cause 72% of total deaths (6). These premature deaths seriously affect average life expectancy and quality of life. In spite of recent progress in addressing NCD and their risk factors, the latest previous health survey (7) conducted in Oman (2008) indicated that a significant fraction (70%) of Omani adults still had an insufficient intake of fruits and vegetables, 40% were physically inactive, and one in seven Omani men use tobacco. Also, more than 40% of adult Omanis had raised blood pressure and 12.3% had raised blood glucose (7).

Oman is one of the several countries selected by WHO to receive integrated support for rapid progress in achieving nine global targets for prevention and control of NCDs. Limited and fragmented data are currently available on the prevalence of NCD risk factors from previous surveys conducted in the past in the Sultanate of Oman. Thus, the need arose for comprehensive, up-to-date, and internationally comparable data on NCD risk factors in order to evaluate the effectiveness of ongoing public health policies and to develop further NCD prevention and control interventions. Hence, this STEPS survey aimed to assess the current prevalence of behavioural and biological risk factors of NCD in Oman.

## Materials And Methods

### Study design and sampling technique

A national cross-sectional community-based survey was conducted using a representative sample population of the Sultanate of Oman based on the WHO STEPwise approach to Surveillance (STEPS) of NCD risk factors (8). The population surveyed adults aged 18 years or older, men and women, as well as nationals and non-Omani residents. Those younger than 18 years old, tourists, and persons from labour camps were excluded. A multi-stage cluster sampling strategy was adopted to select 9053 households from 550 clusters across Oman (823 households from 11 governorates/regions of Oman). One eligible participant aged 18 years or older in each household was randomly selected to take part in the survey. In order to overcome sampling bias, sample weights were calculated and adjusted according to the primary and secondary sampling units. The sample weight was also adjusted for non-response at the household level.

### Data collection

The WHO NCD STEPS instrument consisted of three steps. **Step 1** consisted of face-to-face interviews using an advanced standardized country-specific version of the STEPS questionnaire and locally-adapted

show cards. The questionnaire comprised of 16 modules, containing 139 questions overall which included 78 core, 16 expanded, and 45 country-specific questions. These included socio-demographic characteristics, key behavioural risk factors, lifestyles, and history of chronic diseases. The data collection was conducted in two languages, namely Arabic and English. The tool was validated by translation from the original English version into Arabic as well as back translated, adapted to the local environment and needs, and tested in terms of wording and understanding. **Step 2** consisted of physical measurements (weight, height, waist and hip circumference), and blood pressure to investigate biological risk factors such as raised blood pressure, and overweight and obesity. Calibrated measuring instruments were used throughout the survey for height (SECA<sup>®</sup> 213 portable stadiometer), weight (SECA<sup>®</sup> 813 digital floor scale), and blood pressure (Omron digital blood pressure device). **Step 3** consisted of biochemical markers levels (fasting capillary blood for glucose and lipid profile, and non-fasting urinary samples for sodium) to identify raised blood glucose, raised blood cholesterol, and sodium intake. Calibrated measuring instruments were used throughout the survey for blood parameters (CardioChek<sup>®</sup> Plus analyser). Capillary blood sampling was used to check the fasting blood glucose and cholesterol. Spot urine samples were collected from the participants who were asked to collect a sample in the evening before fasting, which was brought to the appointment for blood testing the next morning. The cut-off points as recommended by WHO were used in the determination of abnormal biochemical blood and urine samples evaluation.

## **Data Management and Statistical Analysis**

A pilot study of 100 households was conducted in one wilayat (province) with the supervision of the central survey team prior to field work initiation. Participant data was entered by data collectors electronically on a hand-held device programmed with e-STEPS software. For each participant, a unique seven-digit participant identifier code was generated. The data obtained from the laboratory results was combined with the main data for the participant using this unique code. Collected data was downloaded from a central database server following which data management included continuously monitoring data collection, uploading and consolidating processes in the field, validating quality of the data, creating weights, removing duplicate records, and checking inconsistencies namely “jump” errors/outliers, absence of data, excess data, and invalid data. A strict data quality control policy was followed to ensure data reliability. The cleaned data sets were thus ensured for data quality and internal consistency. As part of quality assurance and to increase reliability, a re-interview by telephone was done among 500 random households across all 11 governorates for data validation.

Since the multistage cluster sampling design was adapted with nationwide generalization of findings, the population proportional weight was adjusted for this complex survey design. The sample weight comprised of the inverse probability of selection. The household weights took into account the selection

probability of the clusters within each stratum and the size (the number of households) of the cluster. The design weight was adjusted for non-response at the household level. Similarly, the individual weight was adjusted for non-response. Means, medians, proportions, standard errors, and 95% confidence intervals (95% CI) values were calculated to estimate central and dispersion measures and used to assess prevalence differences of NCD risk factors. Statistical procedures for data calculation and analyses were performed through two programs: EpiInfo in collaboration with WHO, and IBM SPSS (Version 20). All the figures and indicators in the tables were calculated using SPSS complex samples analysis.

## **Ethical considerations**

The survey was approved by the Central Research and Ethical Review & Approval Committee of the Ministry of Health, Sultanate of Oman. (Approval No: 26/2015). Informed consent was obtained separately during health history collection and measurement of bio physiologic parameters. The confidentiality of the data gathered was maintained. Any waste generated during the biochemical markers' field procedures was properly safely disposed of as per the recommended protocol. All blood samples were discarded after completing biochemical measurements.

## **Results**

### **Population demographics and socio-economic characteristics**

Of the 9053 eligible persons (823 from each of 11 governorates), 6582 persons consented to participate in the NCD survey. Table 1 represents the socio-demographic variables of the sample involved in the survey. The sample population was almost equal between men and women (49% females; 51% males). The age range of the sample was 24% in the 18–29 years' age group, 32% in the 30–39 years' age group and 31% in the 40–59 years' age group with 9% in the 60+ age group. In terms of education level, the largest proportion (34%) had completed secondary school while 23% had completed a University degree with around 27% not having any formal education. 45% of the sample population were not currently working while 22% were working as a government employee. The distribution of samples in the different governorates (regions) are also shown in Table 1.

### **Behavioural Risk Factors**

**Smoking:** The overall prevalence of current smokers, including daily and non-daily smokers, was 9% (95% CI: 6.1-11.6) (Table 2). The highest prevalence was observed among men (16%, 95% CI: 11.6-21.3). Omani

(6%, 95% CI: 3.6-11.0) smoked less than non-Omani residents (14%, 95% CI: 10.8-18.6). 7% (95% CI: 5.0-10.0) of the population currently smoke tobacco daily. Current daily smoking is most prevalent amongst males (13%, 95% CI: 9.1-19.0) and non-Omani residents (11%, 95% CI: 8.2-15.2). The prevalence of current smoking and current daily smoking was found statistically significant ( $p < 0.05$  level) by sex and nationality.

## **Alcohol consumption**

Alcohol consumption was observed in 2% (95% CI: 0.7-8.4) of the participants (Table 2). The prevalence of alcohol consumption was higher in males (4%, 95% CI: 1.2-11.8) compared to females (0.6%, 95% CI: 0.2-4.0), and higher among non-Omani residents (8%, 95% CI: 3.3-18.2) than Omani (0.4%, 95% CI: 1.2-11.8).

## **Unhealthy diet**

Overall, the mean number of servings of fruit or vegetables consumed per day on average was 4.4 with higher means observed in the female (4.0) and Omani (4.7) population (Table 2). A large proportion (61%, 95% CI: 51.1-69.5) of the population reported eating less than the WHO-recommended 5 servings of fruit or vegetables per day. The prevalence of insufficient fruit or vegetable intake was higher in men (64%, 95% CI: 54.6-72.2) as compared to female (57%, 95% CI: 47.1-66.9). A lower prevalence was seen among the Omani population (56%, 95% CI: 46.7-67.7) than the non-Omani resident population (69%, 95% CI: 63.0-75.0). 24% (95% CI: 15.3-35.9) of the population also reported adding salt or salty sauce always or often to their food before or while eating, with a higher prevalence among the female (28%, 95% CI: 19.5-38.3) and Omani (27%, 95% CI: 18.1-37.4) population. The mean salt intake per day was found to be 8.6g among the survey participants. The mean salt intake per day was found to be higher in males (9.5g) than females (7.4g), and lower among Omani (8g) than non-Omani residents (9g). The prevalence of insufficient fruit or vegetable intake was found to be statistically significant ( $p < 0.05$ ) by sex and nationality.

## **Physical Inactivity**

Insufficient physical activity was prevalent among 39% (95% CI: 27.9-50.6) of the respondents (Table 2). Almost half of the women (49%, 95% CI: 34.7-62.6) along with 30% (95% CI: 22.0-38.5) of men were found to have insufficient physical activity. Omani (42%, 95% CI: 30.3-53.8) had a higher prevalence of insufficient physical activity than non-Omani residents (31%, 95% CI: 21.4-41.7). Omani women (51%, 95% CI: 37.6-63.4) were found to have a higher prevalence of insufficient physical activity compared to Omani men (30%, 95% CI: 20.6-41.6). Overall, the median time spent on physical activity on average per

day was 69 minutes, with females (60 minutes) and Omani (60 minutes) reporting lower median times than males (77 minutes) and non-Omani residents (120 minutes) respectively. The prevalence of insufficient physical activity was found statistically significant ( $p < 0.05$ ) by sex and nationality.

## **Biological Risk Factors**

### **Overweight and Obesity**

With an overall mean Body Mass Index (BMI) of 28, Almost two thirds (66%, 95% CI: 62.4-69.6) of the population were overweight or obese (body mass index  $\geq 25$  kg/m<sup>2</sup>) (Table 3). A higher prevalence of overweight and obesity was observed among women (69%, 95% CI: 65.4-73.1) as compared to men (63%, 95% CI: 57.6-88.8). The Omani population (67%, 95% CI: 63.3-69.6) had a slightly higher prevalence of overweight and obesity than the non-Omani resident population (65%, 95% CI: 58.5-71.1). Likewise, obesity (body mass index  $\geq 30$  kg/m<sup>2</sup>) was more prevalent in females (39%, 95% CI: 34.2-44.7) than males (23%, 95% CI: 19.3-27.7) contributing to an overall prevalence of 31% (95% CI: 26.0-35.7). Omani women (41%, 95% CI: 35.5-46.6) were found to have a higher prevalence of obesity compared to Omani men (28%, 95% CI: 25.2-31.5). The prevalence was higher among Omani (35%, 95% CI: 31.4-39.2) than non-Omani residents (19%, 95% CI: 14.0-25.2). The prevalence of overweight and obesity was found statistically significant ( $p < 0.05$ ) by sex and nationality.

### **Raised blood pressure**

The prevalence of raised blood pressure, including those on medication for raised blood pressure, was 33% (95% CI: 28.0-39.1) (Table 3). A higher prevalence was observed among men (39%, 95% CI: 32.0-46.4) than women (27%, 95% CI: 24.3-30.4). Omani (32%, 95% CI: 26.8-38.0) had a lower prevalence of raised blood pressure compared to non-Omani residents (37%, 95% CI: 32.2-41.1). The prevalence of raised blood pressure was found statistically significant ( $p < 0.05$ ) by sex and nationality.

### **Blood glucose**

16% (95% CI: 15.1-16.3) of the survey participants were found to have raised blood glucose (Table 3). The prevalence was slightly higher among women (16%, 95% CI: 15.2-16.9) than men (15%, 95% CI: 14.5-16.3). A lower prevalence of raised blood glucose was seen in Omani (15%, 95% CI: 13.8-15.3) as compared to non-Omani residents (19%, 95% CI: 17.8-19.9). Impaired glycaemia was prevalent among 12% (95% CI: 11.1-12.2) of the population. Higher prevalences were observed among women (12.6%, 95% CI: 11.9-13.3) and non-Omani residents (13%, 95% CI: 11.7-13.3) as compared to men (11%, 95% CI: 10.5-11.6) and Omani (12%, 95% CI: 11.0-12.1), respectively. The prevalence of raised blood glucose was found statistically significant ( $p < 0.05$ ) by sex and nationality.

### **Raised total cholesterol**

The overall prevalence of raised total cholesterol in the population was 36% (95% CI: 34.7-36.3) (Table 3). The prevalence was higher among women (40%, 95% CI: 38.3-40.7) than men (32%, 95% CI: 30.8-33.0). Higher prevalence was also observed in Omani (37%, 95% CI: 36.0-38.0) than non-Omani residents (31%, 95% CI: 30.1-32.8) population. The prevalence of raised total cholesterol was found statistically significant ( $p < 0.05$ ) by sex and nationality.

### **Table 4: Summary of combined risk factors**

Age category	Men	Women	Omani	Non-Omani	Overall
<b>0 NCD risk factors</b>					
<b>18-69 years (%)</b>	4.9 (2.5-9.3)	5.4 (2.8-10.2)	5.5 (3.1-9.5)	4.3 (3.0-6.1)	<b>5.1</b> (3.2-8.1)
<b>3 or more of the NCD risk factors</b>					
<b>18 - 69 years (%)</b>	35.3 (28.8-42.5)	30.6 (23.0-39.5)	32 (24.3-40.9)	36.1 (32.9-39.5)	<b>33.2</b> (26.6-40.4)
18 - 44 years (%)	31.6 (25.0-39.0)	24.2 (16.7-33.8)	27.7 (20.2-36.8)	29.7 (26.1-33.4)	<b>28.3</b> (22.1-35.4)
45 years and above (%)	44.7 (37.1-52.8)	44.8 (35.1-54.8)	41.8 (31.8-52.6)	53.2 (46.8-59.5)	<b>44.7</b> (36.6-53.1)

### Combined Risk Factors

Combined risk factor analysis was performed with five components: current daily smokers, consumption of less than 5 servings of fruit and vegetables per day, insufficient physical activity, overweight or obesity, and raised blood pressure or currently on medication for raised blood pressure. The analysis of combined risk factors revealed that only 5% of the population were free from any of the risk factors (Table 4). Overall, it was found that 35% (95% CI: 28.8-42.5) of the population had three or more risk factors for chronic disease. In the 18-44 years' category, the overall prevalence of three or more risk factors was found to be 29% (95% CI: 22.1-35.4) with higher prevalence among males (32%, 95% CI: 25.0-39.0) and non-Omani residents (30%, 95% CI: 26.1-33.4). Similarly, in the 45 years and above category, the overall prevalence of three or more risk factors was found to be 45% (95% CI: 36.6-53.1). Men (45%, 95% CI: 37.1-52.8) are women (45%, 95% CI: 35.1-54.8) in this category had equal prevalence of three or more risk factors. The prevalence was found to be lower among Omani (42%, 95% CI: 31.8-52.6) as compared to non-Omani residents (53%, 95% CI: 46.8-59.5).

## Discussion

This nationally representative STEPS survey is the largest survey conducted in Oman which focused on collecting comprehensive information on both modifiable behavioural risk factors (smoking, alcohol consumption, physical inactivity, and unhealthy diet) and biological risk factors (overweight and obesity, raised blood pressure, raised blood glucose, and raised total cholesterol) for NCDs. The 2008 World Health Survey (WHS) was the last survey done in Oman to assess the national prevalence of some of the risk factors of NCDs (9). The current survey demonstrated that the Sultanate of Oman has a high

prevalence of overweight and obesity, raised blood pressure, raised total cholesterol, insufficient fruit or vegetable intake, salt intake, and insufficient physical activity.

**Table 5: Comparison of risk factors from recent STEPS surveys in various EMRO countries**

	Risk Factor Topic	Oman* (2017)	Egypt (2017)	Qatar (2012)	Iraq (2015)	Lebanon (2017)	Kuwait (2014)
<b>Behavioural Risk Factors</b>	Current tobacco smoking (%)	8.0	22.7	16.4	20.7	38	20.5
	Current daily tobacco smoking (%)	6.7	18.4	14.7	19.6	75.6	18
	Alcohol use (in past 30 days) (%)	1.6	0.8	NA	0.6	23.4	0.3
	Insufficient fruit/vegetable consumption (%)	61	90.3	91.1	79.2	73.4	83.8
	Salt intake (g)	9	9	NA	NA	NA	NA
	Insufficient physical activity (%)	39	24.9	45.9	47	61	62.6
<b>Biological Risk Factors</b>	Overweight & Obesity (%)	66	63	70.1	65.4	62.8	77.2
	Obesity (%)	36	35.7	41.4	33.5	28.6	40.2
	Raised Blood Pressure (%)	33.3	29.5	32.9	35.6	32.8	25.1
	Raised Blood Glucose (%)	15.7	15.5	16.7	13.9	9.4	14.6
	Raised Total Cholesterol (%)	36	19.2	21.9	39.6	48.8	55.9

\* Inclusive of non-Omani residents

## Behavioural Risk Factors

In this survey, smoking was found to be mainly prevalent among males and the non-Omani resident population. The overall prevalence of current smoking (9%) is consistent with the 2008 WHS (9%). The prevalence of current smoking among men (16%) increased slightly from 2008 (15%). This increased trend in tobacco smoking can be attributed to urbanization and underlying cultural factors. The government has taken into account the issue of smoking and has implemented several measures to control the usage among the common public. According to the Royal Decree 43/2018, the advertisement of tobacco products is banned in Oman (10). There has also been a ban on smoking in public places since 2010 (11). As a result, Oman also has the lowest prevalence rate in the EMRO region, in contrast with other countries in the region some of which have the highest prevalence rates worldwide (12). Jawad et al. (12) suggests that Oman needs to adopt policies recommended by WHO's MPOWER package in order to maintain the current low prevalence of smoking.

Alcohol use was among the least frequent risk factors in the Sultanate of Oman, with the prevalence at just around 2% of the total population. The prevalence among Omani was very low owing to cultural factors and strict compliance to religious values. Non-Omani residents were the largest proportion consuming alcohol in Oman at 8%. Table 5 demonstrated that Oman is higher than most other EMRO countries - however when only nationals are taken into account, prevalence rates are in line with other EMRO countries. It is important to note that alcohol availability has also been regulated by the stringent laws and monitored by the government sector in Oman (13) (14). Also, given that alcohol consumption is somehow stigmatized in society, low reported prevalence may also be in part an underestimation, so results should be interpreted with some caution.

Insufficient intake of fruit and vegetables intake per day was found to be fairly high at 61% overall, even though the average consumption of fruits and/or vegetables per day of 4.4 servings seen in the survey is close to the recommendation. Furthermore, Oman is the lowest in terms of insufficient intake of fruits and/or vegetables in recent STEPS surveys conducted in the EMRO region while Qatar and Egypt reported prevalence rates of above 90% (Table 5) (15). Also on a positive note, the trend of insufficient fruit and vegetables intake decreased from 68% to 61%, and among the Omani population from 70% to 58% in 2008 WHS as compared to this survey, respectively. A serious concern was the mean salt intake per day (9g) which was found to be almost double the recommended amount (5g). This could be attributed to persons adding salt or salty sauce to their food always or often before or while eating which was found to be 24% in this survey. The STEPS survey conducted in Egypt which also performed urine analysis reported the same high level of salt intake (15). The current survey revealed that women had the highest prevalence of adding salt to the food. Women can have a contributory role in this risk factor as are an important part of the family especially in food preparation. It is also vital that knowledge of healthy eating habits starts young as the prevalence of adequate intake of fruit and vegetables in the eleven EMR countries among adolescents was found to be low (16). Strategies and/or other alternatives to reduce

salt intake, a matter that may require health promotion and education to improve knowledge about sources of salt, should be thought of in order to reduce/modify the risk. The health sector has an important role in determining salt content of processed foods and initiate discussions with the food industry on means to address their reformulation.

In terms of physical activity, WHO recommends exercising at least 150 minutes of moderate or vigorous physical activity weekly. However, it was found in this survey that the median time spent even on total physical activity was only 69 minutes. Omani nationals and women spent only one hour on average for total physical activity per day. This led to 39% of the population having insufficient physical activity, which was consistent with 2008 OWHS (42%) (7). The prevalence of insufficient physical activity in Oman was higher than Egypt (25%) and lower than Qatar (46%), Iraq (47%) Lebanon (61%) and Kuwait (63%) (17). Modernisation coupled with the hot, humid climate lead to people resorting to using private cars for even fairly short distances thus attributing to the lack of regular outdoor physical activity (18). However, health promotion, education, transport modality planning, and policy should be brought together to address this multifactorial issue.

### **Biological Risk Factors**

A serious cause for concern is the prevalence of overweight and obesity ( $BMI \geq 25$ ) which stands at 66% in Oman. There has been a dramatic increase in the prevalence of overweight and obesity among the Omani population from 54% in 2008 WHS to 67% in 2017 (7). Also alarming is the prevalence of obesity among the Omani population which is at 35% overall (up from 24% in 2008 WHS) and strikingly among women at 41% (up from 24% in 2008 WHS). The survey findings are Gulf Cooperation Council (GCC) in line with the prevalence of overweight and obesity in the as well as WHO EMRO countries (19,20). This remarkable change is due to the changes of lifestyle and increase in socioeconomic status. With urbanisation, the availability of junk and fast food has increased, and hence increased public awareness of balanced healthy eating habits are imperative to mitigate this availability.

The prevalence of raised blood pressure from this survey was reported as 33%, which means that one in three people in the population had high blood pressure, a prevalence level that calls for attention from policy makers, health professionals, and civil society to address this multifactorial problem. Also, the prevalence of raised blood pressure among men is more than 10% higher than women, so specific targeted interventions to this group are vital to halt the rise and reduce the prevalence of raised blood pressure overall. Interestingly, the same phenomenon was reported by WHO among the EMRO region as well. (21) In terms of the Omani population, the trend of raised blood pressure seems to be reduced from 40% in 2008 to 32% in this survey. Several researchers consistently report an increasing trend in raised

blood pressure in the region. (22,23). In 2015, the Oman Heart Association (OHA) released the internationally recommended guidelines in management of hypertension to be followed. (24). In addition, the national screening program for 40 years and above may have also had an influence to help to reduce the prevalence of increased Blood pressure.

The observed prevalence of raised blood glucose in Oman is currently at 16% showing a steady increase. The prevalence trend in raised blood glucose among the Omani population is also on the rise from 12% in 2008 to 15% in 2017. The prevalence of raised blood glucose was similar to Egypt (16%), lower than Qatar (17%), but higher than Kuwait (15%), and Iraq (14%) (17). Similarly, the prevalence of impaired fasting glycaemia stands at 12%, a three-fold increase from 2008 WHS (4%). This pre-diabetic group is a significant group, which should be targeted in order to treat them early, hence providing an opportunity to reduce health impacts and costs of diabetes treatment later on in the progression of the disease.

The national prevalence rate of raised total cholesterol was reported as 36% in the survey, which was in line with the global prevalence of raised total cholesterol (25). Our results are lower than a majority of Gulf countries where the prevalence was 50% or higher (26). The prevalence among women was higher than men, which also seemed to be the trend globally (25). The prevalence among the Omani population was observed at 37%, which was higher than the prevalence reported in 2008 (34%) (7). The reported total cholesterol level is lower than Kuwait (56%) and Iraq (40%) but higher than Egypt (19%), Qatar (22%) (17). It is important for the public to recognise that keeping cholesterol levels in check is vital for their overall cardiovascular health.

## Conclusions

The Oman National Non-communicable diseases and their Risk Factors Survey (STEPS) provides essential information on key NCD indicators by age group, sex, and governorates. There is a need to prioritize NCD prevention and control at both the national and governorate level with the multisector governmental as well as societal support as it is an emerging threat to health, social and economic development. The strengthening of implementation of Oman's national policy for diet, physical activity and health along with ensuring continuous engagement with the agricultural sector will promote healthy diet among the population. Regarding physical activity, creating conditions or spaces that are suitable for physical activity, raising population awareness about needed effort and benefits, and promoting more physical activity at all possible times and areas, including work and among the youth, are potential areas for intervention and health improvement. Introduction of legislations & guidelines on production, packaging and responsible marketing of food will aid in reducing consumption of unhealthy foods. Most

importantly, the integration of these key NCD indicators in national health surveys will enhance existing data in order to achieve proper planning and future projections for NCD prevention and control.

## Abbreviations

**NCD:** Non-Communicable Diseases

**WHO:** World Health Organization

**SDG:** Sustainable Development Goals

**EMRO:** (WHO) Eastern Mediterranean Regional Office

**BMI:** Body Mass Index

**CI:** Confidence Interval

**WHS:** World Health Survey

**GCC:** Gulf Cooperation Council

**OHA:** Oman Heart Association

## Declarations

### *Ethics approval and consent to participate*

The study protocol was approved by the Central Research and Ethical Review & Approval Committee of the Ministry of Health, Sultanate of Oman (Approval No: 26/2015). Informed consent was obtained separately during health history collection and measurement of bio-physiologic parameters.

### *Consent for publication*

Not applicable.

### *Availability of data and materials*

The datasets generated and/or analysed during the current study are not publicly available due to data sharing policies but are available from the corresponding author on reasonable request.

### ***Competing interests***

The authors declare that they have no competing interests.

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### ***Authors' contributions***

AAM, SKJ, MM, WAS, ADP, HAK, AAH, ZAB, JI contributed substantially to the acquisition, analysis, and interpretation of data. AAM, SKJ, ADP, MM, WAS, HAK, JI have drafted the work and substantively revised it. All authors have read and approved the manuscript.

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