

Biological Risk Factors

WORLD HEALTH SURVEY
SAUDI ARABIA (KSAWHS)

Published 2021

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1. SURVEY BACKGROUND

1.1 OBJECTIVES

A second round of WHS+ was implemented in 2019. The Saudi Arabian Ministry of Health (MoH) implemented the survey during 2019 in collaboration with the General Authority for Statistics (GASTAT) and the Saudi Health Council.

The main objective of the Kingdom of Saudi Arabia World Health Survey (KSAWHS 2019) is to provide up-to-date, timely and relevant information on SDGs health-related indicators and WHO indicators, framework programmatic indicators, and socio-demographic stratifiers.

1.2 METHODOLOGY

The 2019 Kingdom of Saudi Arabia World Health Survey (KSAWHS 2019) was implemented by the MoH and designed to provide up-to-date and reliable

measurement of priority health-related indicators at national level by urban and rural residence, and for each of the 13 administrative areas. The Master Sample Frame (MSF) used for the 2019 KSAWHS was based on the Population and Housing Census of the Kingdom, which was conducted in 2010 by the General Authority of Statistics (GASTAT).

A nationally representative sample of completed interviews with 9,339 households was conducted from the 13 administrative regions according to population size. The KSAWHS 2019 followed a stratified three-stage sample design with a probability proportional to population size, as follows: sampling PSUs at the first stage, then a systematic sampling of households of a fixed size of eight households per PSU at the second stage, and at the third stage, an adult member of the household aged 15+ was selected using a random number generated by the tablet computer at the end of the household interview. A total of 8,912 individual interviews were conducted as a result of stage 3 selection.

All analyses were performed using the survey design and the normalized weights of the households and individuals, so that the results would be representative at the national level as well as the domain level.

Two questionnaires were used in this survey: household, and individual. The questionnaires were based on the WHO's World Health Survey (WHS) questionnaires and the Tunisian 2015 WHS questionnaires (4, 5). Survey indicators were mapped to the Sustainable Development Goals (SDGs) and the WHO Global Reference List of 100 Core Health Indicators, and the questionnaires were further adopted to cover further indicators to meet national priorities.

Field supervisors and interviewers were recruited based on the following criteria: 1-Being a physician or nurse (i.e. having a bachelor's degree or above in medicine or nursing); 2-Being proficient in English and Arabic; 3-Having knowledge of the dialects of the region where they will work.

The household questionnaire was administered to the head of the household or the most knowledgeable person of the house if the head of the household was not present at the time of the interview.

Use of tablets/CAPI helped reduce errors and prevent missing data, remove the manual data entry steps and allow for timely monitoring of the quality of the data.

2. Overall Results

2-1 Blood Pressure:

14% of respondents have raised blood pressure.

2-2 Anthropometrics:

In general, less than half of respondents (40%) have normal BMI. However, the percentage of overweight and obese are 38% and 20%, respectively.

2-3 Blood Glucose:

The percentage of respondents with raised blood glucose is 4% and the percentage with impaired glucose tolerance is 11%.

2-4 Cholesterol:

The percentage of respondents with raised cholesterol is 43%.

2-6 Hemoglobin:

Overall, the percentage of respondents with low haemoglobin is (50%), mild (20%), moderate (24%), and severe (6%).

This report focuses on the biological risk factors of the respondents; measured through a clinical health examination and a blood test. Information on the biological risk factors could give insight into the wellbeing of individuals and their risks of developing diseases such as cardiovascular problems. This report presents information on blood pressure, weight, anthropometrics, blood glucose, cholesterol, and hemoglobin levels. WHO guidelines and classifications were used to define cut-offs to produce results in line with the international metadata of the SDGs and the Global Reference List of 100 Core Health Indicators (10, 11).

1 Blood Pressure:

High blood pressure or hypertension is a serious medical condition that needs to be addressed. It is referred to as the “silent killer”, as it can have no warning signs or symptoms. If left untreated, it can lead to eye, kidney, and cardiovascular disease. Hypertension is a major risk factor for premature mortality.

Hypertension based on measured blood pressure

Defined as having systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg. 11

11 Plausible values were as follows: for systolic blood pressure min=70 mmHg, max=270 mmHg; for diastolic blood pressure min=30 mmHg, max=150 mmHg. Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis.

Note: The percentages for cases mentioned in this report are based on measurements such as (clinical health examination or blood test) and may not be identical to the percentages that participants self-reported (based on clinical diagnosis) in subsequent reports.

Patterns of measurement indicators:

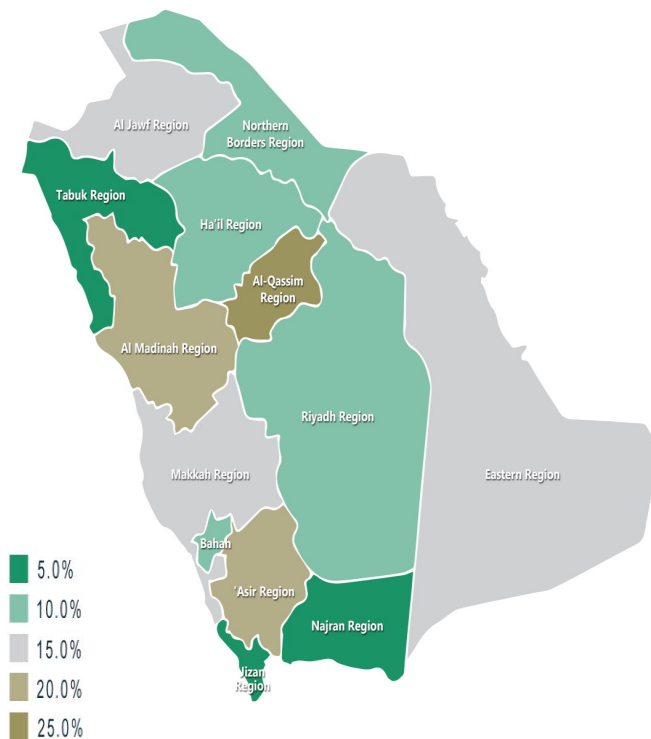
- 16% of rural residents have raised blood pressure, compared with 13% of urban residents.
- Raised blood pressure decreases with higher education; decreasing from 35% in respondents with no formal education to 10% in respondents with more than secondary school completion.
- Raised blood pressure by region shows that Tabuk has the lowest percentage of raised blood pressure (4%), while Qasim has the highest (26%).

Table 8.1 presents the mean systolic and diastolic blood pressure and pulse rate

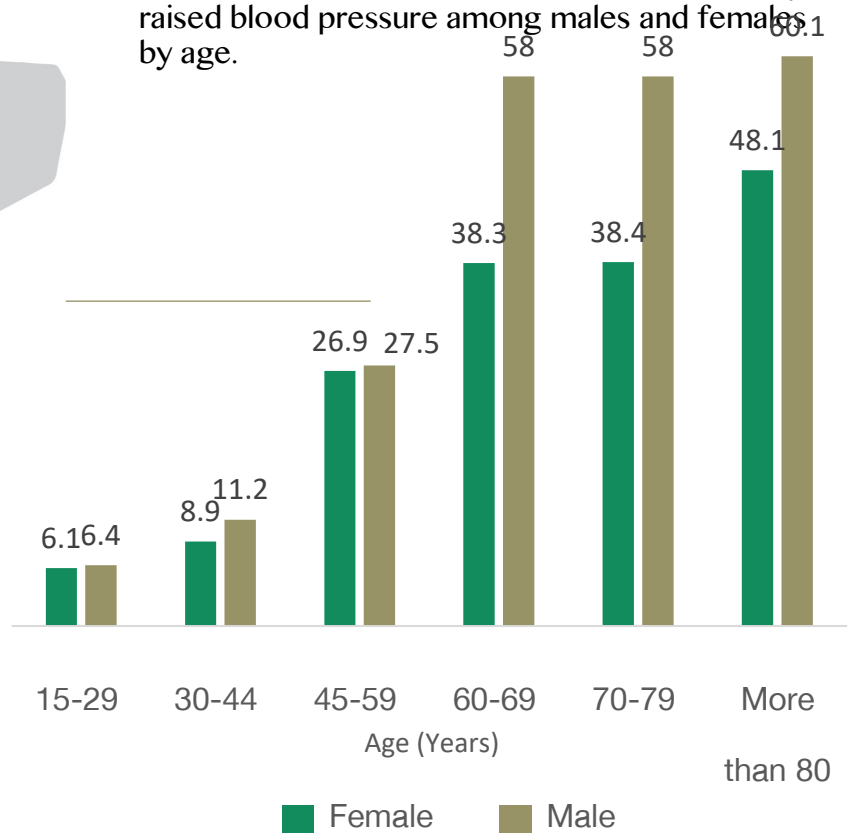
The mean systolic blood pressure is 123 mmHg, the mean diastolic blood pressure is 80 mmHg, and mean pulse rate is 80 beats per minute. The measured values of systolic and diastolic blood pressure progressively increase with age; from 120 mmHg and 79 mmHg, respectively, in the age group 15-29, to 138 mmHg and 86 mmHg, respectively, in the age group 80+.

Table 8.2 demonstrates information on raised blood pressure

The table indicates that 14% of respondents have raised blood pressure. The percentage of respondents with raised blood pressure dramatically increases with age; from 6% in the age group 15-29 to 56% in the age group 80+. More males have raised blood pressure than females (15% vs. 12%). The figure below displays raised blood pressure among males and females by age.



Percentage of respondents who have raised blood pressure based on measured blood pressure



Percentage of males and females who have raised blood pressure based on measured blood pressure

Patterns of measurement indicators:

- The percentage of respondents with obesity is higher in urban areas than rural areas (21% vs. 18%).
- In general, the percentage of obese respondents decreases as education increases, ranging from 29% in respondents with no formal education, to 18% in respondents with more than secondary school education.
- The percentage of respondents who are overweight or obese is displayed in the Figure below. Overweight is the highest in Al Jawf (52%) and Tabuk (50%), and obesity is the highest in Bahah (33%) and Najran (33%).

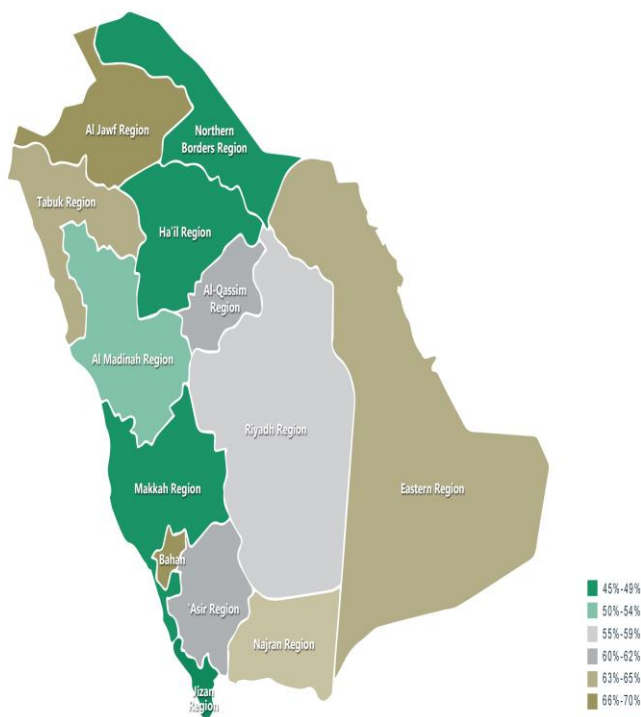


Figure: Overweight and obesity by region

Percentage distribution of respondents by BMI classification

2. Anthropometrics

Body Mass Index (BMI)

Calculated by dividing the ratio of weight in kilograms to the square of height in meters (kg/m²). It is categorized as: underweight (<18.5 kg/m²), normal (18.5-24.9 kg/m²), overweight (25.0-29.9 kg/m²) obese (≥30.0 kg/m²) 12.

Abnormal waist circumference

Defined as waist >80 cm in women and as waist >94 cm in men.

Abnormal waist/hip ratio

Defined as a waist/hip ratio ≥0.85 cm in women and as waist/hip ratio ≥0.9 cm in men.

Measurement of Anthropometrics

Anthropometrics is a screening tool to examine the health of individuals. Fat distribution across the body, measured by BMI or waist and hip circumference, can be an indicator of risk of certain diseases. Conditions related to overweight and obesity include cardiovascular diseases, some cancers, and diabetes.

2. Anthropometrics: Body Mass Index (BMI)

Table 8.3 shows the following:

39% of respondents have normal BMI; however, 3% are underweight, 38% are overweight, and 20% are obese. The mean BMI of the respondents is 26.4 kg/ m². In general, the percentage of respondents with obesity increases with age, from 10% in the age group 18-29, to 29% in the age group 70-79, before falling to 22% in respondents 80+ years. The percentage of overweight is higher in males (43%) than females (33%) while the percentage of obesity is higher in females (21%) than males (19%).

12 Plausible values for BMI were min=10 (kg/m²), max=80 (kg/m²). Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis. Pregnant women were excluded.

Blood Glucose:

Elevated blood glucose level can lead to serious complications. These include, but are not limited to neuropathy, nephropathy, cardiovascular disease and susceptibility to infection. However, prediabetic children may not experience the same symptoms or be at the same risk for diabetes complications as diabetic individuals.

Diabetes based on measured random blood glucose (raised blood glucose)

Defined as random glucose levels ≥ 11.1 mmol/L. 13, 14.

Impaired glucose tolerance

Defined as random glucose levels ≥ 7.8 and < 11.1 mmol/L. 13, 14

Table 8.6 presents the following:

Random blood glucose among the respondents. The mean random blood glucose is 6.1 mmol/L. Impaired glucose function and raised blood glucose is found in 11% and 4% of respondents, respectively.

The percentage of respondents with raised blood glucose increases with advancing age, increasing from 4% in the 15-29 age group, to 7% in the 80+ group.

Males and females have similar percentages of raised blood glucose (4%) respectively. The percentage of males and females with raised blood glucose by age is illustrated in the following Figure.

2. Anthropometrics : Waist and Hip Circumference

Table 8.4 and Table 8.5 present the mean waist and hip circumference and the percentage of abnormal waist circumference and abnormal waist/hip ratio.

The mean waist and hip circumferences for males are 71 cm and 50 cm, respectively. The mean waist and hip circumferences for females are 66 cm and 49 cm, respectively. Abnormal waist circumference is found in 30% of respondents. The majority of respondents (91%) have abnormal waist/hip ratio.

There is a steady increase in abnormal waist circumference with age, from 23% in the 15-29 age group, to 58% in the 80+ age group. Females have higher percentages of abnormal waist circumference than males (34% vs. 27%).

Patterns of measurement indicators:

- Rural residents have a higher percentage of abnormal waist circumference compared to urban residents (35% vs. 29%).
- The percentage with abnormal waist circumference generally decreases with increasing education, ranging from 47% in respondents with no formal education, to 30% in respondents with more than secondary school education.
- The region with the highest percentage of abnormal waist circumference is Najran (77%), and the region with the lowest is the Northern Borders (5%).

13 Random glucose levels are categorised as follows: Normal < 7.8 mmol/L, Impaired glucose tolerance < 11.1 mmol/L; Diabetes ≥ 11.1 mmol/L

14 Plausible values for random blood glucose were min=1.5 (mmol/L), max=30 (mmol/L). Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis

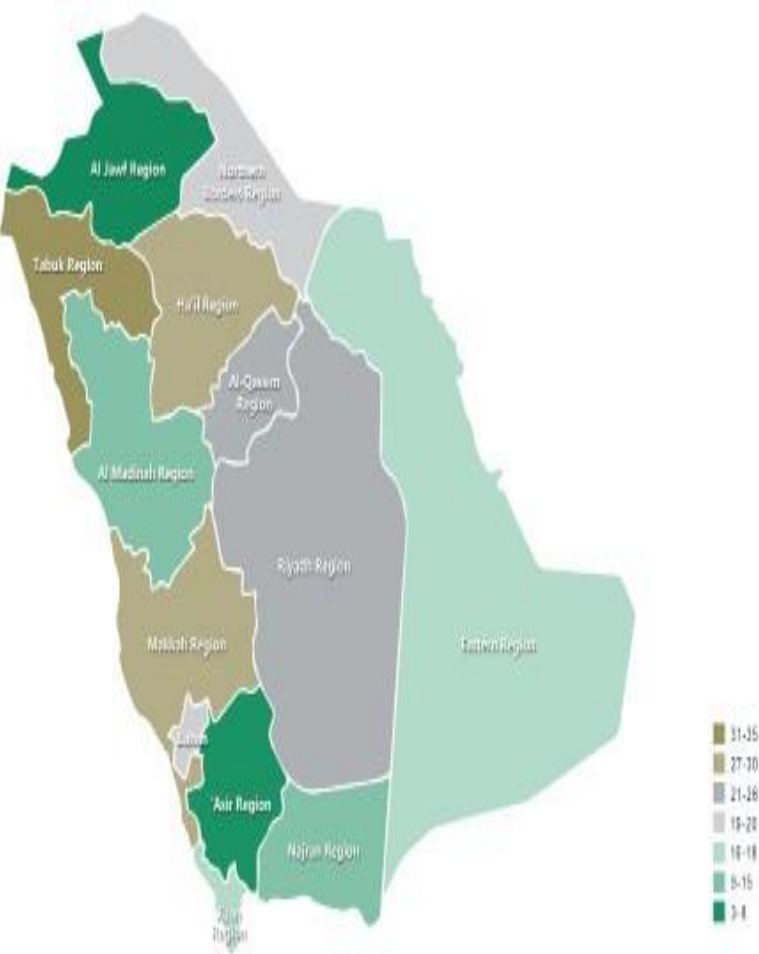
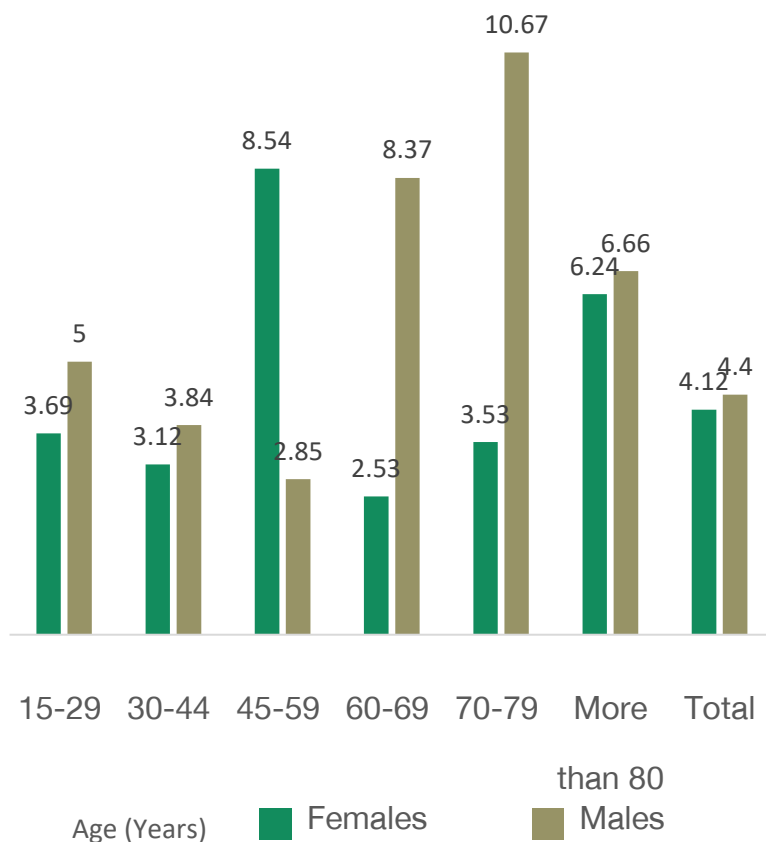


Figure: Raised blood glucose by region

The percentage of respondents who have raised blood glucose based on measured random blood glucose

Cholesterol:

Cholesterol is crucial to maintain normal functioning of the human body. Cholesterol levels are primarily measured by total cholesterol, high-density lipoprotein (HDL), and low-density lipoprotein (LDL). Whereas high levels of total cholesterol and LDL are considered to be dangerous, a high level of HDL is considered protective. If presented in abnormal concentrations, these lipids can increase the risk of certain diseases, such as pancreatitis, atherosclerosis, and cardiovascular disease.



Percentage of males and females who have raised blood glucose based on measured random blood glucose

Patterns of measurement indicators:

- The percentage of respondents with raised blood glucose increases with increasing household wealth; 4% of respondents in the lowest wealth quintile have raised blood glucose, compared with 6% of respondents in the highest quintile.
- The percentage of respondents with raised blood glucose varies from region to region, the highest being Tabuk (8%) and the lowest Najran (1%).

Patterns of measurement indicators:

- Respondents living in rural areas have higher percentages of raised cholesterol than respondents living in urban areas (47% vs. 42%).
- Raised cholesterol decreases with education, ranging from 52% in respondents with no education to 40% in respondents with more than secondary school education.
- The lowest percentage of raised cholesterol is found in respondents with the highest household wealth (38%).
- The percentage of raised cholesterol varies among regions; the Northern Borders has the highest percentage (64%), while Bahah has the lowest percentage (26%).

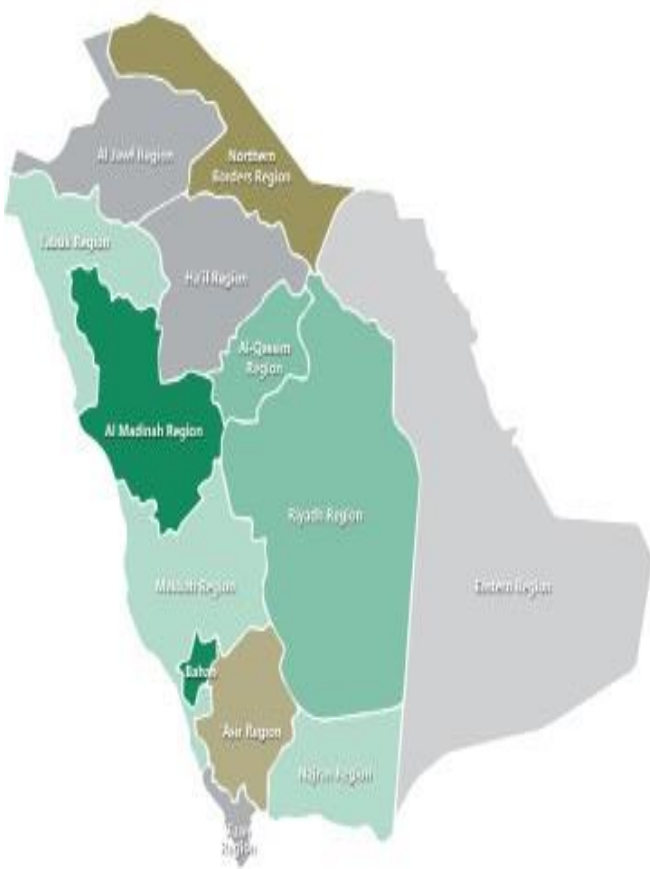


Figure: Raised cholesterol by region

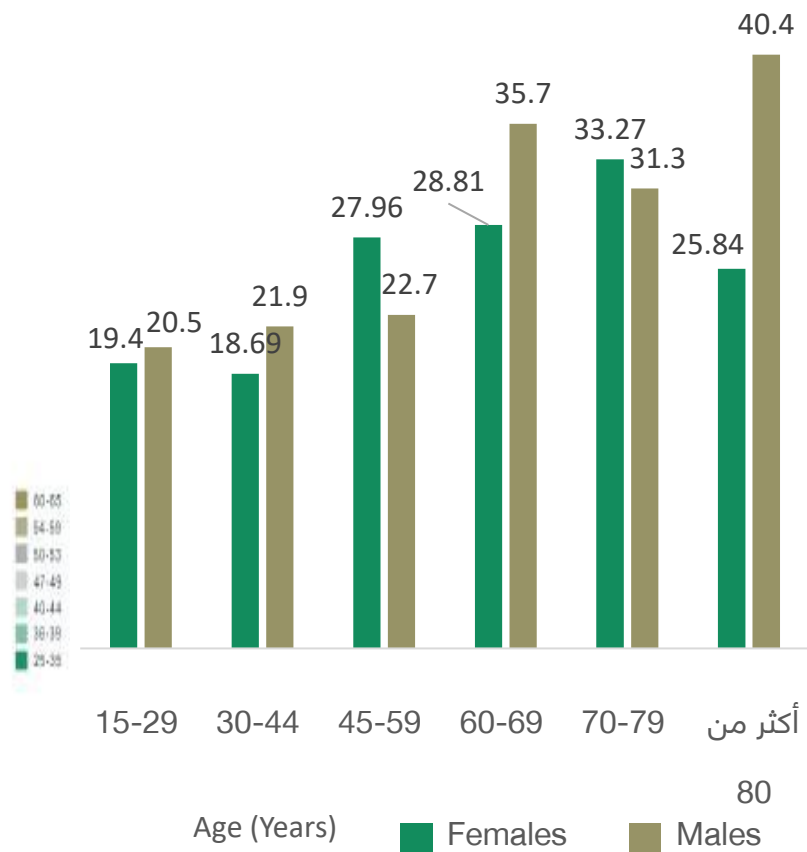
Percentage of respondents who have raised cholesterol based on measured cholesterol

Hypercholesterolemia (raised cholesterol in the blood)

Defined as total cholesterol (TC) levels ≥ 5 mmol/L. 15

Table 8.7 affirms the following:

Cholesterol is crucial to maintaining normal functioning of the human body. Cholesterol levels are primarily measured by total cholesterol, high-density lipoprotein (HDL), and low-density lipoprotein (LDL). Whereas high levels of total cholesterol and LDL are considered to be dangerous, a high level of HDL is considered protective. If presented in abnormal concentrations, these lipids can increase the risk of certain diseases, such as pancreatitis, atherosclerosis, and cardiovascular disease.



Percentage of males and females who have raised cholesterol based on measured cholesterol

15 Plausible values were as follows: for LDL min=0.5 mmol/L, max=10 mmol/L; for HDL min=0.4 mmol/L; max=5 mmol/L; for TC min=1.75 mmol/L, max=20 mmol/L. Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis.

Patterns of measurement indicators:

- The percentage of anemia is higher among non-Saudi respondents (56%) compared to Saudi respondents (49%).
- The percentage of anemia is highest in respondents with no formal education (57%) and respondents with more than secondary school education (52%).
- The percentage of anemia varies widely by region, ranging from a low percentage of 13% in the Northern Borders to a higher percentage of 82% in Bahah.

Hemoglobin:

Hemoglobin is responsible for delivering oxygen throughout the body. Anemia occurs when there is a low hemoglobin level in the blood. Iron deficiency is a major cause for anemia, which is usually a result of poor diet. However, certain infectious diseases, chronic diseases, and genetic conditions, such as sickle cell anemia and thalassemia, can give rise to anemia. Individuals with anemia experience (among other health problems) fatigue, pregnancy complications, susceptibility to diseases, and heart problems.

Anemia based on measured blood hemoglobin (low hemoglobin) (11)

Defined as hemoglobin levels <120 g/L for females (7.5 mmol/L), <110 g/L for pregnant females (6.8 mmol/L), and <130 g/L for males (8.0 mmol/L) 16,17.

Table 8.8 indicates that the mean hemoglobin level is 120.8 g/L. Anemia based on measured low hemoglobin is found in 50% of respondents; mild anemia (20%), moderate anemia (24%), and severe anemia (6%). In general, the percentage of any anemia rises with age to reach its highest (70%) in the 80+ age group. Males show a higher percentage of anemia than females (52% and 48%, respectively). In terms of severity among females, 15% have mild, 26% have moderate, and 7% have severe anemia. In terms of severity among males, 25% have mild, 23% have moderate, and 5% have severe anemia. The percentage of anemia among pregnant women is 53%.

16 Plausible values were as follows for females: min=40 g/L, max=180 g/L; for males: min=50 g/L, max=200 g/L. Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis.

17 Hemoglobin level adjusted for smoking, adjustment -0.3 g/l for all smokers.

List of Main Tables

In the upcoming slides, the tables will be presented according to age, sex, nationality, residence, marital status, education, wealth and region

Blood Pressure

8.1 : Mean blood pressure and pulse rate

8.2 Blood Pressure

Anthropometrics

8.3 Body Mass Index (BMI)

8.4 Abnormal waist circumference

8.5 Abnormal waist/hip ratio

8.6 Blood Glucose

8.7 Hemoglobin

8.8 Cholesterol

8.1 Mean systolic and diastolic blood pressure and mean pulse rate

According to age, sex, nationality, residence, marital status, education, wealth and region

8.1 Blood pressure and pulse rate by age

The percentage of respondents with raised blood pressure dramatically increases with age; from 6% in the age group 15-29 to 56% in the age group 80+.

Measurement indicators	Systolic blood pressure 1		Diastolic blood pressure 1		pulse rate	
	Average (MMHG)	Number of respondents	Average (MMHG)	Number of respondents	Average (pulse/minute)	Number of respondents
Age						
15-29 years-old	120	3240	79	3243	80	3259
30-44 years-old	122	3634	80	3634	80	3651
45-59 years-old	129	1233	84	1233	81	1237
60-69 years-old	135	354	84	353	81	355
70-79 years-old	135	134	83	134	80	134
80 years-old and more	138	52	86	52	82	52

1 Plausible values were as follows: for systolic blood pressure min=70 mmHg, max=270 mmHg; for diastolic blood pressure min=30 mmHg, max=150 mmHg. Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis

8.1 Blood pressure and pulse rate by sex, nationality, residence and marital status

More males have raised blood pressure than females (15% vs. 12%).

Measurement indicators	Systolic blood pressure ¹		Diastolic blood pressure ¹		Pulse rate	
	Average (MMHG)	Number of respondents	Average (MMHG)	Number of respondents	Average (pulse/minute)	Number of respondents
Sex						
Male	125	4,557	81	4,561	80	4,585
Female	122	4,090	80	4,088	80	4,103
Nationality						
Saudi	123	7,549	80	7,547	80	7,570
Non-Saudi	124	1,098	81	1,102	80	1,118
Residence						
Urban	123	7,469	80	7,472	80	7,506
Rural	124	1,178	82	1,177	80	1,182
Marital Status						
Never married	120	2,182	79	2,184	80	2,192
Currently Married	124	5,799	81	5,799	80	5,829
Formerly Married	129	667	82	667	80	668

¹ Plausible values were as follows: for systolic blood pressure min=70 mmHg, max=270 mmHg; for diastolic blood pressure min=30 mmHg, max=150 mmHg. Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis

8.1 Blood pressure and pulse rate by education– wealth

The percentage of respondents with raised blood pressure dramatically increases with both low and high incomes, in addition to respondents with no formal education.

Measurement indicators	Systolic blood pressure 1		Diastolic blood pressure 1		Pulse rate	
	Average (MMHG)	Number of respondents	Average (MMHG)	Number of respondents	Average (pulse/minute)	Number of respondents
No formal education	132	465	83	463	81	470
Less than secondary school	125	1296	81	1299	81	1310
Secondary school	123	3328	80	3329	81	3347
More than secondary school	122	3558	80	3558	79	3562
Wealth Quintile						
Lowest	124	2,025	80	2,028	80	2,047
Second	122	1,873	80	1,871	80	1,878
Middle	122	1,657	81	1,658	81	1,667
Fourth	123	1,602	81	1,602	81	1,604
Highest	124	1,491	81	1,491	80	1,492

1 Plausible values were as follows: for systolic blood pressure min=70 mmHg, max=270 mmHg; for diastolic blood pressure min=30 mmHg, max=150 mmHg. Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis

8.1 Blood pressure and pulse rate by region

The percentage of respondents with raised blood pressure dramatically increases in Al Jawf .

Measurement indicators	Systolic blood pressure 1		Diastolic blood pressure 1		Pulse rate	
	Average (MMHG)	Number of respondents	Average (MMHG)	Number of respondents	Average (pulse/minute)	Number of respondents
Riyadh	124	2,306	80	2,305	79	2,315
Makkah al mukramah	123	2,169	82	2,169	80	2,174
Al Madinah al monwarah	123	628	81	631	80	648
Al Qassim	126	364	84	364	81	364
Eastern province	123	1,123	78	1,123	83	1,129
Asier	126	611	81	611	79	611
Tabuk	119	300	77	300	84	300
Hail	121	163	81	163	77	163
Northern borders	112	87	78	87	81	87
Jazan	120	385	81	385	82	385
Najran	123	193	79	193	82	193
Al Baha	122	153	77	153	80	153
Al Jouf	127	165	79	165	78	165
Total	123	8,647	80	8,649	80	8,688

1 Plausible values were as follows: for systolic blood pressure min=70 mmHg, max=270 mmHg; for diastolic blood pressure min=30 mmHg, max=150 mmHg. Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis

8.2 Blood Pressure

According to age, sex, nationality, residence, marital status, education, wealth and region

8.2 Blood pressure and pulse rate by age

Measurement indicators	Systolic blood pressure 1			Total	Number of respondents
Age	Low	Normal	High		
15-29 years-old	1	97	3	100	3,240
30-44 years-old	1	95	5	100	3,634
45-59 years-old	0	80	20	100	1,233
60-69 years-old	0	62	38	100	354
70-79 years-old	0	63	37	100	134
80 years-old and more	0	55	45	100	52

Measurement indicators	Diastolic blood pressure 2			Total	Number of respondents	Raised blood pressure 3	Number of respondents
Age	Low	Normal	High				
15-29 years-old	1	94	5	100	3,243	6	3,240
30-44 years-old	1	92	7	100	3,634	10	3,632
45-59 years-old	0	82	18	100	1,233	27	1,233
60-69 years-old	0	73	27	100	353	47	353
70-79 years-old	1	75	25	100	134	48	134
80 years-old and more	1	63	36	100	52	56	52

1 Systolic blood pressure is categorized as: Low <90 mmHg; 90 mmHg=> Normal <140 mmHg; Raised >=140 mmHg

2 Diastolic blood pressure is categorized as: Low <60 mmHg; 60 mmHg<= Normal >90 mmHg; Raised >=90 mmHg

3 Raised blood pressure is defined as systolic blood pressure >=140 mmHg or diastolic blood pressure >=90 mmHg

8.2 Blood pressure and pulse rate by sex, nationality, residence and marital status

Measurement indicators	Systolic blood pressure 1			Total	Number of respondents
	Low	Normal	High		
Sex					
Male	91	0	9	100	4,557
Female	92	1	7	100	4,090
Nationality					
Saudi	91	1	8	100	7,549
Non-Saudi	91	0	8	100	1,098
Residence					
Urban	91	1	8	100	7,469
Rural	90	1	10	100	1,178
Marital Status					
Never married	96	1	4	100	2,182
Currently Married	91	1	9	100	5,799
Formerly Married	80	1	20	100	667

Measurement indicators	Diastolic blood pressure 2			Total	Number of respondents	Rised blood pressure 3	Number of respondents
	Low	Normal	High				
Sex							
Male	1	90	10	100	4,561	15	4,556
Female	1	91	8	100	4,088	12	4,087
Nationality							
Saudi	1	90	9	100	7,547	14	7,546
Non-Saudi	1	90	9	100	1,102	13	1,098
Residence							
Urban	1	91	9	100	7,472	13	7,467
Rural	0	89	11	100	1,177	16	1,177
Marital Status							
Never married	1	95	4	100	2,184	7	2,182
Currently Married	1	89	10	100	5,799	15	5,795
Formerly Married	0	84	16	100	667	26	667

1 Systolic blood pressure is categorized as: Low <90 mmHg; 90 mmHg>= Normal <140 mmHg; Raised >= 140 mmHg

2 Diastolic blood pressure is categorized as: Low <60 mmHg; 60 mmHg<= Normal >90 mmHg; Raised >=90 mmHg

3 Raised blood pressure is defined as systolic blood pressure >= 140 mmHg or diastolic blood

8.2 Blood pressure and pulse rate by education–wealth

Measurement indicators	Systolic blood pressure 1			Total	Number of respondents
Education level	Low	Normal	High		
No formal education	0	71	29	100	465
Less than secondary school	0	87	13	100	1296
Secondary school	1	92	7	100	3328
More than secondary school	1	94	5	100	3558
Wealth Quintile					
Lowest	1	90	10	100	2025
Second	1	92	7	100	1873
Middle	1	93	6	100	1657
Fourth	1	91	8	100	1602
Highest	0	90	10	100	1491

Measurement indicators	Diastolic blood pressure 2			Total	Number of respondents	Raised blood pressure 3	Number of respondents
Education level	Low	Normal	High				
No formal education	1	80	19	100	463	35	463
Less than secondary school	1	87	12	100	1299	18	1296
Secondary school	1	90	9	100	3329	13	3327
More than secondary school	1	93	7	100	3558	10	3557
Wealth Quintile							
Lowest	1	91	8	100	2028	14	2024
Second	0	93	7	100	1871	11	1870
Middle	1	91	8	100	1658	12	1657
Fourth	1	88	11	100	1602	15	1602
Highest	0	88	11	100	1491	16	1491

1 Systolic blood pressure is categorized as: Low <90 mmHg; 90 mmHg>= Normal <140 mmHg; Raised>=140 mmHg

2 Diastolic blood pressure is categorized as: Low <60 mmHg; 60 mmHg<= Normal >90 mmHg; Raised >=90 mmHg

3 Raised blood pressure is defined as systolic blood pressure >= 140 mmHg or diastolic blood pressure >=90 mmHg

8.2 Blood pressure and pulse rate by region

Measurement indicators	Systolic blood pressure 1			Total	Number of respondents
	Low	Normal	High		
Riyadh	0	93	7	100	2306
Makkah al mukramah	1	92	7	100	2169
Al Madinah al monwarah	0	91	9	100	628
Al Qassim	0	87	13	100	364
Eastern province	0	90	10	100	1123
Asier	0	83	17	100	611
Tabuk	3	94	3	100	300
Hail	0	95	5	100	163
Northern borders	19	77	3	100	87
Jazan	0	97	3	100	385
Najran	0	94	6	100	193
Al Baha	0	91	9	100	153
Al Jouf	0	87	13	100	165
Total	1	91	8	100	8647

Measurement indicators	Diastolic blood pressure 2			Total	Number of respondents	Raised blood pressure 3	Number of respondents
	Low	Normal	High				
Riyadh	0	92	8	100	2305	11	2305
Makkah al mukramah	1	90	9	100	2169	13	2168
Al Madinah al monwarah	2	85	13	100	631	21	627
Al Qassim	1	79	20	100	364	26	364
Eastern province	1	91	8	100	1123	13	1123
Asier	1	85	14	100	611	22	611
Tabuk	1	98	2	100	300	4	300
Hail	0	92	8	100	163	10	163
Northern borders	2	91	8	100	87	10	87
Jazan	0	95	5	100	385	8	385
Najran	1	98	1	100	193	6	193
Al Baha	2	94	4	100	153	11	153
Al Jouf	0	95	5	100	165	13	165
Total	1	90	9	100	8649	14	8644

1 Systolic blood pressure is categorized as: Low <90 mmHg; 90 mmHg>= Normal <140 mmHg; Raised >= 140 mmHg

2 Diastolic blood pressure is categorized as: Low <60 mmHg; 60 mmHg<= Normal >90 mmHg; Raised >=90 mmHg

3 Raised blood pressure is defined as systolic blood pressure >= 140 mmHg or diastolic blood pressure >=90 mmHg

8.3 Body Mass Index (BMI)

According to age, sex, nationality, residence, marital status, education, wealth and region

8.4 Mean waist and hip circumference by age

Measurement indicators	Waist circumference		Hip circumference	
	Mean (CM)	Number of respondents	Mean (CM)	Number of respondents
Age				
15-29 years-old	63	2771	47	2674
30-44 years-old	70	3191	51	3042
45-59 years-old	73	1086	51	1016
60-69 years-old	77	293	56	268
70-79 years-old	79	100	55	96
80 years-old and more	83	38	65	37

8.4 Mean waist and hip circumference by sex, nationality, residence, marital status

Measurement indicators	Waist circumference		Hip circumference	
	Mean (CM)	Number of respondents	Mean (CM)	Number of respondents
Sex				
Male	71	4144	50	3908
Female	66	3335	49	3225
Nationality				
Saudi	69	6462	50	6191
Non-Saudi	67	1017	45	941
Residence				
Urban	68	6523	49	6241
Rural	72	956	54	892
Marital Status				
Never married	63	1956	47	1882
Currently Married	71	4976	51	4726
Formerly Married	68	547	47	524

1 Pregnant women were excluded

8.4 Mean waist and hip circumference by education- wealth

Measurement indicators	Waist circumference		Hip circumference	
Education level	Mean (CM)	Number of respondents	Mean (CM)	Number of respondents
No formal education	76	376	55	345
Less than secondary school	68	1153	50	1086
Secondary school	68	2935	50	2800
More than secondary school	69	3014	49	2901
Wealth Quintile				
Lowest	69	1764	50	1692
Second	73	1588	53	1522
Middle	69	1418	51	1334
Fourth	69	1403	51	1309
Highest	62	1306	43	1275

8.4 Mean waist and hip circumference by region

Measurement indicators	Waist circumference		Hip circumference	
Region	Mean (CM)	Number of respondents	Mean (CM)	Number of respondents
Riyadh	61	1869	43	1775
Makkah al mukramah	69	1810	51	1657
Al Madinah al monwarah	55	548	41	527
Al Qassim	62	340	54	327
Eastern province	68	1012	51	994
Asier	93	581	45	550
Tabuk	68	278	63	276
Hail	90	155	41	154
Northern borders	54	69	47	63
Jazan	56	327	49	320
Najran	100	185	50	184
Al Baha	95	150	103	150
Al Jouf	88	156	80	154
Total	69	7479	50	7132

1 Pregnant women were excluded

8.5 Abnormal waist circumference and waist/hip ratio

According to age, sex, nationality, residence, marital status, education, wealth and region

8.5 Abnormal waist circumference and waist/hip ratio by age

Measurement indicators	Abnormal waist circumference 1	Number of respondents	Abnormal waist/hip ratio 2	Number of respondents
Age				
15-29 years-old	22	2771	90	2666
30-44 years-old	32	3191	92	3039
45-59 years-old	39	1086	93	1016
60-69 years-old	40	293	94	268
70-79 years-old	49	100	91	96
80 years-old and more	58	38	84	37

8.5 Abnormal waist circumference and waist/hip ratio by sex, nationality, residence and marital status

Measurement indicators	Abnormal waist circumference 1	Number of respondents	Abnormal waist/hip ratio 2	Number of respondents
Sex				
Male	27	4144	91	3900
Female	34	3335	92	3221
Nationality				
Saudi	30	6462	91	6180
Non-Saudi	29	1017	93	941
Residence				
Urban	29	6523	92	6231
Rural	35	956	90	890
Marital Status				
Never married	20	1956	89	1877
Currently Married	33	4976	92	4720
Formerly Married	36	547	93	524

1 Abnormal waist circumference is defined as >80 cm in women and >94 cm in men. Pregnant women were excluded.

2 Abnormal waist/hip ratio is defined as ≥ 0.85 cm in women and ≥ 0.9 cm in men.

8.5 Abnormal waist circumference and waist/hip ratio by education – wealth

Measurement indicators	Abnormal waist circumference 1	Number of respondents	Abnormal waist/hip ratio 2	Number of respondents
Education level				
No formal education	47	376	93	345
Less than secondary school	30	1153	92	1086
Secondary school	28	2935	90	2796
More than secondary school	30	3014	92	2894
Wealth Quintile				
Lowest	28	1764	93	1692
Second	37	1588	92	1521
Middle	31	1418	89	1326
Fourth	31	1403	90	1309
Highest	23	1306	93	1273

8.5 Abnormal waist circumference and waist/hip ratio by region

Measurement indicators	Abnormal waist circumference 1	Number of respondents	Abnormal waist/hip ratio 2	Number of respondents
Region				
Riyadh	19	1869	94	1765
Makkah al mukramah	30	1810	91	1657
Al Madinah al monwarah	12	548	97	527
Al Qassim	20	340	89	327
Eastern province	32	1012	84	994
Asier	70	581	100	550
Tabuk	19	278	83	276
Hail	57	155	100	154
Northern borders	5	69	93	63
Jazan	13	327	88	320
Najran	77	185	98	184
Al Baha	67	150	70	150
Al Jouf	45	156	84	154
Total	30	7479	91	7121

1 Abnormal waist circumference is defined as >80 cm in women and >94 cm in men. Pregnant women were excluded.

2 Abnormal waist/hip ratio is defined as ≥ 0.85 cm in women and ≥ 0.9 cm in men.

8.6 Blood Glucose

According to age, sex, nationality, residence, marital status, education, wealth and region

8.6 Blood glucose levels according to age

Measurement indicators	MEAN NONFASTING BLOOD GLUCOSE (MMOL/L)	RANDOM BLOOD GLUCOSE LEVEL 2			TOTAL NUMBER OF RESPONDENTS	TOTAL NUMBER OF RESPONDENTS
Age		Normal 1	IMPAIRED GLUCOSE TOLERANCE (PREDIABETES)	RAISED BLOOD GLUCOSE		
15-29 years-old	6	86	10	4	100	2907
30-44 years-old	6	86	10	4	100	3114
45-59 years-old	6	83	11	6	100	1076
60-69 years-old	7	75	20	5	100	318
70-79 years-old	6	78	15	7	100	119
80 years-old and more	7	67	27	7	100	50

8.6 Blood glucose levels according to sex, nationality, residence and marital status

Measurement indicators	MEAN NONFASTING BLOOD GLUCOSE (MMOL/L)	RANDOM BLOOD GLUCOSE LEVEL 2			TOTAL NUMBER OF RESPONDENTS	TOTAL NUMBER OF RESPONDENTS
Sex		Normal 1	IMPAIRED GLUCOSE TOLERANCE (PREDIABETES)	RAISED BLOOD GLUCOSE		
Male	6	85	11	4	100	3991
Female	6	86	10	4	100	3592
Nationality						
Saudi	6	85	11	4	100	6546
Non-Saudi	6	86	9	4	100	1037
Residence						
Urban	6	85	11	5	100	6581
Rural	6	87	11	2	100	1002
Marital Status						
Never married	6	86	10	4	100	1927
Currently Married	6	86	10	4	100	5065
Formerly Married	6	79	14	7	100	591

1 Plausible values for random blood glucose were min=1.5 (mmol/L), max=30 (mmol/L). Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis

2 Random glucose levels are categorized as follows: Normal \leq Impaired glucose tolerance < 11.1 mmol/L; Raised glucose ≥ 11.1 mmol/L.

8.6 Blood glucose levels according to education – wealth

Measurement indicators	MEAN NONFASTING BLOOD GLUCOSE (MMOL/L)	RANDOM BLOOD GLUCOSE LEVEL 2			TOTAL NUMBER OF RESPONDENTS	TOTAL NUMBER OF RESPONDENTS
Education level		Normal 1	IMPAIRED GLUCOSE TOLERANCE (PREDIABETES)	RAISED BLOOD GLUCOSE		
No formal education	6	82	15	3	100	390
Less than secondary school	6	85	10	5	100	1103
Secondary school	6	86	10	4	100	2897
More than secondary school	6	85	11	4	100	3194
Wealth Quintile						
Lowest	6	87	9	4	100	1806
Second	6	85	11	4	100	1603
Middle	6	85	11	4	100	1424
Fourth	6	86	11	4	100	1392
Highest	6	82	12	6	100	1358

8.6 Blood glucose levels according to region

Measurement indicators	MEAN NONFASTING BLOOD GLUCOSE (MMOL/L)	RANDOM BLOOD GLUCOSE LEVEL 2			TOTAL NUMBER OF RESPONDENTS	TOTAL NUMBER OF RESPONDENTS
Region		Normal 1	IMPAIRED GLUCOSE TOLERANCE (PREDIABETES)	RAISED BLOOD GLUCOSE		
Riyadh	6	83	11	7	100	1981
Makkah al mukramah	6	82	14	4	100	2126
Al Madinah al monwarah	6	90	5	5	100	654
Al Qassim	6	85	9	6	100	283
Eastern province	6	89	9	2	100	884
Asier	6	94	5	1	100	565
Tabuk	7	63	29	8	100	200
Hail	6	89	9	2	100	121
Northern borders	6	87	13	0	100	5
Jazan	6	87	12	2	100	324
Najran	6	92	8	1	100	175
Al Baha	5	83	17	1	100	134
Al Jouf	5	98	1	1	100	132
Total	6	85	11	4	100	7583

1 Plausible values for random blood glucose were min=1.5 (mmol/L), max=30 (mmol/L). Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis

2 Random glucose levels are categorized as follows: Normal \leq Impaired glucose tolerance < 11.1 mmol/L; Raised glucose ≥ 11.1 mmol/L.

8.7 Cholesterol levels

According to age, sex, nationality, residence, marital status, education, wealth and region

8.7 Cholesterol levels according to age

Measurement indicators	HDL1		LDL1		Raised Serum Cholesterol 2	Number of respondents
Age	Mean (MMOL/L)	Number of respondents	Mean (MMOL/L)	Number of respondents		
15-29 years-old	3	1875	3	2898	39	2438
30-44 years-old	3	2223	3	3104	43	2611
45-59 years-old	3	721	3	1077	46	881
60-69 years-old	2	197	3	314	48	273
70-79 years-old	3	84	3	121	52	106
80 years-old and more	2	36	3	47	68	43

8.7 Cholesterol levels according to sex, nationality, residence and marital status

Measurement indicators	HDL1		LDL1		Raised Serum Cholesterol 2	Number of respondents
Sex	Mean (MMOL/L)	Number of respondents	Mean (MMOL/L)	Number of respondents		
Male	3	2739	3	3971	42	3319
Female	3	2397	3	3590	43	3034
Nationality						
Saudi	3	4520	3	6527	43	5530
Non-Saudi	3	616	3	1033	41	823
Residence						
Urban	3	4302	3	6562	42	5420
Rural	2	834	3	999	47	934
Marital Status						
Never married	3	1230	3	1911	37	1607
Currently Married	3	3537	3	5061	45	4286
Formerly Married	3	369	4	589	40	460

1 Plausible values were as follows: for LDL min=0.5 mmol/L, max=10 mmol/L; for HDL min=0.4 mmol/L; max=5 mmol/L; for TC min=1.75 mmol/L, max=20 mmol/L. Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis.

2 Raised serum cholesterol is defined as total cholesterol \geq 5 mmol/L

8.7 Cholesterol levels according to education- wealth

Measurement indicators	HDL1		LDL1		Raised Serum Cholesterol ²	Number of respondents
Education level	Mean (MMOL/L)	Number of respondents	Mean (MMOL/L)	Number of respondents		
No formal education	2	300	3	388	52	340
Less than secondary school	2	758	3	1091	43	926
Secondary school	3	2047	3	2902	44	2526
More than secondary school	3	2031	3	3179	40	2562
Wealth Quintile						
Lowest	2	1199	3	1793	44	1555
Second	3	1073	3	1588	44	1324
Middle	3	932	3	1425	44	1212
Fourth	2	974	3	1398	43	1163
Highest	3	958	4	1358	38	1100

1 Plausible values were as follows: for LDL min=0.5 mmol/L, max=10 mmol/L; for HDL min=0.4 mmol/L; max=5 mmol/L; for TC min=1.75 mmol/L, max=20 mmol/L. Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis.

2 Raised serum cholesterol is defined as total cholesterol ≥ 5 mmol/L.

8.7 Cholesterol levels according to region

Measurement indicators	HDL 1		LDL 1		Raised Serum Cholesterol 2	Number of respondents
Region	Mean (MMOL/L)	Number of respondents	Mean (MMOL/L)	Number of respondents		
Riyadh	3	1402	4	2000	36	1428
Makkah al mukramah	4	762	3	2109	43	1712
Al Madinah al monwarah	3	451	3	655	28	461
Al Qassim	2	281	3	279	32	276
Eastern province	2	769	3	868	48	859
Asier	2	561	3	566	60	564
Tabuk	3	132	3	197	39	174
Hail	2	102	3	121	52	121
Northern borders	2	4	5	5	64	5
Jazan	3	237	4	324	54	311
Najran	1	174	2	171	41	174
Al Baha	1	131	3	134	26	134
Al Jouf	2	131	2	133	51	132
Total	3	5136	3	7561	43	6353

1 Plausible values were as follows: for LDL min=0.5 mmol/L, max=10 mmol/L; for HDL min=0.4 mmol/L; max=5 mmol/L; for TC min=1.75 mmol/L, max=20 mmol/L. Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis.

2 Raised serum cholesterol is defined as total cholesterol \geq 5 mmol/L.

8.8 Hemoglobin (Hgb)

According to age, sex, nationality, residence, marital status, education, wealth and region

8.8 Hemoglobin (Hgb) according to age

Measurement indicators	Mean Hemoglobin (G/L) 1,2	Anemia Status by Hemoglobin Level 3				Number of respondents
Age		Any Anemia	Mild	Moderate	Severe	
15-29 years-old	120	50	18	25	7	2837
30-44 years-old	122	49	22	22	6	3056
45-59 years-old	122	50	21	23	6	1051
60-69 years-old	116	56	18	30	8	317
70-79 years-old	117	52	16	28	8	116
80 years old and more	118	70	20	39	11	50

8.8 Hemoglobin (Hgb) according to sex, nationality, residence, marital status, education, wealth and region

Measurement indicators	Mean Hemoglobin (G/L) 1,2	Anemia Status by Hemoglobin Level 3				Number of respondents
Sex		Any Anemia	Mild	Moderate	Severe	
Male	125	52	25	23	5	3898
Female	117	48	15	26	7	3529
Nationality						
Saudi	121	49	20	24	6	6413
Non-Saudi	120	56	23	26	7	1014
Residence						
Urban	121	50	20	24	6	6430
Rural	121	49	20	22	7	997
Marital Status						
Never married	120	52	19	26	6	1862
Currently Married	122	49	21	23	6	4992
Formerly Married	115	54	15	31	8	573

1 Hemoglobin adjusted for smoking, adjustment -0.3 g/l for all smokers.

2 Plausible values were as follows for females: min=40 g/L, max=180 g/L; for males: min=50 g/L, max=200 g/L. Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis.

3 Hemoglobin levels are categorized as follows for women: Mild 110-119 g/L; Moderate 80-109 g/L; Severe <80 g/L, for pregnant women: Mild 100-109 g/L; Moderate 70-99 g/L; Severe <70 g/L, for men: Mild 110-129 g/L; Moderate 80-109 g/L; Severe <80 g/L.

8.8 Hemoglobin (Hgb) according to education – wealth

Measurement indicators	Mean Hemoglobin (G/L) 1,2	Anemia Status by Hemoglobin Level 3				Number of respondents
Education level		Any Anemia	Mild	Moderate	Severe	
No formal education	115	57	21	28	7	389
Less than secondary school	122	49	21	23	5	1096
Secondary school	122	48	19	23	6	2847
More than secondary school	121	52	20	25	6	3094
Wealth Quintile						
Lowest	124	47	22	21	4	1790
Second	119	52	20	25	7	1558
Middle	121	49	21	23	6	1399
Fourth	120	49	18	25	6	1387
Highest	118	55	19	28	8	1293

1 Hemoglobin adjusted for smoking, adjustment -0.3 g/l for all smokers.

2 Plausible values were as follows for females: min=40 g/L, max=180 g/L; for males: min=50 g/L, max=200 g/L. Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis.

3 Hemoglobin levels are categorized as follows for women: Mild 110-119 g/L; Moderate 80-109 g/L; Severe <80 g/L, for pregnant women: Mild 100-109 g/L; Moderate 70-99 g/L; Severe <70 g/L, for men: Mild 110-129 g/L; Moderate 80-109 g/L; Severe <80 g/L.

8.8 Hemoglobin (Hgb) according to region

Measurement indicators	Mean Hemoglobin (G/L) 1,2	Anemia Status by Hemoglobin Level 3				Number of respondents
Region		Any Anemia	Mild	Moderate	Severe	
Riyadh	118	55	19	28	8	1893
Makkah al mukramah	119	56	21	30	5	2069
Al Madinah al monwarah	123	48	24	20	4	627
Al Qassim	135	26	14	11	1	284
Eastern province	128	36	23	13	0	887
Asier	118	55	26	20	10	566
Tabuk	115	50	19	12	18	208
Hail	142	18	16	1	0	121
Northern borders	137	13	0	13	0	5
Jazan	127	34	19	14	1	325
Najran	102	79	11	50	19	175
Al Baha	97	82	5	63	13	134
Al Jouf	128	27	13	12	2	133
Total	121	50	20	24	6	7427

1 Hemoglobin adjusted for smoking, adjustment -0.3 g/l for all smokers.

2 Plausible values were as follows for females: min=40 g/L, max=180 g/L; for males: min=50 g/L, max=200 g/L. Any values below the minimum plausible value or above the maximum plausible value were excluded from the analysis.

3 Hemoglobin levels are categorized as follows for women: Mild 110-119 g/L; Moderate 80-109 g/L; Severe <80 g/L, for pregnant women: Mild 100-109 g/L; Moderate 70-99 g/L; Severe <70 g/L, for men: Mild 110-129 g/L; Moderate 80-109 g/L; Severe <80 g/L.

2-1 Key Findings

- 16% of rural residents have raised blood pressure, compared with 13% of urban residents.
- By education levels, 35% of respondents with no formal education have Raised blood pressure.
- According to region, Tabuk has the lowest percentage of raised blood pressure (4%), while Al Jawf has the highest (26%).
- 39% of respondents have normal BMI; however, 3% are underweight, 38% are overweight, and 20% are obese.
- The mean BMI of the respondents is 26.4 kg/ m². In general, the percentage of respondents with obesity increases with age, from 10% in the age group 18-29, to 29% in the age group 70-79, before falling to 22% in respondents 80+ years.
- The percentage of overweight is higher in males (43%) than females (33%) while the percentage of obesity is higher in females (21%) than males (19%).
- The percentage of respondents with obesity is higher in urban areas than rural areas (21% vs. 18%).
- In general, the percentage of obese respondents decreases as education increases, ranging from 29% in respondents with no formal education, to 18% in respondents with more than secondary school education.
- Overweight is the highest in Al Jawf (52%) and Tabuk (50%), and obesity is the highest in Bahah (33%) and Najran (33%).
- Rural residents have a higher percentage of abnormal waist circumference compared to urban residents (35% vs. 29%).
- The percentage with abnormal waist circumference generally decreases with increasing education, ranging from 47% in respondents with no formal education, to 30% in respondents with more than secondary school education.
- The region with the highest percentage of abnormal waist circumference is Najran (77%), and the region with the lowest is the Northern Borders (5%).
- The percentage of respondents with raised blood glucose increases with increasing household wealth; 4% of respondents in

2-2 Key Findings

- The percentage of respondents with raised blood glucose varies from region to region (Figure 6.6), the highest being Tabuk (8%) and the lowest Najran (1%).
- Respondents living in rural areas have higher percentages of raised cholesterol than respondents living in urban areas (47% vs. 42%).
- The percentage of anemia is higher among non-Saudi respondents (56%) compared to Saudi respondents (49%).
- The percentage of anemia is highest in respondents with no formal education (57%) and respondents with more than secondary school education (52%).



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