

## Research Article

# Gender Differences in Healthcare Status and Utilization: A Comprehensive Study on Adults in Saudi Arabia

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### ABSTRACT

**Background:** Saudi Arabia's demographic composition is changing, and older adults are expected to represent an increasingly more significant portion of the population. There are notable gender differences in health status among older adults. This study aimed to compare the prevalence of common chronic conditions and healthcare utilization between older Saudi men and women.

**Methods:** The study used a cross-sectional design, and the sample included 400 men and 304 women (age  $\geq 55$  years) from Buraydah, Al-Qassim. Research assistants assessed self-reported demographics, lifestyle, and disease history. They measured the participant's height, weight, blood pressure, and random blood glucose (using a glucometer). Logistic regressions were used to evaluate the association between chronic disease status (i.e., absence vs. presence) and healthcare utilization (i.e., annual health check-ups).

**Results:** The mean and standard deviation for age and body mass index (BMI) were  $62.0 \pm 7.4$  years and  $30.3 \pm 6.5$  (kg/m<sup>2</sup>), respectively. The presence of chronic disease was high for both genders (87.0% Males vs. 86.2% females). However, a more significant proportion of men had hypertension (78.0% vs 70.1%) and heart disease (17.0% vs 10.9%) compared to women. In comparison, women had a higher prevalence of type 2 diabetes (54.9% vs. 45.5%), asthma (15.5% vs. 9.5%), and gastric peptic ulcer (17.1% vs 9.8%) than men. Women reported higher healthcare utilization and were three times more likely to have had a check-up than men.

**Conclusions:** There are significant gender differences in chronic disease prevalence and healthcare utilization among older Saudi adults that warrant more research on this segment of the population.

## INTRODUCTION

There are significant gender differences in health behaviours (e.g., physical activity, smoking), chronic conditions, and healthcare utilisation among older adults. Women are less likely than men to get adequate activity over their lifespans but less likely to have been smokers (McLaughlin *et al.*, 2016; Higgins *et al.*, 2015). Women develop cardiovascular diseases later than men but exhibit more accelerated pathologies (Huebschmann *et al.*, 2019; Zbierajewski *et al.*, 2009). Women are more likely than men to utilise preventive care services, such as flu shots and regular check-ups (Vaidya *et al.*, 2002; Sociasset *et al.*, 2016). Gender-specific data on chronic conditions

and healthcare utilisation among elderly Saudi citizens have not been adequately reported in the literature.

The Saudi Health Interview Survey (SHIS) provided estimates (2013) on hypertension, diabetes, and obesity among the elderly, but it was not stratified by gender (El-Bcheraoui *et al.*, 2014; El-Bcheraoui *et al.*, 2014; Memish *et al.*, 2014). According to that report, the prevalence of hypertension and diabetes among those aged 65 or older were 65.2% and 50.4%, respectively. However, other studies suggest that there may be essential differences between older men and women. Obesity prevalence was higher among women (33.5% vs 24.1%), and for those aged 55 to 64, the prevalence increased by 10% between 2005 and 2013 (Memish *et al.*, 2014). Type 2 diabetes

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was higher among men than women (49.8% vs. 43.6%) in the 60 to 69-year age stratum (Al-Rubeaan *et al.*, 2015). An earlier study (2008) found the prevalence of hypertension higher in females than in males (50.4% vs. 44.6%) in the 60 to 70-year age group (Al-Nozha *et al.*, 2007). Other national studies did not report gender differences in specific age strata (Al-Rubeaan *et al.*, 2014), or they provided only self-reported data on chronic diseases (Khoja *et al.*, 2018).

The prevalence of chronic conditions and associated risk factors are usually higher among the elderly. However, the data come from adult studies that reported age-stratified analyses of disease outcomes (El-Bcheraoui *et al.*, 2014; Memish *et al.*, 2014). Few studies have targeted the elderly population in Saudi Arabia (Khoja *et al.*, 2018). Without such studies, many issues important to older adults have been overlooked, such as health-related behaviours, quality of life, and mental health. This information is critical to meet the healthcare needs of the elderly, who are an increasing portion of the population (Al-Rubeaan *et al.*, 2014). In 2010, the elderly constituted only 3% of the total population, but by 2050, they are projected to be nearly 20% of the total population (Abusaaq *et al.*, 2019). Elderly health studies could guide community awareness campaigns, screening programs, and healthcare policies. The study objectives were to compare the prevalence of chronic conditions and healthcare utilisation, specifically annual health check-ups, between older Saudi men and women to provide initial data to the policymakers of Saudi Arabia. It was hypothesised that women would have more chronic conditions and utilise more healthcare services.

## MATERIALS AND METHODS

### Study Design

The study employed a cross-sectional design and was implemented in two phases: male participants in the first phase and female participants in the second phase. The Al-Qassim Region Medical Ethical Review Committee approved the study.

### Sample size

The total population of the Al-Qassim region of Saudi Arabia at the time the study was started was 991,032, of which 9.5% were 55 years and older (General Authority for Statistics: Kingdom of Saudi Arabia, Demography Survey, 2016). Therefore, the target sample size for this study was 400 men and 400 women (95% confidence and with a 5% margin of error).

### Sampling strategy

In both study phases, the inclusion criteria were being a Saudi national and 55 years of age or older. Research assistants described the study objectives and procedures to potential participants and invited the eligible ones to join. All participants read and signed the consent form before enrollment.

### Phase One

A multi-stage semi-random sampling technique was used to obtain the sample. A detailed area map of Buraydah City was used to list the neighbourhoods (a total of 96 neighbourhoods), and 20 were selected randomly. All mosques in the selected neighbourhoods were listed (133 mosques needed for 400 participants). However, 160 mosques (an extra 20%) were selected to ensure the study had the required sample.

### Phase Two

The sampling strategy for females was more inclusive, given the conservative nature of Saudi society, where it is difficult to recruit women. Twelve Quranic schools were selected in Buraydah city (note: women attend these schools widely in this region of Al-Qassim). Research assistants recruited all eligible women from each school.

### Assessment

Participants were interviewed using standardised questionnaires to obtain demographic information, lifestyle, treatment-seeking behaviours, and chronic conditions. Participants were asked the following: a) whether their physician had told them in the past that they had hypertension, diabetes, heart disease, asthma, peptic ulcer, or cancer, b) the time since the diagnosis, and c) whether they used medication. Per standard protocols, they were assessed for physical measurements (i.e., height, weight, and blood pressure) and blood glucose. Two blood pressure readings were taken with a digital sphygmomanometer, and the lowest value was recorded. Random blood glucose was measured with a glucometer (Accu-Chek Active (Freckmann *et al.*, 2010).

### Outcome

Heart disease, asthma, and peptic ulcer were entirely self-reported. Both measurement and self-reported data determined hypertension and diabetes status. Hypertension was defined as systolic blood pressure of  $\geq 140$  or diastolic  $\geq 90$  mm Hg or use of anti-hypertensive medication. Diabetes was defined as blood glucose  $\geq 200$  mg/dl or the use of anti-diabetic medication. The number of chronic conditions was derived from the summation of conditions and was categorised as either absence (none) or presence (one or more).

### Covariates

Body mass index (BMI) was calculated as kg/m<sup>2</sup> and was divided into  $<25$ , 25-29.9, and  $\geq 30$ . The other variables were age ( $<60$ , 60-69,  $\geq 70$ ), marital status (currently married vs. not), employment status (currently employed vs. not), daily walking (yes, no), cigarette smoking (never, former, current), and economic status (poor, lower-middle class, upper-middle class, rich).

### Data Analysis

Data analysis was conducted with SPSS (version 22); all tests were two-sided with an alpha level of 0.05.

Descriptive statistics (mean and standard deviation for continuous and frequency for categorical variables) were calculated and compared between men and women. Furthermore, the prevalence of each disease (i.e., hypertension, diabetes, heart disease, asthma, peptic ulcer, and cancer), the number of diseases (none vs one or more), as well as treatment preferences, treatment practices, and healthcare utilisation, were compared between men and women. Logistic regression was employed to model the associations between selected factors and the following two outcomes: a) chronic disease (none vs. one or more) and b) annual health check-up (no vs. yes). Factors were selected *a priori* based on the literature and health behaviour theories. Each variable was tested in an unadjusted model. Then, the following variables were entered into the model simultaneously for the adjusted model: age, gender, body mass index, marital status, employment, socioeconomic status, daily walking, and smoking status. Furthermore, each outcome was controlled for in the other outcome's model since the two variables were correlated. The odds ratio and the associated 95% confidence interval were estimated.

## RESULTS

The participants included 400 men and 304 women over the age of 55. The recruitment for women was lower due to several obstacles to data collection, mostly primarily related to conflicting schedules between the research assistants and Quran schools. Men and women differed in nearly all sociodemographic characteristics. The proportion of women under 60 was higher than that of men (54.3% vs. 40.0%). Women were more likely to be obese (58.6% vs. 34.3%) and widowed (31.3% vs. 0.0%) than men. Men were more likely to be employed (35.0% vs. 7.2%) and smokers (9.3% vs. 1.6%) than women. The proportion of men and women who walked daily was similar (54.5% vs. 59.2%). Women reported a higher socioeconomic status than men, especially those in the upper-middle class (49.3% vs 41.0%), but overall, the majority of the sample reported being middle class (Table 1).

Men and women exhibited significant differences in the prevalence and types of chronic diseases. A more significant proportion of men had hypertension (78.0% vs 70.1%) and heart disease (17.0% vs 10.9%) than compared to women. In contrast, a higher proportion of women had all other chronic conditions despite being, on average, younger. Women had a higher prevalence of type-2 diabetes (54.9% vs 45.5%), asthma (15.5% vs 9.5%), and gastric peptic ulcer (17.1% vs. 9.8%) than men, with no difference in cancer (2.3% vs. 1.6%). There was no significant difference in the proportion of men and women who had at least one chronic condition (i.e., any type) (86.2% for women vs. 87.0% for men) (Table 2).

Although most participants received advice from doctors (75.1%), women were more likely to receive advice from traditional healers (9.5% vs. 8.3%). In the past year, women were more likely to have more hospital visits; 88.5% of women had two or more visits compared to

61.5% of men. Additionally, women were more likely to have had an annual health check-up (60.9% vs. 34.3%) (Table 3).

**Table 1:** Demographic characteristics of older Saudi adults in Al-Qassim, Saudi Arabia (n=704).

Variable	Men Per cent (n=400)	Women Per cent (n=304)	p-value
Age in years			< 0.001
<60	40.0	54.3	
60 -69	39.5	31.6	
≥ 70	20.5	14.1	
Body Mass Index (kg/m <sup>2</sup> )			< 0.001
<25	22.3	11.5	
25 -29.9	43.5	29.9	
≥ 30	34.3	58.6	
Marital status			< 0.001
Married	98.0	62.5	
Widowed	0.0	31.3	
Divorced	0.0	6.2	
Employed			< 0.001
Yes	35.0	7.2	
Walk daily			0.11
Yes	54.5	59.2	
Cigarette smoking			< 0.001
Never smoker	76.5	97.4	
Past smoker	14.2	1.0	
Current smoker	9.3	1.6	
Socioeconomic status			0.011
Poor	8.8	3.3	
Lower-middle class	44.0	41.1	
Upper-middle class	41.0	49.3	
Rich	6.3	6.3	

**Table 2:** Chronic disease status of older Saudi adults in Al-Qassim Saudi Arabia (n=704).

Variable	Men Per cent (n=400)	Women Per cent (n=304)	p-value
Type 2 diabetes	45.5	54.9	0.013
Hypertension	78.0	70.1	0.017
Heart disease	17.0	10.9	0.021
Asthma	9.5	15.5	0.016
Gastric peptic ulcer	9.8	17.1	0.004
Cancer	2.3	1.6	0.57
Total (1 or more chronic conditions)	87.0	86.2	0.75

In the adjusted model for the presence of chronic conditions, there was no significant difference in the likelihood of having a chronic condition between men and women. Other factors significantly related to a chronic condition included being aged ≥ 70 years and being overweight or obese. Additionally, participants with an annual health check-up were 2.9 times more likely to have a chronic condition including being aged ≥ 70 years and being overweight or obese. Additionally, participants with an annual health check-up were 2.9 times more likely to have a chronic condition (Table 4). In the adjusted annual health check-up model, a significant gender effect was observed, indicating that women were 2.9 times more likely to have had a check-up than men. Additionally,

having a higher socioeconomic status, engaging in daily walker walking, and being a non-smoker were associated with annual check-ups. Those with one or more chronic conditions were also 2.8 times more likely to have had annual check-ups (reference: no conditions) (Table 4).

**Table 3:** Treatment-seeking of older Saudi adults in Al-Qassim Saudi Arabia (n=704).

Variable	Men Percent (n=400)	Women Percent (n=304)	p-value
<b>Treatment preferences</b>			
Sought advice from			0.001
Doctor	73.3	77.6	
Pharmacist	18.0	6.9	
Traditional healer	8.3	9.5	
Other	0.5	5.9	
<b>Treatment practices</b>			
Self-medicate without advice			0.06
Yes	48.3	41.1	
Prescribed medicine			0.91
Complete full course	62.4	62.8	
Quit when I feel better	37.6	37.2	
<b>Healthcare utilization</b>			
Hospital visits last year			0.001
None	38.5	11.5	
1-2	35.8	28.0	
3-4	15.0	24.3	
>5	10.8	36.2	
Annual health check-ups			0.001
Yes	34.3	60.9	

## DISCUSSION

The study's main finding was that women were more likely to have more frequently used healthcare services than men. Gender was not significantly associated with having a chronic disease, but there were differences in the types of chronic diseases. The use of complementary and alternative therapies was every day among older Saudis and more prevalent among women. In the gender distribution of chronic diseases in this study, men had a higher prevalence of hypertension and heart disease. In comparison, women had a higher prevalence of type-2 diabetes, asthma, and peptic ulcer. In contrast, earlier Saudi-based studies reported that women had a slightly higher prevalence of hypertension than men (El Bcheraoui et al., 2014; Al-Nozha et al., 2007; Daoud et al., 2016; Aldiab et al., 2018). There are several potential explanations for this difference. First, the women were significantly younger than the men. Second, men had more exposure to smoking cigarettes than women. Finally, men experience vascular changes at a younger age and are therefore at risk for heart disease at an earlier age. In contrast, women experience more accelerated age-related vascular changes at midlife, rapidly increasing their risk in older ages. For type 2 diabetes, our data suggest that older women have a higher prevalence than older men, but

earlier studies reported the opposite (Al-Rubeaan et al., 2015). The disease progression could explain this; in the earlier study, impaired fasting glucose was reported and showed that women had a significantly higher prevalence of impaired fasting glucose in the age strata for 60-69 and 70+ years, which may be explained by menopause. Despite the variations in the individual disease estimates across genders, it is consistent that all the estimates for chronic diseases are significantly higher for older adults than the general adult population estimates. With each age stratum increase, there is a proportional increase in disease risk. Furthermore, this study identified factors associated with completing annual check-ups. Daily walking, chronic conditions and smoking were significantly related to annual health check-ups. The positive relationship between walking and check-ups and the negative relationship between smoking and check-ups are corroborated by the evidence on health behaviour clustering (Kino et al., 2017). Studies across the lifespan, ranging from adolescents to older adults, have shown that risky health behaviours such as a sedentary lifestyle, unhealthy diet, smoking, and drinking alcohol tend to cluster together (Busch et al., 2013; de Bourdeaudhuij et al., 1999; Helgadottir et al., 2015). Positive health behaviours also tend to cluster together and yield a 'healthy' lifestyle with a low risk for disease. In light of these findings, annual health check-ups should be explicitly promoted to current smokers because a) they are less likely to have completed their check-ups, b) smoking carries a high risk for a wide range of diseases, and c) smokers are likely to be engaged in other unhealthy behaviours (Paul et al., 2016). Another important finding from this study is that a relevant portion of older Saudis, both men and women, use alternative or herbal remedies and consult traditional healers.

This finding is consistent with earlier studies (Alrowais et al., 2017; Al-Bedah et al., 2013; Azaizeh et al., 2010). There are significant areas of concern surrounding this practice; the source of information is usually friends and family and not health professionals, and the Al-Qassim treating physician is not typically aware of this practice (Stub et al., 2016; Saad et al., 2006). Community health programs should be initiated to raise awareness about traditional medicines, and physicians should be required to document traditional medicine use in the patient files. A few limitations of this study should be noted. A few questions were used to assess each outcome; for example, more information could have been ascertained regarding the types and frequency of use of traditional medicines. Data were based on a single (as opposed to multiple) time point assessment; hence, some measurement error is likely.

## CONCLUSION

This study used an innovative sampling strategy to obtain its participants. It is customary among Saudi men to go to the mosque for daily prayers, and most older women attend Quran schools. Therefore, mosques/schools were chosen as the sampling unit for the study instead of sampling based on household or individual (restricted option because of sociocultural norms). The study provides val-

**Table 4:** Adjusted logistic models for A) the presence of a chronic condition (none vs. one or more) and B) annual health check-ups (no vs. yes) among older Saudi adults in Al-Qassim, Saudi Arabia (n=704).

Variable	N	Chronic Condition		Health Check-up	
		Odds ratio	95% CI	Odds ratio	95% CI
Age in years					
<60	309	Ref		Ref	
60 -69	241	1.6	0.92, 2.80	1.2	0.84, 1.81
≥ 70	120	2.9*	1.25, 6.62	1.2	0.71, 1.92
Gender					
Men	400	Ref		Ref	
Women	270	0.7	0.36, 1.25	2.9*	1.91, 4.56
Body mass index (kg/m <sup>2</sup> )					
<25	119	Ref		Ref	
25 -29.9	257	1.9*	1.09, 3.36	1.2	0.76, 1.95
≥ 30	294	3.8*	2.08, 7.11	0.9	0.60, 1.53
Marital status					
Married	109	Ref		Ref	
Single/widowed/divorced	561	1.1	0.55, 2.36	1.0	0.60, 1.58
Employed					
No	511	Ref		Ref	
Yes	159	0.9	0.48, 1.60	0.8	0.54, 1.32
Socioeconomic status					
Lower-middle class	282	0.5	0.11, 2.27	1.5	0.68, 3.12
Upper-middle class	301	0.4	0.08, 1.62	1.8	0.86, 3.94
Rich	42	0.2	0.04, 1.02	3.2*	1.22, 8.45
Walk daily					
No	288	Ref		Ref	
Yes	382	1.1	0.69, 1.81	1.7*	1.21, 2.35
Cigarette smoking					
Never smoked	568	Ref		Ref	
Past smoker	60	1.6	0.65, 4.20	1.0	0.57, 1.87
Current smoker	42	3.7	0.81, 16.38	0.4*	0.16, 0.87
Annual health check-up					
No	366	Ref		-	-
Yes	304	2.9*	1.72, 4.82	-	-
Chronic condition					
None		-	-	Ref	
One or more		-	-	2.8*	1.68, 4.71

-uable information to the local community and can guide the direction of community health campaigns aimed at older adults. Future studies should continue to address research questions that specifically affect older adults in the community.

Our findings suggest that healthcare professionals in Saudi Arabia should pay careful attention to using traditional medicine among their patients. Finally, annual health check-ups should be promoted to the community's older adults and target high-risk groups such as smokers.

## AUTHOR CONTRIBUTIONS

JS, AMR, AA, NS, HTA, and AAM contributed substantially to the conception, design of the work, acquisition, analysis, and interpretation of data. JS and HTA performed the drafting of the manuscript. NS, HTA, and AAM performed critical evaluations for important intellectual content. All authors have critically reviewed and approved the final draft and are responsible for its contents.

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## DECLARATIONS

### Ethical Approval

This study received ethical approval from the General Directorate of Health Affairs, Al-Qassim Region, Ministry of Health, Saudi Arabia (Ethical approval # 2017417).

### Participants Consent

All participants gave informed consent at the onset of the study. They were assured of confidentiality and their right to withdraw from the study.

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## Conflict of Interest

All authors have declared that no financial support was received from any organisation for the submitted work. All authors have declared that no other relationships or activities could appear to have influenced the submitted work.

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## REFERENCES

- Azaizeh, H., Saad, B., Cooper, E., & Said, O. (2010). Traditional Arabic and Islamic Medicine, a Re-Emerging Health Aid. *Evidence-Based Complementary and Alternative Medicine*, 7(4), 419–424. <https://doi.org/10.1093/ecam/nen039>
- AlBedah, A. M. N., Khalil, M. K. M., Elolemy, A. T., Al Mudaiheem, A. A., Al Eidi, S., Al-Yahia, O. A., Al-Gabbany, S. A., & Henary, B. Y. (2013, May). The use of and out-of-pocket spending on complementary and alternative medicine in Qassim province, Saudi Arabia. *Annals of Saudi Medicine*, 33(3), 282–289. <https://doi.org/10.5144/0256-4947.2013.282>
- Alrowais, N. A., & Alyousefi, N. A. (2017, March). The prevalence extent of Complementary and Alternative Medicine (CAM) use among Saudis. *Saudi Pharmaceutical Journal*, 25(3), 306–318. <https://doi.org/10.1016/j.jsps.2016.09.009>
- Al-Rubeaan, K., Al-Manaa, H., Khoja, T., Ahmad, N., Al-Sharqawi, A., Siddiqui, K., AlNaqeb, D., Aburishah, K., Youssef, A., Al-Batil, A., Al-Otaibi, M., & Al Ghamdi, A. (2014, November). The Saudi Abnormal Glucose Metabolism and Diabetes Impact Study (SAUDI-DM). *Annals of Saudi Medicine*, 34(6), 465–475. <https://doi.org/10.5144/0256-4947.2014.465>
- Al-Rubeaan, K., Al-Manaa, H. A., Khoja, T. A., Ahmad, N. A., Al-Sharqawi, A. H., Siddiqui, K., Alnaqeb, D., Aburishah, K. H., Youssef, A. M., Al-Batil, A., Alotaibi, M. S., & Al-Gamdi, A. A. (2014, December). Epidemiology of abnormal glucose metabolism in a country facing its epidemic: SAUDI-DM study. *Journal of Diabetes*, 7(5), 622–632. <https://doi.org/10.1111/1753-0407.12224>
- Abusaaq HI. Population Aging in Saudi Arabia. Saudi Arabian Monetary Agency, 2015. [Cited 1 November 2019.] Available from URL: <http://www.sama.gov.sa/en-US/EconomicResearch/WorkingPapers/population%20aging%20in%20saudi%20arabia.pdf>.
- Al-Nozha M, Abdullah M, Arafah M, Khalil M, Khan N, Al-Mazrou Y, et al. Hypertension in Saudi Arabia. *Saudi Med J*. 2007; 28:77-84.
- Aldiab, A., Shubair, M. M., Al-Zahrani, J. M., Aldossari, K. K., Al-Ghamdi, S., Househ, M., Razzak, H. A., El-Metwally, A., & Jradi, H. (2018, November 29). Prevalence of hypertension and prehypertension and its associated cardioembolic risk factors; a population-based cross-sectional study in Alkharj, Saudi Arabia. *BMC Public Health*, 18(1). <https://doi.org/10.1186/s12889-018-6216-9>
- Busch, V., Van Stel, H. F., Schrijvers, A. J., & de Leeuw, J. R. (2013, December). Clustering of health-related behaviors, health outcomes and demographics in Dutch adolescents: a cross-sectional study. *BMC Public Health*, 13(1). <https://doi.org/10.1186/1471-2458-13-1118>
- De Bourdeaudhuij, I., & Van Oost, P. (1999, April). A cluster-analytical approach toward physical activity and other health-related behaviors. *Medicine & Science in Sports & Exercise*, 31(4), 605–612. <https://doi.org/10.1097/00005768-199904000-00019>
- Daoud, F., El Bcheraoui, C., Tuffaha, M., AlMazroa, M. A., Al Saeedi, M., Nooh, R. M., Al Rayess, Z., Al-Raddadi, R. M., Memish, Z. A., Basulaiman, M., Al Rabeeah, A. A., & Mokdad, A. H. (2015, October 29). The health status of Saudi women: findings from a national survey. *Journal of Public Health*, fdv157. <https://doi.org/10.1093/pubmed/fdv157>
- El Bcheraoui, C., Memish, Z. A., Tuffaha, M., Daoud, F., Robinson, M., Jaber, S., Mikhitarian, S., Al Saeedi, M., AlMazroa, M. A., Mokdad, A. H., & Al Rabeeah, A. A. (2014). Hypertension and Its Associated Risk Factors in the Kingdom of Saudi Arabia, 2013: A National Survey. *International Journal of Hypertension*, 2014, 1–8. <https://doi.org/10.1155/2014/564679>
- Freckmann, G., Baumstark, A., Jendrike, N., Zschornack, E., Kocher, S., Tshiananga, J., Heister, F., & Haug, C. (2010, March). System Accuracy Evaluation of 27 Blood Glucose Monitoring Systems According to DIN EN ISO 15197. *Diabetes Technology & Therapeutics*, 12(3), 221–231. <https://doi.org/10.1089/dia.2009.0128>
- El Bcheraoui, C., Memish, Z. A., Tuffaha, M., Daoud, F., Robinson, M., Jaber, S., Mikhitarian, S., Al Saeedi, M., AlMazroa, M. A., Mokdad, A. H., & Al Rabeeah, A. A. (2014). Hypertension and Its Associated Risk Factors in the Kingdom of Saudi Arabia, 2013: A National Survey. *International Journal of Hypertension*, 2014, 1–8. <https://doi.org/10.1155/2014/564679>

- General Authority for Statistics: Kingdom of Saudi Arabia. Demography Survey, 2016. [Cited 1 November 2019.] Available from URL: [https://www.stats.gov.sa/sites/default/files/en-demographic-research-2016\\_2.pdf](https://www.stats.gov.sa/sites/default/files/en-demographic-research-2016_2.pdf).
- Helgadottir, B., Moller, J., & Laflamme, L. (2015, April 22). Patterns in health-related behaviours and fall injuries among older people: a population-based study in Stockholm County, Sweden. *Age And Ageing*, 44(4), 604–610. <https://doi.org/10.1093/ageing/afv051>
- Huebschmann, A. G., Huxley, R. R., Kohrt, W. M., Zeitler, P., Regensteiner, J. G., & Reusch, J. E. B. (2019, August 27). Sex differences in the burden of type 2 diabetes and cardiovascular risk across the life course. *Diabetologia*, 62(10), 1761–1772. <https://doi.org/10.1007/s00125-019-4939-5>
- Higgins, S. T., Kurti, A. N., Redner, R., White, T. J., Gaalema, D. E., Roberts, M. E., Doogan, N. J., Tidey, J. W., Miller, M. E., Stanton, C. A., Henningfield, J. E., & Atwood, G. S. (2015, November). A literature review on prevalence of gender differences and intersections with other vulnerabilities to tobacco use in the United States, 2004–2014. *Preventive Medicine*, 80, 89–100. <https://doi.org/10.1016/j.ypmed.2015.06.009>
- Kino, S., Bernabé, E., & Sabbah, W. (2017, May 23). Socioeconomic inequality in clusters of health-related behaviours in Europe: latent class analysis of a cross-sectional European survey. *BMC Public Health*, 17(1). <https://doi.org/10.1186/s12889-017-4440-3>
- Khoja, A. T., Aljawadi, M. H., Al-Shammari, S. A., Mohamed, A. G., Al-Manaa, H. A., Morlock, L., Ahmed, S., & Khoja, T. A. (2018, February). The health of Saudi older adults; results from the Saudi National Survey for Elderly Health (SNSEH) 2006–2015. *Saudi Pharmaceutical Journal*, 26(2), 292–300. <https://doi.org/10.1016/j.jsps.2017.11.008>
- Memish, Z. A., El Bcheraoui, C., Tuffaha, M., Robinson, M., Daoud, F., Jaber, S., Mikhitarian, S., Al Saeedi, M., AlMazroa, M. A., Mokdad, A. H., & Al Rabeeah, A. A. (2014, October 9). Obesity and Associated Factors — Kingdom of Saudi Arabia, 2013. *Preventing Chronic Disease*, 11. <https://doi.org/10.5888/pcd11.140236>
- McLaughlin, S. J., Connell, C. M., & Janevic, M. R. (2015, July 17). Gender Differences in Trajectories of Physical Activity Among Older Americans With Diabetes. *Journal of Aging and Health*, 28(3), 460–480. <https://doi.org/10.1177/0898264315594136>
- Paul, C., Tzelepis, F., Bisquera, A., Noble, N., & Wiggers, J. (2016, December). Just how high-risk are ongoing smokers? Exploring clusters of health risk behaviours among current and ex-smokers. *Preventive Medicine*, 93, 70–75. <https://doi.org/10.1016/j.ypmed.2016.09.021>
- Saad, B., Azaizeh, H., Abu-Hijleh, G., & Said, O. (2006). Safety of Traditional Arab Herbal Medicine. *Evidence-Based Complementary and Alternative Medicine*, 3(4), 433–439. <https://doi.org/10.1093/ecam/nel058>
- Stub, T., Quandt, S. A., Arcury, T. A., Sandberg, J. C., Kristofersen, A. E., Musial, F., & Salamonsen, A. (2016, September 8). Perception of risk and communication among conventional and complementary health care providers involving cancer patients' use of complementary therapies: a literature review. *BMC Complementary and Alternative Medicine*, 16(1). <https://doi.org/10.1186/s12906-016-1326-3>
- Sociás, M. E., Koehoorn, M., & Shoveller, J. (2016, January). Gender Inequalities in Access to Health Care among Adults Living in British Columbia, Canada. *Women's Health Issues*, 26(1), 74–79. <https://doi.org/10.1016/j.whi.2015.08.001>
- Vaidya, V., Partha, G., & Karmakar, M. (2012, February). Gender Differences in Utilization of Preventive Care Services in the United States. *Journal of Women's Health*, 21(2), 140–145. <https://doi.org/10.1089/jwh.2011.2876>
- Zbierajewski-Eischeid, S. J., & Loeb, S. J. (2009, January). Myocardial Infarction in Women. *Dimensions of Critical Care Nursing*, 28(1), 1–6. <https://doi.org/10.1097/01.dcc.0000325090.93411.ce>