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KUWAIT PROGRAMME

DETERMINANTS OF DIABETES IN KUWAIT

EVIDENCE FROM THE WORLD HEALTH SURVEY

ZLATKO NIKOLOSKI

LSE Middle East Centre Kuwait Programme Paper Series | 6 | August 2020

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About the Author

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Abstract

Diabetes is one of the most prevalent non-communicable diseases in the Middle East and North Africa (MENA) region, particularly among countries within the Gulf Cooperation Council (GCC). We analysed data from the World Health Organization's World Health Survey conducted in Kuwait in 2013 in order to distil the main demographic and socio-economic determinants of diabetes. A subjective measure of diabetes was used given the low blood chemistry measurement response rates. An analysis of key risk factors indicated that obese, hypertensive and insufficiently active respondents were more likely to be diabetic. In addition, when examining the prevalence of multiple chronic conditions, our results showed that diabetic patients were more likely to have been diagnosed with two or more chronic conditions compared to non-diabetics. Finally, results from the multivariate logistic regression model indicated that people's weight, age and employment status were the most significant predictors of diabetes. Although not the focus of this paper, similar results yield for the entire population (i.e. nationals and expatriates). Given the cost associated with diabetes and that diabetics were more likely to suffer from multiple chronic conditions, the government should devote more effort to preventive types of healthcare.

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Background

Diabetes is a global epidemic that affects 387 million people (aged 20–79) worldwide.[1] The prevalence of diabetes mellitus is also high in the MENA (Middle East and North Africa) region. As of 2015, there were 35.4 million people (aged 20–79) in the MENA region with diabetes. By 2040, this figure is expected to increase to 72.1 million.[2]

Within the MENA region, countries in the Gulf Cooperation Council (GCC – Kuwait, Bahrain, Oman, Saudi Arabia, the United Arab Emirates and Qatar) have the highest prevalence rate of diabetes. According to World Development Indicators, diabetes prevalence in the GCC countries ranges from 14.8 percent in Oman to 20 percent in Saudi Arabia.[3] Diabetes therefore places a significant burden on GCC countries' healthcare systems. For example, in the UAE, diabetes is the 6th leading cause of death, with similar rates found across the region.[4]

Diabetes prevalence is notable in Kuwait. In 2015, the International Diabetes Foundation (IDF) reported that one in seven adults were diagnosed with diabetes.[5] The same report stated that the total unadjusted- and age-adjusted diabetes prevalence rate for those aged 20–79 years amounted to 14.3 percent and 20 percent, respectively. These estimates suggest that roughly 400,000 people (approximately 10.3 percent of the population in Kuwait) suffer from diabetes. Moreover, these figures do not include those who were undiagnosed, which, according to the IDF, is approximately a third of the overall population with diabetes.

Despite these high rates, nationally representative evidence on demographic and socio-economic characteristics, as well as risk factors associated with diabetes in Kuwait, are limited. To date, there are three studies addressing determinants of diabetes from an analytical point of view. Using a sample of 3,003 individuals and relying on a logit modelling analysis, Abdella et al. concluded that older and obese individuals, those suffering from hypertension, high cholesterol and elevated triglycerides, as well as individuals whose parents had or have diabetes were more likely to be diabetic.[6] Similarly, but relying on a markedly smaller sample of 460 individuals and using simple bivariate logistic model analysis, Al-Khalaf et al. found that age, BMI (body mass index), waist circumference,

The author would like to thank Dasman Diabetes Institute for their assistance with this paper.

[1] Azeem Majeed, Adel A. El-Sayed, Tawfik Khoja, Riyadh Alshamsan, Christopher Millett and Salman Rawaf, 'Diabetes in the Middle-East and North Africa: An Update', Diabetes Research and Clinical Practice 103/2 (2014), pp. 218-222.

[2] Ibid.

[3] 'World Development Indicators', *World Bank*. Available at hhtps://www.wdi.org (accessed 29 March 2020).

[4] '2008 Annual Report, Preventive Medicine Sector', *United Arab Emirates Ministry of Health*, mimeo.

[5] 'IDF Diabetes Atlas 7th Edition - Kuwait Country Report 2015', International Diabetes Federation, IDF Diabetes Atlas (2015).

[6] Nabila Abdella, Monira Al Arouj, A. Al Nakhi, A. Al Assoussi and Mohammad A.A. Moussa, 'Non-Insulin-Dependent Diabetes in Kuwait: Prevalence Rates and Associated Risk Factors', *Diabetes Research and Clinical Practice* 42/3 (1998), pp. 187-196.

and family history were the factors most strongly associated with diabetes.[7] When using a multivariate logistic regression, again, family history and waist circumference were strong predictors of diabetes, as were age and hypertension status. Finally, in a study using a nationally representative sample of 6,356 individuals, Ahmed et al. found that age and BMI are the most significant determinants of diabetes in Kuwait.[8] Education was also a statistically significant determinant of diabetes, indicating those that achieved a high level of education were less likely to be diabetic.

Further evidence on the prevalence of diabetes in Kuwait is available through the recently developed STEPS study instrument.[9] The survey was carried out as part of the Gulf survey of the Council of Health Ministers of the GCC states. This survey is the first national survey on risk factors of non-communicable diseases (NCDs) in Kuwait. It should be noted, however, that the survey only included Kuwaiti nationals, therefore omitting a significant amount of data given that 70 percent of the population was non-nationals.[10]

Studying the link between diabetes and its main socio-economic, demographic and risk factors is important given the complications associated with it. Diabetes increases the risk of cardiovascular diseases such as ischemic heart disease, stroke and peripheral cardiovascular disease.[11] In addition, the literature suggests that people diagnosed with diabetes have a much lower quality of life compared to people without the condition.[12]

Against this background and using WHO World Health Survey (WHS) data, this paper to examines the relationship between diabetes and demographic/socio-economic characteristics, key risk factors and chronic conditions; and to determine statistically significant predictors of diabetes among the Kuwaiti national population. Given the low response rate to the biomarker questions, our analysis relies upon a subjective measure of diabetes (i.e. self-assessed).

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[7] Mohamad M. Al-Khalaf, Mohammad M. Eid, Haithem Al Najjar, Khaled M. Alhajry, Suhail A. Doi and Lukman Thalib, 'Screening for Diabetes in Kuwait and Evaluation of Risk Scores', *Eastern Mediterranean Health Journal* 16/7 (2010), pp. 725–31.

[8] Faruk Ahmed, Carol Waslien, Mona Al-Sumaie, Prasanna Prakash and Ahmad Allafi, 'Trends and Risk Factors of Hyperglycemia and Diabetes among Kuwaiti Adults: National Nutrition Surveillance Data from 2002 to 2009', *BMC Public Health* 13/103 (2013), pp. 1–9.

[9] 'Kuwait STEPS survey', *WHO*. Available at https://www.who.int/ncds/surveillance/steps/kuwait/en/ (accessed 29 March 2020).

[10] 'Kuwait Population Statistics – Mid Year 2016', *Kuwait Central Statistical Bureau*. Available at https://www.csb.gov.kw/Default_EN (accessed 29 March 2020).

[11] Emerging Risk Factors Collaboration, 'Diabetes Mellitus, Fasting Blood Glucose Concentration, and Risk of Vascular Disease: A Collaborative Meta-Analysis of 102 Prospective Studies', *The Lancet* 375/9733 (2010), pp. 2215–22.

[12] Oddvar Solli, Knut Stavem, Ivar Sonbo Kristiansen, 'Health-Related Quality of Life in Diabetes: The Associations of Complications with EQ-5D Scores', *Health and Quality of Life Outcomes*, 8/18 (2010), pp. 1–8.

Research Objectives

The purpose of this research is three-fold: (i) to identify the key risk factors, and further, what proportion of those exhibiting these risk factors were diabetic; (ii) to study the relationship between diabetes and other chronic conditions; and (iii) to establish the key demographic and socio-economic determinants of diabetics. The aforementioned research objectives focused on the Kuwaiti national population only (although as a robustness check we have also conducted the analysis on the entire sample, including Kuwaiti nationals as well as expatriates).

Methods

Sampling and Data Collection

The study was based on the Kuwait WHS, which covered all six of the counrty's governorates. Two sampling units were selected for this survey. The first unit was a household, including both Kuwaiti and non-Kuwaiti households. The second unit of this survey was an individual, aged 18 years and above, randomly selected from the household. A separate sampling frame was prepared for selecting domestic house workers. A face-to-face structured interview was conducted using paper and pencil (PAPI) questionnaires in the residence of the respondent. Several body measurements were carried out including blood pressure, pulse, hand grip, weight, height, waist and hip circumferences, visual acuity, pulmonary function tests, cognitive functions as well as certain laboratory tests. Interviews were conducted either in Arabic or English.[13] Probability methods were implemented to ensure that a representative sample of the target population of Kuwaitis and non-Kuwaitis was obtained. The sampling plan, final sample and the methodology to calculate the sample weights was developed in collaboration with experts from the WHO.[14]

To select the households, a stratified random sample without replacement was used. For the Kuwaiti population, the sample stratification was based on the six governorates, whereas the non-Kuwaiti population stratification depended on the governorate and type of households.[15]

As stated in the WHS report, throughout the implementation of the survey, all ethical procedures were followed. This included at the design, training and implementation stages. All participants were assured that the information provided would be confidential and would not be used for any reason other than scientific purposes. It was stressed to the participants that they had the right to refuse participation and to withdraw from participation at any time.[16]

Given the purpose of our paper, we have used individual level data for Kuwaiti nationals when carrying out the analyses (although as a robustness check we have also repeated the analysis on the entire sample). Based on the sampling procedure noted above, the total sample used for the analysis included 2,518 individuals.

[13] 'World Health Survey, Kuwait', *WHO* (2013).
[14] Ibid.
[15] Ibid.
[16] Ibid.

Data Analysis

Diabetes

In the analysis of the paper, we have relied on a subjective measure of diabetes. The survey questionnaire asked respondents: 'Have you ever been diagnosed with diabetes (high blood sugar)?'. Based on this question, a dummy variable was created which took a value of 1 if the respondent answered the question affirmatively and 0 otherwise. While we did attempt to couple this analysis with analysing the determinants of the objective measure of diabetes, the low response rate prevented us from doing so. More specifically, of the 2,518 respondents, 531 agreed to participate in the biomarkers part of the questionnaire. Of those, 471 (88.7 percent) recorded a fasting blood glucose level of 0, thus leading to removal of these respondents from the analysis. This reduced the total potential sample of analysis to 70 respondents.

Obesity

The WHS records the height and weight of respondents, which was used to develop a BMI index based on the UK NHS.[17] A BMI less than 18.5 was considered underweight, greater than or equal to 18.5 and less than or equal to 24.9 as normal, greater than 24.9 and less than or equal to 29.9 as overweight and greater than 29.9 as obese.

Hypertension

The WHS includes an objective and subjective measure of hypertension. To construct the objective measure of hypertension, we relied on average measurements of systolic and diastolic blood pressures (i.e. the average of three measurements was used). A dummy variable was then created which took the value of 1 if the respondent's average systolic blood pressure was less than 120 and average diastolic blood pressure less than 80 (i.e. the respondent had a healthy blood pressure) and 0 if not.

For the subjective measure of hypertension, we relied on the question: 'Have you ever been diagnosed with hypertension?'. Based on this, a dummy variable was created which took a value of 1 if the respondent answered the question affirmatively and 0 otherwise.

Other Risk Factors Associated with Diabetes

In addition, the analysis includes two additional correlates of diabetes: exercise and fruit and vegetable consumption.[18] Regarding the former, we relied on four questions in the survey which enquire about the level of intensive or moderate physical labour or activity

[17] 'What is the body mass index (BMI)?', *NHS*. Available at https://www.nhs.uk/chq/Pages/3215.aspx (accessed 16 November 2017).

[18] Faleh Mohamed Hussain Ali, Zlatko Nikoloski, Husein Reka, Orsida Gjebrea and Elias Mossialos, 'The Diabetes-Obesity-Hypertension Nexus in Qatar: Evidence from the World Health Survey', *Population Health Metrics*, 12/18 (2014), pp. 1–10.

undertaken. More specifically, a person is considered active if they answered in the affirmative to any of the following:

(i) Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate [for example working in the army or in an oil field] for at least 10 minutes continuously?

(ii) Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate [such as brisk walking, carrying light loads, cleaning, cooking or washing clothes] for at least 10 minutes continuously?

(iii) Do you do any vigorous-intensity sports, fitness or recreational [leisure] activities that cause large increases in breathing or heart rate [like running or football] for at least 10 minutes continuously?

(iv) Do you do any moderate-intensity sports, fitness or recreational [leisure] activities that cause a small increase in breathing or heart rate [such as brisk walking, cycling or swimming] for at least 10 minutes at a time?

Regarding fruit and vegetable consumption, those who noted that they consumed five or more servings of fruit and vegetables in a typical day were coded as 1 and 0 otherwise. Furthermore, given anomalies in the data, those who stated that they consumed 20 or more servings of fruit and vegetables a day were removed from the study and subsequent analysis.

Prevalence of Chronic Conditions

The WHS asked respondents whether or not they have been diagnosed with certain chronic conditions. Chronic conditions included in the individual survey were: chronic lung disease, arthritis, hypertension, asthma, angina, stroke and diabetes. Using results from all of these variables, excluding diabetes, we developed a categorical variable for the number of chronic conditions a respondent has been diagnosed with.

Demographic and Socio-Economic Variables

In our analyses, we relied on a sample of Kuwaiti nationals (as these were the ones surveyed by the WHS). Based on the age of the respondents, the following six age categories were created: 18–29, 30–44, 45–59, 60–69, 70–79 and 80+. In addition, the analyses controlled for gender and educational attainment which included the following categories: less than primary school, completed primary school, completed secondary school, completed high school, completed college, completed university and completed postgraduate study.

Wealth has been reported as a significant determinant of diabetes in the literature, therefore we included this variable as a correlate of diabetes prevalence. We considered two measures of wealth; one objective and the other subjective. The objective measure of wealth is a categorical variable based on the indicators of permanent income. This measure

used a standard set of dichotomous questions on household assets and services such as ownership of televisions, cars, as well as access to public services such as electricity, running water and sewerage. Factor analysis was used to create a wealth score and, based on the obtained score, divided households into five quintiles. The subjective measure of wealth used results from the WHS question which asked respondents whether they had enough money to meet their needs (five responses available). Those whose income could 'completely' or 'mostly' meet their needs were classified as 'rich'.

Statistics

To examine the relationship between diabetes and socio-economic characteristics, risk factors and chronic conditions, we simply tabulated these variables for the Kuwaiti population only.

Regarding the determinants of diabetes, we used multiple logistic regressions. As mentioned above, given the low rate of response for the objective measure of diabetes, logistic regressions were conducted using a subjective measure of diabetes. The independent variables were selected based on a literature review conducted in the context of GCC countries and availability in the WHS questionnaire.[19] Results were presented as odds ratios. All analyses were conducted in STATA 14 and included standard robust errors.

Results

Table 1 gives the breakdown of the sample population by their main characteristics. It also provides a summary of the prevalence of diabetes by different demographic, socio-economic and risk factor categories. The survey population included more women than men with 61.36% of respondents being female. Those aged 30–44 represent the largest group in the sample at 40.11%. Younger respondents, aged 18–29 years, represent approximately a quarter of the sample (28.67%), followed by those aged 45–59 (19.94%). The remaining age categories (i.e. 60–69, 70–79 and 80+) combined comprised just 11.29% of the sample.

A disaggregation of diabetes prevalence across demographic characteristics found that the disease is more common among females than males (14.79 percent vs. 11.26 percent), and for those who were older. For example, diabetes prevalence was over 60 percent in those aged 80 and above, while it was only 2.92 percent in the youngest age bracket (18–29). Similar findings occurred when accounting for the total population, that is, both nationals and expatriates (see Appendix A).

[19] Ibid.

Table 1: Descriptive Statistics – Diabetes and Demographic Characteristics (Nationals Only)

Personal Characteristics	Number of Responses (N)	Proportion (%)	Diabetes* Prevalence (%)
Sex			
Male	973	38.64%	11.26%
Female	1,545	61.36%	14.79%
Age			
18–29	722	28.67%	2.92%
30–44	1,010	40.11%	6.32%
45–59	502	19.94%	24.30%
60–69	192	7.63%	43.46%
70–79	77	3.06%	48.05%
80+	15	0.60%	66.67%
Total Number of Respondents		2,518	

*Note: *Subjective diabetes (i.e self-assessed).*

Table 2 provides a summary of the main socio-economic characteristics, including diabetes prevalence. As discussed in the methodology section, using the objective measure of wealth, we have grouped individuals into five wealth categories of equal size. Just over one third of respondents obtained a high school education (36.88 percent), while approximately another third (31.99 percent) had a college education. Just under half of the respondents (45.87 percent) were employed while the rest were unemployed.

In terms of diabetes prevalence, no clear association emerged between wealth and whether or not a person had diabetes (when using a subjective measure of wealth, those who were wealthier were less likely to be diabetic). The prevalence of diabetes, however, does decrease with education level. For example, 41.67 percent of those without any education (i.e. less than primary school) stated they were diabetic compared to 5 percent of those with university and/or postgraduate degrees. Similar findings occurred when using the total population (see Appendix A).

Table 2: Descriptive Statistics – Diabetes and Socio-Economic Characteristics

Socio-Economic Characteristics	Number of Responses (N)	Proportion (%)	Diabetes Prevalence*(%)
Wealth score (quintiles)			
1	460	19.54%	17.32%
2	472	20.05%	10.34%
3	476	20.22%	13.35%
4	481	20.43%	11.67%
5	465	19.75%	13.42%
Wealth (subjective)			
Poorest	927	38.05%	11.59%
Poor	963	39.53%	12.99%
Middle	444	18.23%	16.70%
Rich	69	2.83%	13.24%
Richest	33	1.35%	21.21%
Education			
Less than primary education	85	3.62%	41.67%
Primary education	94	4.00%	29.03%
Secondary education	492	20.93%	12.65%
High school education	867	36.88%	9.40%
College education	752	31.99%	7.11%
University or postgrad	61	2.59%	5.00%
Working status			
Employed	1,363	45.87%	6.88%
Not employed	1,155	54.13%	18.99%

*Note: *Subjective diabetes (i.e. self-assessed).*

Table 3 provides a summary of the main health risk factors among the Kuwaiti population as well as the diabetes prevalence per risk factor. The results show that almost half of the sample are considered overweight (49.52%), while about a third are obese (32.01%); 32.09% of respondents are sufficiently active; 14.68% and 23.54% of respondents have a healthy blood pressure when measured subjectively and objectively, respectively.

Regarding diabetes prevalence, those who were overweight or obese were more likely to have diabetes (10.28 percent and 18.07 percent, respectively) when compared to those who were of normal weight (6.55 percent). Similarly, those with an unhealthy blood pressure (objectively or subjectively measured) and those who were not physically active

were more likely to be diabetic. Lastly, whether or not a person smoked did not impact their likelihood of having diabetes. When using data for the total population, similar trends existed (see Appendix A).

Table 3: Descriptive Statistics – Diabetes and Risk Factors

Health Characteristics	Number of Responses (N)	Proportion (%)	Diabetes Prevalence (%)
Weight (BMI)			
Underweight	21	0.83%	4.76%
Normal	444	17.63%	6.55%
Overweight	806	32.01%	10.28%
Obese	1,247	49.52%	18.07%
Physical activity			
Sufficiently active	808	32.09%	8.84%
Insufficiently active	1,710	67.91%	15.59%
Fruit and vegetable consumption			
Sufficient	628	27.82%	14.95%
Insufficient	1,629	72.18%	12.55%
Tobacco consumption			
Smoker	363	14.42%	13.61%
Non-smoker	2,155	85.58%	13.39%
Blood pressure[a] (subjective)			
Healthy	366	14.68%	51.23%
Not healthy	2,127	85.32%	6.97%
Blood pressure[a] (objective)			
Healthy	468	23.54%	4.95%
Not healthy	1,520	76.46%	17.41%

*Note: *Subjective diabetes (i.e. self-assessed). [a]Healthy blood pressure was characterised as a person whose systolic and diastolic blood pressure was less than 120 and 80, respectively.*

Table 4 summarised the proportion of diabetic and non-diabetic respondents with 0, 1, 2, 3, 4 or 5 chronic conditions. The results showed that 8.66% of diabetics had three chronic conditions compared to 3.61% of non-diabetics. These figures increased to 25.07% and 15.09% when looking at those with two chronic conditions, respectively. Again, similar results were found when examining the total population (see Appendix A).

Table 4: Summary Statistics – Diabetes and Number of Chronic Conditions

Number of Chronic Conditions	Number of Responses and Proportion (%) – Diabetics	Number of Responses and Proportion (%) – Non-Diabetics
Zero	65 (19.40%)	84 (3.89%)
One	150 (44.78%)	1,659 (76.77%)
Two	84 (25.07%)	326 (15.09%)
Three	20 (8.66%)	78 (3.61%)
Four	5 (1.49%)	13 (0.60%)
Five	2 (0.60%)	1 (0.05%)
Total	335	2,161

The main results of our multivariate logistic regression analysis are included in Table 5 which consists of three models. Model 1 controlled for demographic and socio-economic variables only. Model 2, in addition to demographic and socio-economic variables, controlled for clinical characteristics (i.e. weight, nutrition and activity levels). Lastly, Model 3 was used as a robustness check for Model 2 by replacing the objective measure of wealth with a subjective measure.

Across all three logistic regression models for subjective diabetes, the independent variables related to age groups were statistically significant at the 1% level. The results show that older respondents are more likely to have been diagnosed with diabetes. For example, when taking into account personal, socio-economic and clinical characteristics (Model 2), the odds ratio for those aged 30–44 years was 2.63 indicating that those in this age group are 2.63 times more likely to have diabetes than those aged 18–29 years. Moreover, the odds ratios for the other age categories were even higher.

The binary variable indicating whether a respondent was obese or not was included in Models 2 and 3. In both of these models, the odds ratio was positive, greater than one and statistically significant at the 5% level. As suggested by the odds ratios, those who were obese are roughly 1.5 times more likely to have been diagnosed with diabetes compared to those who were not.

Variables describing fruit and vegetable consumption, activity levels, gender and education are not predictors of diabetes among Kuwaiti nationals. Subjective and objective measures of wealth are also not statistically significant predictors of diabetes, however, employment status, which could act as a proxy for wealth, was significant at the 5% level across all three models. These results suggest that those who are employed are less likely to be diabetic.

When taking into account the whole population, age, obesity and employment were again statistically significant predictors of diabetes. Unlike the national population, fruit and vegetable consumption is also a determinant of the disease (see Appendix B).

Table 5: Logistic Regression Results (Subjective Diabetes)

Variables	(1)	(2)	(3)
18–29	REF -	REF -	REF -
30–44	2.487*** (0.777)	2.626*** (0.864)	2.808*** (0.913)
45–59	9.554*** (2.632)	9.956*** (2.946)	9.734*** (2.917)
60–69	19.03*** (5.590)	21.16*** (6.760)	22.90*** (7.335)
70–79	19.06*** (7.057)	17.25*** (6.812)	20.82*** (8.464)
80+	56.86*** (40.60)	50.65*** (37.33)	60.35*** (44.03)
Female	1.217 (0.206)	1.078 (0.190)	0.999 (0.174)
University or postgrad	0.833 (0.166)	0.924 (0.198)	0.897 (0.185)
Employed	0.676** (0.134)	0.630** (0.134)	0.650** (0.138)
1st wealth quintile	REF -	REF -	-
2nd wealth quintile	0.713 (0.186)	0.674 (0.187)	-
3rd wealth quintile	0.920 (0.222)	0.965 (0.247)	-
4th wealth quintile	0.699 (0.167)	0.700 (0.176)	-
5th wealth quintile	0.761 (0.190)	0.692 (0.188)	-
Obese	-	1.519** (0.254)	1.501** (0.248)
Sufficiently active	-	0.943 (0.186)	1.002 (0.188)
Fruit and vegetable consumption	-	1.364 (0.261)	1.348 (0.252)
Richest (subjective)	-	-	REF -
Rich (subjective)	-	-	0.336 (0.266)
Number of Observations Pseudo R^2	2,334 0.186	2,116 0.205	2,191 0.206

Note: Continues on next page.

Variables	(1)	(2)	(3)
Middle (subjective)	-	-	0.472 (0.321)
Poor (subjective)	-	-	0.367 (0.240)
Poorest (subjective)	-	-	0.288* (0.190)
Number of Observations Pseudo R^2	2,334 0.186	2,116 0.205	2,191 0.206

*Note: (1) Regression with personal and socio-economic characteristics; (2) Regression with personal, socio-economic and clinical characteristics; (3) is a regression testing for model (2)'s robustness. *** significant at 1%, ** significant at 5%, * significant at 10%. Robust standard errors in parentheses.*

Discussion

The WHO's WHS for Kuwait (2013) provided a range of information on risk factors, preventative care, chronic conditions, wellbeing and healthcare utilisation. Using this information, our paper explored research questions related to the prevalence and determinants of diabetes among Kuwaiti nationals (n=2,518) (although for completeness we have also repeated the analysis on the entire sample as a robustness check, reported in the appendices of the paper).

Determinants of diabetes were investigated using both subjective and objective measures. While the objective measures of diabetes are preferable (as they reduce bias), however, given the paucity of data collected using this measure (n=70), we relied upon self-assessed diabetes for our analysis. Using the subjective measure of diabetes, data from the WHS suggests 13.42 percent of Kuwaiti nationals are diabetic. The findings of the present study were found to be similar to prevalence rates reported by the 2006 STEPS survey in Kuwait, where 12.4 percent of participants were found to be diabetic using objective measures.[20] This may suggest Kuwait operates a strong health system by being able to correctly identify pre-diabetic and diabetic individuals.

Diabetes (Type 2) is an NCD that may be avoided by leading a healthy lifestyle. For this reason, our paper explored a range of risk factors associated with the disease. Our results found that, in general, Kuwaiti nationals do not lead healthy lifestyles with 32.01% and 49.52% of the population either obese or overweight, respectively. Furthermore, only 32.09% and 12.07% are sufficiently active and consume enough fruit and vegetables, respectively. When broken down by gender, it is clear that women are at greater risk of developing NCDs compared to men.

[20] Kuwait STEPS survey available at https://www.who.int/ncds/surveillance/steps/kuwait/en/ (accessed 29 March 2020).

Poor diet and exercise among Kuwaiti nationals indicate that the prevalence of diabetes as well as a range of other NCDs will continue to rise (already 77.20% of deaths were attributed to NCDs in Kuwait).[21] For example, using WHS data, it is clear that diabetic patients are associated with having multiple chronic conditions. Specifically, 25.07% of nationals with diabetes have two chronic conditions compared to 15.09% of those without diabetes. This proportional difference increases to 82 percent when looking at those with three chronic conditions (i.e. 8.66% vs. 3.61%).

Growing rates of NCDs will intensify the economic burden on the healthcare system through increases in both direct (e.g. patient care) and indirect (e.g. lower productivity) costs. For example, a recent study estimated that direct and indirect costs of the five leading NCDs in the GCC equated to US$36.2 billion in 2013, with this figure expected to increase to US$68 billion by 2022.[22] Given falling oil prices partnered with Kuwait's reliance on oil (approximately 38.5 percent of GDP is comprised of oil rent), such costs may soon exceed potential revenue sources.[23]

Our analysis also examined key determinants of diabetes among Kuwaiti nationals (and as a robustness check we have also conducted the analysis on the full dataset including non-nationals). Results from our analysis showed that as people get older. they are more likely to be diagnosed with diabetes. For example, controlling for demographic, socio-economic and clinical characteristics (Model 2), those who were 80 years or over were 50.7 times more likely to be diabetic than those aged 18-29 years ($p<0.001$). Being obese and unemployed were also found to be significant predictors of diabetes ($p<0.05$).

Previous analysis of the main risk factors associated with diabetes (obesity, lack of exercise) identified a few reasons as to why people living in Kuwait and the wider GCC are at a heightened risk of diabetes. Some of these reasons include: the increasing availability of fast-food restaurants, cars and cheap labour; social stigma associated with walking outdoors; high temperatures; inadequately designed pedestrian walkways and bicycle routes; social norms to spend time with family and extended networks (which were usually inactive and include meals) as well as sedentary work and school environments.[24, 25]

Findings from this paper indicate that policy-makers should focus their attention on pre-

[21] 'World Development Indicators', *World Bank*. Available at hhttps://www.wdi.org (accessed 29 March 2020).

[22] 'The $68 Billion Challenge - Quantifying and Tackling the Burden of Chronic Diseases in the GCC', *Booz & Company*, 2013. Available at https://arabiangazette.com/gcc-economic-burden-hit-68bn-2022-ncds-20131203/ (accessed 29 March 2020).

[23] 'National Accounts (at Current Prices): Revised and Provisional 2014-16', *Kuwait Central Statistical Bureau* (2016). Available at https://www.csb.gov.kw/Pages/Statistics_en?ID=55&ParentCatID=%203 (accessed 29 March 2020).

[24] Lisa Klautzer, Joachim Becker and Soeren Mattke, 'The Curse of Wealth – Middle Eastern Countries Need To Address the Rapidly Rising Burden of Diabetes', *International Journal of Health Policy Management* 2/3 (2013), pp. 109–14.

[25] Kazem Behbehani, 'Kuwait National Programme for Healthy Living: First 5-Year Plan (2013-2017)', *Medical Principles and Practice* 23 (Suppl. 1) (2014), pp. 32–42.

ventative healthcare services. For example, through education and awareness campaigns to get people moving, as well as improving individuals' nutritional knowledge of food. With regard to diabetes specifically, a national diabetes strategy endorsed by all key public and private stakeholders would help streamline efforts to reduce the prevalence of the disease (e.g. promotion of regular testing for pre-diabetic cases).

While our study adds value to the existing knowledge on the determinants of diabetes in the GCC countries, future research efforts should focus on investigating causal links between diabetes and its determinants. Longitudinal studies would serve as a complement to the present study, especially in order to determine causality and the directional effects of the explanatory variables. The results would add further rigour to the existing policy measures aimed at addressing diabetes in Kuwait.

Limitations

The current study was limited by the cross-sectional nature of the data, which cannot confer causality. This limitation also prevented any analysis of temporal changes in the prevalence of diabetes and how they were influenced by their main determinants. Secondly, the low and unreliable response rate on the objective diabetes measure prevented us from ascertaining our analysis using this type of diabetes status.

Conclusion

The purpose of this paper was to gain a better understanding of diabetes and its main determinants among the Kuwaiti national population. Using the WHO's WHS (2013), the paper finds that: 1) age, weight, gender, and activity levels are correlated with diabetes; and 2) those who are diabetic were more likely to suffer from two or more chronic conditions.

Given the high cost of treating diabetes and other NCDs (which diabetics are predisposed to), high rates of the disease represent a key challenge for the Kuwaiti healthcare sector. Therefore, in order to finance a high-quality healthcare system amidst falling oil prices, policy-makers in the country should focus their attention on public health initiatives. In particular, initiatives like promotion of healthy lifestyle campaigns, prevention interventions (e.g. encouraging people to control their weight) as well as early detection and treatment could significantly reduce the long-term burden of diabetes in Kuwait.

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Appendix A: Total Population Descriptive Statistics

Table A1: Summary Statistics – Diabetes and Personal Characteristics (Nationals and Expatriates)

Personal Characteristics	Number of Responses (N)	Proportion (%)	Diabetes Prevalence* (%)
Sex			
Male	1,774	46.34%	9.42%
Female	2,054	53.66%	12.59%
Age			
18–29	962	25.13%	2.51%
30–44	1,690	44.15%	5.26%
45–59	838	21.89%	20.10%
60–69	237	6.19%	38.98%
70–79	84	2.19%	48.81%
80+	17	0.44%	58.82%
Total Number of Respondents	3,828		

*Note: *Subjective diabetes (i.e. self-assessed).*

Table A2: Summary Statistics – Diabetes and Socio-Economic Characteristics (Nationals and Expatriates)

Socio-Economic Characteristics	Number of Responses (N)	Proportion (%)	Diabetes Prevalence* (%)
Wealth source (quintiles)			
1	710	19.80%	12.80%
2	717	19.99%	9.18%
3	722	20.13%	11.14%
4	731	20.38%	9.89%
5	706	19.69%	11.86%
Wealth (subjective)			
Poorest	1,290	34.84%	9.89%
Poor	1,418	38.29%	10.59%
Middle	781	21.09%	13.24%
Rich	151	4.08%	12.00%
Richest	63	1.70%	14.29%
Education			
Less than primary education	115	3.16%	33.33%
Primary education	148	4.07%	22.45%
...Secondary education	639	16.69%	11.65%
High school education	1,208	33.21%	8.74%
College education	1,329	36.53%	6.59%
University or postgrad	199	5.47%	4.10%
Working status			
Employed	2.086	54.49%	6.76%
Not employed	1,742	45.51%	16.35%

*Note: *Subjective diabetes (i.e. self-assessed).*

Table A3: Summary Statistics – Diabetes and Risk Factors (Nationals and Expatriates)

Health Characteristics	Number of Responses (N)	Proportion (%)	Diabetes Prevalence* (%)
Weight (BMI)			
Underweight	36	0.94%	5.56%
Normal	759	19.83%	5.28%
Overweight	1,294	33.80%	8.48%
Obese	1,739	45.43%	15.77%
Physical activity			
Sufficiently active	1,179	30.80%	8.53%
Insufficiently active	2,649	69.20%	12.27%
Fruit and vegetable consumption			
Sufficient	939	26.64%	12.65%
Insufficient	2,586	73.36%	10.19%
Tobacco consumption			
Smoker	557	14.55%	12.17%
Non-smoker	3,271	85.45%	10.92%
Blood pressure (subjective)			
Healthy	3,328	87.79%	6.08%
Not healthy	463	12.21%	47.40%
Blood pressure (objective)			
Healthy	715	23.45%	4.36%
Not healthy	2,334	76.55%	14.40%

*Note: *Subjective diabetes (i.e. self-assessed). [a] Healthy blood pressure was characterised as a person whose systolic and diastolic blood pressure was less than 120 and 80, respectively.*

Table A4: Summary Statistics – Diabetes and Number of Chronic Conditions (Nationals and Expatriates)

Number of Chronic Conditions	Number or Responses and Proportion (%) - Diabetics	Number of Responses and Proportion (%) - Non-diabetics
Zero	83 (19.67%)	131 (3.88%)
One	202 (47.87%)	2,728 (80.85%)
Two	97 (22.99%)	407 (12.06%)
Three	33 (7.82%)	90 (2.67%)
Four	5 (1.18%)	17 (0.50%)
Five	2 (0.47%)	1 (0.03%)
Total	422	3,374

Appendix B: Total Population Logistic Regression Results

Table B1: Logistic Regression Results [Subjective Diabetes] (Nationals and Expatriates)

Variables	(1)	(2)	(3)
18–29	REF	REF	REF
	-	-	-
30–44	2.522***	2.763***	3.002***
	(0.706)	(0.839)	(0.889)
45–59	10.63***	11.34***	10.84***
	(2.720)	(3.167)	(3.020)
60–69	20.14***	24.17***	25.06***
	(5.546)	(7.297)	(7.540)
70–79	25.01***	28.16***	31.06***
	(8.699)	(10.69)	(12.00)
80+	41.47***	42.64***	75.59***
	(27.22)	(31.89)	(55.45)
Female	1.194	1.056	1.017
	(0.174)	(0.160)	(0.152)
University or postgrad	0.720**	0.767	0.821
Employed	0.699**	0.652**	0.633***
Number of Observations	3,557	3,305	3,422
Pseuo R^2	0.177	0.198	0.200

Variables	(1)	(2)	(3)
	(0.113)	(0.111)	(0.103)
1st wealth quintile	REF	REF	-
	-	-	
2nd wealth quintile	0.941	0.944	-
	(0.203)	(0.216)	
3rd wealth quintile	1.004	1.069	-
	(0.216)	(0.240)	
4th wealth quintile	0.811	0.846	-
	(0.168)	(0.182)	
5th wealth quintile	0.924	0.858	-
	(0.199)	(0.199)	
Obese	-	1.661***	1.595***
		(0.241)	(0.225)
Sufficiently active	-	1.060	1.071
		(0.180)	(0.168)
Fruit and vegetable consumption	-	1.442**	1.446**
		(0.233)	(0.227)
Richest (subjective)	-	-	REF
			-
Rich (subjective)	-	-	0.645
			(0.381)
Middle (subjective)	-	-	0.688
			(0.367)
Poor (subjective)	-	-	0.548
			(0.285)
Poorest (subjective)	-	-	0.452
			(0.237)
Number of Observations	3,557	3,305	3,422
Pseuo R^2	0.177	0.198	0.200

*Note: (1) Regression with personal and socio-economic characteristics; (2) Regression with personal, socio-economic and clinical characteristics; (3) is a regression testing for model (2)'s robustness. *** significant at 1%, ** significant at 5%, * significant at 10%. Robust standard errors in parentheses.*

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