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Factors associated with diabetes mellitus and hypertension among adults in the northern rural area, Afghanistan

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ABSTRACT

Afghanistan has an increasing trend of mortality due to non-communicable diseases but most studies were conducted in urban areas. This study aimed to assess the prevalence and factors associated with diabetes mellitus and hypertension in a rural area in Afghanistan. A cross-sectional study was conducted from September to October 2019 including 373 people who were 18–79 years old and lived in Andkhoy District, Afghanistan. Demographic and lifestyle data was collected by face-to-face interviews after informed consent was obtained. Height, body weight, blood pressure, waist circumference, and blood sugar level were measured by the data collection team. A logistic regression model was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs). The prevalence of diabetes mellitus and hypertension was 9.7% and 29.5%, respectively. Factors associated with diabetes mellitus were male gender (adjusted OR [AOR]=9.81, 95% CI: 2.48–38.90), family history of diabetes mellitus (AOR=3.84, 95% CI: 1.30–11.38), low physical activity (AOR=4.53, 95% CI: 1.13–18.26), and high waist circumference (AOR=7.93, 95% CI: 2.40–26.20). Snuff users were negatively associated with diabetes mellitus (AOR=0.18, 95% CI: 0.04–0.75). Factors associated with hypertension were the age group of 40–59 years (AOR=4.22, 95% CI: 1.99–8.95) and 60–79 years (AOR=19.83, 95% CI: 7.19–54.71) compared to 18–39 years, family history of hypertension (AOR=2.17, 95% CI: 1.15–4.10), and palaw intake of 3 times per week or more (AOR=1.86, 95% CI: 1.03–3.38). Lifestyle interventions for increasing physical activity should be introduced and health education about snuff usage and salt intake should be promoted in communities in Afghanistan.

Keywords: Afghanistan, diabetes mellitus, hypertension, non-communicable disease, rural area

Abbreviations:
AOR: adjusted odds ratio
BMI: body mass index
BP: blood pressure
CI: confidence interval
DM: diabetes mellitus
HT: hypertension

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NCD: non-communicable disease
OR: odds ratio
WC: waist circumference
WHO: World Health Organization

INTRODUCTION

Non-communicable diseases (NCDs), including cardiovascular diseases, cancers, diabetes mellitus (DM), and chronic respiratory diseases, are the leading cause of death globally. The number of avertable deaths due to NCDs has been increasing in most countries and deaths due to NCDs accounted for 73.4% of the total global deaths in 2017.[1,2] NCDs are one of the important health problems in each country but low- and middle-income countries have higher risks of deaths due to NCDs compared to high-income countries. According to the World Health Organization (WHO), NCDs contributed to 78% of all deaths and 85% of premature adult deaths in low- and middle-income countries in 2016.[3] It is estimated that NCDs will contribute to approximately 70% of all deaths in the world and 85% of all deaths in low- and middle-income countries by 2025.[3] Therefore, the following target was set as the Sustainable Development Goal Target 3.4, "Reducing by one third premature mortality from NCDs through prevention and treatment, and promote mental health and well-being by 2030."[4]

Common behavioral risk factors of NCDs are unhealthy diet, physical inactivity, smoking, and harmful use of alcohol, but these behaviors are modifiable by individuals.[5,6] Physical inactivity and unhealthy diets, which are called metabolic risk factors, are associated with raised blood pressure, increased blood glucose, elevated blood lipids, and obesity.[7] People who have the metabolic risk factors are significantly more likely to develop cardiovascular disease, which is the major NCD that causes premature deaths.[8] Controlling modifiable risk factors may be one of the most important ways for reducing premature deaths due to NCDs. Intervention for people who have a family history of NCDs is also important because a family history of hypertension (HT), diabetes, cardiovascular disease, and obesity is a predictive factor of each disease.[9,10]

Afghanistan, which is a low-income country located in Central Asia, is one of the countries that has both an increasing trend of mortality due to NCDs and a high premature mortality due to NCDs.[11] In 2011, the mortality due to NCDs in Afghanistan was the highest in the world and premature deaths (deaths before 60 years old) due to NCDs were the second highest in the world both among men (63%) and women (51%).[12] In 2018, the major cause of death in Afghanistan was cardiovascular disease, followed by cancer, chronic respiratory disease, and DM and deaths due to NCDs accounted for 44% of all deaths.[3] Most studies on NCDs in Afghanistan were conducted in urban areas or Kabul, the capital of the country. The prevalence of overweight/obesity, HT, and high blood sugar was 69.3%, 46.2%, and 13.3%, respectively among adults of 40 years old or older in Kabul in 2011–2012[13]; 57.6%, 32.3% and 9.1%, respectively, among adults of 25–70 years old in Kabul in 2015[14]; 58.2%, 25.7% and 29.7%, respectively among school teachers (18 years or older) in Kabul in 2023[15]; 57.2%, 24.2%, and 11.4%, respectively, in Jalalabad City in 2013[16]; and 52.6%, 19.5%, and 31.0%, respectively, among adults of 20–75 years in Kandahar Province.[17] Jalalabad City is an urban area and 91.1% of the participants of the study conducted in Kandahar Province lived in urban areas. Therefore, there has been no study on the prevalence and associated risk factors for DM and HT in rural areas of Afghanistan due to bad access.[18] The priority of NCDs is lower compared to infectious diseases and maternal and child health; however, it is necessary to understand the burden of NCDs in rural areas in

order to develop health policies in the whole country. The aim of this study is to estimate the prevalence and the factors associated with DM and HT in the rural population in Afghanistan.

MATERIALS AND METHODS

Study design

This is a cross-sectional study which was conducted in the Andkhoy District of Faryab Province, in the northern part of Afghanistan, from September 2019 to October 2019. In 2019, the total population of the district was 44,715, including 22,164 men and 22,551 women.[19] A multistage sampling method was used to select study samples from permanent residents in the district who were 18–79 years old. We used the list of clusters for the Expanded Program for Immunization that included the village names, the number of households, and the total population in each cluster. In the first stage of sampling, four clusters were selected from all seven clusters using a lottery method. In the second stage, four villages were randomly selected from all villages in each cluster. In the third stage, every third household was selected starting from the household on the right-side area of the village. Finally, one person who was 18–79 years old and lived in the district for six months or more was selected from each selected household. When a household had two or more eligible persons, a lottery method was used to select the designated participant.[20] Temporary residents (less than six months) of the selected household, pregnant women, and people who did not agree to participate were excluded from the study.

Sample size

The sample size was calculated using a single population proportion formula by assuming a 50% prevalence which produces the largest sample size, with a range of ±5% at a 95% confidence interval (CI) in a population of 44,715. The sample size was 381, which was considered reasonable for achieving the study objectives. Of the 381 adults who were selected as study samples, 373 adults were included in this study because eight people did not agree to participate in the study.

Data collection

The data collection team comprised of a medical doctor, a female nurse, and three trained volunteer staff. The data were collected based on the WHO STEPwise approach, which consisted of three steps; collecting socio-demographic and lifestyle data by face-to-face interviews using a questionnaire (Step 1); measurements of height, weight, waist circumference (WC), and blood pressure (BP) (Step 2); biochemical assessments for blood sugar level (Step 3).[20] The questionnaire for demographic and lifestyle data was developed by modifying the WHO STEPwise approach questionnaire to be adapted culturally to Afghanistan people and translated into the Dari language (the official language in Afghanistan). The team members had training for data collection by the principal researcher and a pretest was conducted including 20 participants in the Andkhoy District in August 2019.

Socio-demographic factors

Socio-demographic factors included sex, age, education, marital status, occupational type, and monthly household income. Age was categorized into 18–39 years old, 40–59 years old, and 60–79 years old. The educational level was categorized into no education, primary or secondary school, and high school or higher. Marital status was categorized into single, married, and other (divorced and widowed). Occupational type had five choices (unemployed, employed, student,

housewife, and farmer/daily worker) and was categorized into unemployed (including students and housewives), employed, and farmer/daily worker. Monthly household income was categorized into three groups, such as < 100 USD, 100 – < 200 USD, and 200 USD or higher.

Factors related to lifestyle and health

Factors related to lifestyle and health included family history of HT, family history of DM, history of smoking, history of snuff use, intake of fruits and vegetables, cooking oil, palaw intake, physical activity, current treatment for HT, and current treatment for DM. Smoking history meant an experience of smoking and included current smokers and previous smokers. Snuff is a type of smokeless tobacco product that is made from finely ground or pulverized tobacco leaves and the participants were asked if they had ever used snuff. The participants were asked how often they had fruits and vegetables in a typical week. Consumption of less than five servings and five servings or more of fruits and vegetables per week was defined as low and high intake of fruits and vegetables, respectively.[20] Regarding cooking oil, the participants were asked about the type of oil that they mostly used for meal preparation in their household and chose one from liquid vegetable oil, solid vegetable oil, and other oil. Palaw is one of the main dishes in Afghanistan and Central Asian countries and a variety of palaw is cooked with raisins, carrots, oil, and lamb. One portion of palaw contains 348 calories, 54 g of carbohydrates, 1.89 g of salt, and 12 g of fat.[21] Intake of palaw was categorized into < 3 times per week and ≥ 3 times per week. Categories of physical activity were defined based on the WHO's recommendations for physical activity for health: at least 150 minutes of moderate-intensity aerobic physical activity throughout a week, at least 75 minutes of vigorous-intensity aerobic physical activity throughout a week, or an equivalent combination of moderate- and vigorous-intensity activities.[22] The participants were asked if they had at least 30 minutes of vigorous-intensity physical activity 3 days per week or at least 30 minutes of moderate-intensity physical activity 5 days per week. Participants who answered yes were categorized into high physical activity and the others were low physical activity. All participants were asked if they had treatment for HT or DM at the time of interview.

Measurement of height, weight, WC, and BP

A non-flexible measuring tape was used to measure the height of the participants (with a precision of 0.1 cm), while they stood in an upright position on a flat surface with no shoes on. The weight of the participants was measured using a portable weight measuring scale while the participants were wearing light clothing and was recorded to the nearest 0.1 kg. Body mass index (BMI) was calculated as the weight in kilograms divided by the height in meters squared. A participant with BMI of ≥ 30 kg/m^2 was categorized into obese, 25.0–29.9 kg/m^2 into overweight, 18.5–24.9 kg/m^2 into normal weight, and < 18.5 kg/m^2 into underweight. WC was measured using a flexible plastic tape at the midpoint between the lower part of the lowest rib and highest point of the hip on the mid-axillary line. A WC of ≥ 94 cm in men and ≥ 80 cm in women was defined as a high WC.[23] BP was measured by the trained health staff using a calibrated sphygmomanometer. The average of three readings measured 5 minutes apart was considered as the final BP for the analysis. Participants whose systolic BP was ≥ 140 mmHg or diastolic BP was ≥ 90 mmHg or who reported use of antihypertensive medications were categorized into having HT in this study.[24]

Measuring the blood sugar level

Blood samples were taken from the study participants and the fasting blood sugar level or the random blood sugar levels were measured using Accu-Chek Active glucometer (Roche Diagnostic Corporation, Indianapolis, IN, USA). All participants were asked when they ate or

drank last and fasting was defined as having no food or drink with calories for at least 8 hours. Participants with fasting blood sugar ≥ 126 mg/dL or random blood sugar ≥ 200 mg/dL or those who reported use of antidiabetic medications were defined as having DM in this study.[25] Of the 373 participants, 17 participants had their fasting blood sugar levels measured and 356 had their random blood sugar levels measured.

Data analysis

Statistical analysis was performed using the Statistical Package for Social Science version 24.0 (SPSS Inc, Chicago, IL, USA) and descriptive statistics were determined for all the variables. Chi-square test was performed to compare the characteristics of males and females but Fisher's exact test was used when 20% of expected cell counts were less than 5. A logistic regression model was used to estimate odds ratio (OR) and 95% CI. Statistical significance was set at $P < 0.05$.

Ethics approval

The Institutional Review Board of the Ministry of Public Health of Afghanistan approved this study on August 21, 2019 (approval number: A.0819.0062). Written informed consent was obtained from participants who were literate. When participants were illiterate, their fingerprints were affixed on the consent form to confirm their agreement after interviewers read the form.

RESULTS

The data of 373 participants who lived in the Andkhoy District of Afghanistan were analyzed in this study, including 228 women (61.1%) and 145 men (38.9%). The mean age of the 373 participants was 43.2 years old (standard deviation, 15.2) and the major age group was 18–39 years old (n=161, 43.2%) followed by 40–59 years old (n=147, 39.4%) (Table 1). The proportion of those having no education was 68.1% and it was higher among women (79.8%) than men (49.7%). Most participants (n=305, 81.8%) were married, were unemployed (n=234, 62.7%), and had a monthly household income of less than 100 USD (n=240, 64.3%). There were more female participants who were 40–59 years old (43.0% vs 33.8%), had no education (79.8% vs 49.7%), were unemployed (89.9% vs 20.0%), and had monthly household income < 100 USD (68.0% vs 58.6%) than male. There were fewer female participants who were 60–79 years old (13.6%) than male (23.4%).

A family history of DM and HT was found among 14.5% (n=54) and 34.9% (n=130) of the participants, respectively (Table 2). Most participants had never smoked (n=327, 87.7%) or used snuff (n=317, 85.0%). In terms of food intake, 328 participants (87.9%) had a low intake of fruits and vegetables and 96 participants (25.7%) had palaw three times per week or more, respectively. Most participants (n=282, 75.6%) answered that they used liquid oil for cooking and no participants used solid oil. Of all participants, 246 participants (66.0%) were categorized as low physical activity. According to BMI, 24 participants (6.4%) and 105 participants (28.2%) were categorized into obesity and overweight, respectively, while 16 participants (4.3%) were categorized into underweight. There were 153 participants (41.0%) whose WC was high. The prevalence of DM was 9.7% (n=36) in total, 7.9% (n=18) in women, and 12.4% (n=18) in men. Of the 36 participants categorized into DM, 11 participants had treatment or dietary intervention for DM and 25 participants were diagnosed with DM by fasting blood sugar or random blood sugar during the data collection. The prevalence of HT was 29.5% (n=110) in total, 32.5% (n=74) in women, and 24.8% (n=36) in men. Of the 110 participants, 84 participants had treatment

Table 1 Socio-demographic factors of study participants

Variables	Total (N=373)	Female (N=228)	Male (N=145)	*P*
	N (%)	N (%)	N (%)	
Age (years old)				
18–39	161 (43.2)	99 (43.4)	62 (42.8)	0.033[a]
40–59	147 (39.4)	98 (43.0)	49 (33.8)	
60–79	65 (17.4)	31 (13.6)	34 (23.4)	
Education				
No education	254 (68.1)	182 (79.8)	72 (49.7)	<0.001[a]
Primary/secondary	42 (11.3)	18 (7.9)	24 (16.6)	
High school or higher	77 (20.6)	28 (12.3)	49 (33.8)	
Marital status				
Single	44 (11.8)	25 (11.0)	19 (13.1)	0.523[a]
Married	305 (81.8)	186 (81.6)	119 (82.1)	
Divorced/widowed	24 (6.4)	17 (7.5)	7 (4.8)	
Occupation				
Unemployed	234 (62.7)	205 (89.9)	29 (20.0)	<0.001[a]
Employed	67 (18.0)	15 (6.6)	52 (35.9)	
Farmer/daily worker	72 (19.3)	8 (3.5)	64 (44.1)	
Monthly household income (USD)				
< 100	240 (64.3)	155 (68.0)	85 (58.6)	0.021[b]
100 – < 200	124 (33.2)	71 (31.1)	53 (36.6)	
200 ≤	9 (2.4)	2 (0.9)	7 (4.8)	

[a]Chi-square test was performed.
[b]Fisher's exact test was performed.

for HT and 26 participants were diagnosed with HT by measuring BP (Table 2). There were more female participants who had never smoked (95.6% vs 75.2%), had high intake of fruits and vegetables (14.9% vs 7.6%), had palaw three times per week or more (31.6% vs 16.6%), and had high WC (50.9% vs 25.5%).

The characteristics of 36 participants who had DM were compared with the others (n=337). Binary logistic regression analysis showed that participants who were 60–79 years old (OR=6.04, 95% CI: 2.31–15.79) had more DM compared to those who were 18–39 years old (Table 3). Participants who had family history of DM (OR=4.08, 95% CI: 1.92–8.68), family history of HT (OR=2.28, 95% CI: 1.14–4.55), palaw intake of three or more times per week (OR=2.57, 95% CI: 1.27–5.19), low physical activity (OR=6.40, 95% CI: 1.92–21.31), obesity (OR=7.12, 95% CI: 2.65–19.15) compared to normal BMI/underweight, and high WC (OR=5.02, 95% CI: 2.29–11.03) compared to normal WC were associated with DM. Multivariate analysis showed that male compared to female (adjusted OR (AOR)=9.81, 95% CI: 2.48–38.90), family history of DM (AOR=3.84, 95% CI: 1.30–11.38), no history of used snuff (AOR=0.18, 95% CI: 0.04–0.75), low physical activity (AOR=4.53, 95% CI: 1.13–18.26), and high WC (AOR=7.93, 95% CI: 2.40–26.20) were associated with DM.

Table 2 Factors related to lifestyle and health of study participants

Variables	Total (N=373)	Female (N=228)	Male (N=145)	*P*
	N (%)	N (%)	N (%)	
Family history of DM				
No	319 (85.5)	193 (84.6)	126 (86.9)	0.329
Yes	54 (14.5)	35 (15.4)	19 (13.1)	
Family history of HT				
No	243 (65.1)	79 (34.6)	94 (64.8)	0.502
Yes	130 (34.9)	149 (65.4)	51 (35.2)	
History of smoking				
No	327 (87.7)	218 (95.6)	109 (75.2)	<0.001
Yes	46 (12.3)	10 (4.4)	36 (24.8)	
History of snuff use				
No	317 (85.0)	199 (87.3)	118 (81.4)	0.081
Yes	56 (15.0)	29 (12.7)	27 (18.6)	
Intake of fruits and vegetables				
High	45 (12.1)	34 (14.9)	11 (7.6)	0.023
Low	328 (87.9)	194 (85.1)	134 (92.4)	
Cooking oil				
Liquid oil	282 (75.6)	166 (72.8)	116 (80.0)	0.072
Other oil	91 (24.4)	62 (27.2)	29 (20.0)	
Palaw intake (per week)				
< 3 times	227 (74.3)	156 (68.4)	121 (83.4)	0.001
3 times ≤	96 (25.7)	72 (31.6)	24 (16.6)	
Physical activity				
High	127 (34.0)	70 (30.7)	57 (39.3)	0.055
Low	246 (66.0)	158 (69.3)	88 (60.7)	
BMI				
Underweight	16 (4.3)	9 (3.9)	7 (4.8)	0.206
Normal	228 (61.1)	144 (63.2)	84 (57.9)	
Overweight	105 (28.2)	57 (25.0)	48 (33.1)	
Obese	24 (6.4)	18 (7.9)	6 (4.1)	
High waist circumference				
No	220 (59.0)	112 (49.1)	108 (74.5)	<0.001
Yes	153 (41.0)	116 (50.9)	37 (25.5)	
DM				
No	337 (90.3)	210 (92.1)	127 (87.6)	0.105
Yes	36 (9.7)	18 (7.9)	18 (12.4)	
HT				
No	263 (70.5)	154 (67.5)	109 (75.2)	0.072
Yes	110 (29.5)	74 (32.5)	36 (24.8)	

DM: diabetes mellitus
HT: hypertension
BMI: body mass index
Chi-square test was performed to compare characteristics between females and males.

Table 3 Factors associated with diabetes mellitus among 373 adults in Andkhoy District

Variables	DM N (%)	OR (95% CI)	*P*	AOR (95% CI)	*P*
Sex					
Female	18 (7.9)	1 (Reference)		1 (Reference)	
Male	18 (12.4)	1.65 (0.83–3.29)	0.153	9.81 (2.48–38.90)	0.001
Age (years old)					
18–39	7 (4.3)	1 (Reference)		1 (Reference)	
40–59	15 (10.2)	2.50 (0.99–6.32)	0.053	1.19 (0.36–4.00)	0.775
60–79	14 (21.5)	6.04 (2.31–15.79)	<0.001	3.42 (0.86–13.67)	0.082
Education					
No Education	26 (10.2)	1 (Reference)		1 (Reference)	
Primary/secondary	3 (7.1)	0.67 (0.19–2.34)	0.535	0.55 (0.10 –3.05)	0.494
High school or higher	7 (9.1)	0.88 (0.37–2.11)	0.769	0.34 (0.06–1.88)	0.218
Marital statues					
Single	1 (2.3)	1 (Reference)		1 (Reference)	
Married	33 (10.8)	5.22 (0.70–39.14)	0.108	4.28 (0.39–46.68)	0.233
Divorced/widowed	2 (8.3)	3.91 (0.34–45.52)	0.276	1.91 (0.10–37.86)	0.672
Occupation					
Unemployed	22 (9.4)	1 (Reference)		1 (Reference)	
Employed	10 (14.9)	1.69 (0.76–3.77)	0.200	1.29 (0.25–6.72)	0.766
Farmer/daily worker	4 (5.6)	0.57 (0.19–1.70)	0.312	0.34 (0.07–1.60)	0.173
Monthly household income (USD)					
< 100	22 (9.2)	1 (Reference)		1 (Reference)	
100 – < 200	13 (10.5)	1.16 (0.56–2.39)	0.686	0.96 (0.34–2.69)	0.942
200 ≤	1 (11.1)	1.24 (0.15–10.37)	0.843	0.35 (0.02–7.02)	0.494
Family history of DM					
No	23 (7.2)	1 (Reference)		1 (Reference)	
Yes	13 (24.1)	4.08 (1.92–8.68)	<0.001	3.84 (1.30–11.38)	0.015
Family history of HT					
No	17 (7.0)	1 (Reference)		1 (Reference)	
Yes	19 (14.6)	2.28 (1.14–4.55)	0.020	1.55 (0.59–4.07)	0.369
History of smoking					
No	31 (9.5)	1 (Reference)		1 (Reference)	
Yes	5 (10.9)	1.16 (0.43–3.16)	0.765	1.48 (0.39–5.57)	0.562
History of snuff use					
No	32 (10.1)	1 (Reference)		1 (Reference)	
Yes	4 (7.1)	0.69 (0.23–2.02)	0.493	0.18 (0.04–0.75)	0.018
Intake of fruits and vegetables					
High	4 (8.9)	1 (Reference)		1 (Reference)	
Low	32 (9.8)	1.11 (0.37–3.29)	0.853	0.73 (0.19–2.87)	0.652
Cooking oil					
Liquid oil	31 (11.0)	1 (Reference)		1 (Reference)	
Other oil	5 (5.5)	0.47 (0.18–1.25)	0.130	0.72 (0.22–2.32)	0.583
Palaw intake (per week)					
< 3 times	20 (7.2)	1 (Reference)		1 (Reference)	
3 times ≤	16 (16.7)	2.57 (1.27–5.19)	0.009	2.38 (0.99–5.73)	0.053

Physical activity					
High	3 (2.4)	1 (Reference)		1 (Reference)	
Low	33 (13.4)	6.40 (1.92–21.31)	0.002	4.53 (1.13–18.26)	0.034
BMI					
Normal/underweight	16 (7.0)	1 (Reference)		1 (Reference)	
Overweight	12 (11.4)	1.84 (0.84–4.04)	0.129	0.34 (0.11–1.05)	0.061
Obese	8 (33.3)	7.12 (2.65–19.15)	<0.001	2.51 (0.58–10.91)	0.218
High waist circumference					
No	9 (4.1)	1 (Reference)		1 (Reference)	
Yes	27 (17.6)	5.02 (2.29–11.03)	<0.001	7.93 (2.40–26.20)	0.001

DM: diabetes mellitus
HT: hypertension
BMI: body mass index
OR: odds ratio
CI: confidence interval
AOR: adjusted odds ratio

The characteristics of 110 participants who had HT were compared with the others (n=263). Binary logistic regression analysis showed the age group of 40–59 years old (OR=5.11, 95% CI: 2.76–9.46) and 60–79 years old (OR=15.48, 95% CI: 7.53–31.85) compared to the age group of 18–39 years old, being married (OR=4.52, 95% CI: 1.57–13.01) and divorced/widowed (OR=8.46, 95% CI: 2.30–31.18) compared to single, family history of DM (OR=2.60, 95% CI: 1.44–4.68) and HT (OR=2.01, 95% CI: 1.27–3.18), palaw intake of three or more times per week (OR=2.71, 95% CI: 1.66–4.40) compared to less than three times per week, low physical activity (OR=2.31, 95% CI: 1.38–3.86), overweight (OR=2.48, 95% CI: 1.52–4.05) and obesity (OR=2.91, 95% CI: 1.23–6.85) compared to normal BMI/underweight, and high WC (OR=2.87, 95%CI: 1.82–4.54) compared to normal WC were associated with HT (Table 4). Having an education and having an occupation were negatively associated with HT. In multivariable logistic regression analysis, the age group of 40–59 years old (AOR=4.22, 95% CI: 1.99–8.95) and 60–79 years old (AOR=19.83, 95% CI: 7.19–54.71) compared to the age group of 18–39 years old, family history of HT (AOR=2.17, 95% CI: 1.15–4.10), and consuming palaw 3 times per week or more (AOR=1.86, 95% CI: 1.03–3.38) compared to palaw 3 times < per week were associated with HT.

Table 4 Factors associated with hypertension among 373 adults in Andkhoy District

Variables	DM N (%)	OR (95% CI)	*P*	AOR (95% CI)	*P*
Sex					
Female	74 (32.5)	1 (Reference)		1 (Reference)	
Male	36 (24.8)	0.69 (0.43–1.10)	0.116	0.74 (0.31–1.79)	0.507
Age (years old)					
18–39	16 (9.9)	1 (Reference)		1 (Reference)	
40–59	53 (36.1)	5.11 (2.76–9.46)	<0.001	4.22 (1.99–8.95)	<0.001
60–79	41 (63.1)	15.48 (7.53–31.85)	<0.001	19.83 (7.19–54.71)	<0.001
Education					
No education	88 (34.6)	1 (Reference)		1 (Reference)	
Primary/secondary	9 (21.4)	0.51 (0.24–1.12)	0.095	1.40 (0.52–3.79)	0.509
High school or higher	13 (16.9)	0.38 (0.20–0.73)	0.004	0.77 (0.26–2.30)	0.643

Marital status					
Single	4 (9.1)	1 (Reference)		1 (Reference)	
Married	95 (31.1)	4.52 (1.57–13.01)	0.005	1.37 (0.39–4.87)	0.623
Divorced/widowed	11 (45.8)	8.46 (2.30–31.18)	0.001	0.82 (0.16–4.24)	0.812
Occupation					
Unemployed	82 (35.0)	1 (Reference)		1 (Reference)	
Employed	15 (22.4)	0.53 (0.28–1.01)	0.053	0.86 (0.27–2.72)	0.802
Farmer/daily worker	13 (18.1)	0.41 (0.21–0.79)	0.008	0.62 (0.23–1.66)	0.343
Monthly household income (USD)					
< 100	72 (30.0)	1 (Reference)		1 (Reference)	
100 – < 200	34 (27.4)	0.88 (0.54–1.43)	0.608	1.06 (0.55–2.04)	0.860
200 ≤	4 (44.4)	1.87 (0.49–7.15)	0.363	0.74 (0.13–4.10)	0.726
Family history of DM					
No	84 (26.3)	1 (Reference)		1 (Reference)	
Yes	26 (48.1)	2.60 (1.44–4.68)	0.001	1.80 (0.79–4.10)	0.163
Family history of HT					
No	59 (24.3)	1 (Reference)		1 (Reference)	
Yes	51 (39.2)	2.01 (1.27–3.18)	0.003	2.17 (1.15–4.10)	0.017
History of smoking					
No	102 (31.2)	1 (Reference)		1 (Reference)	
Yes	8 (17.4)	0.46 (0.21–1.03)	0.059	1.00 (0.37–2.67)	0.996
History of snuff use					
No	88 (27.8)	1 (Reference)		1 (Reference)	
Yes	22 (39.3)	1.68 (0.93–3.04)	0.083	0.81 (0.39–1.70)	0.580
Intake of fruits and vegetables					
High	11 (24.4)	1 (Reference)		1 (Reference)	
Low	99 (30.2)	1.34 (0.65–2.74)	0.430	1.20 (0.49–2.90)	0.692
Cooking oil					
Liquid oil	89 (31.6)	1 (Reference)		1 (Reference)	
Other oil	21 (23.1)	0.65 (0.38–1.13)	0.124	0.90 (0.47–1.75)	0.759
Palaw intake (per week)					
< 3 times	66 (23.8)	1 (Reference)		1 (Reference)	
3 times ≤	44 (45.8)	2.71 (1.66–4.40)	<0.001	1.86 (1.03–3.38)	0.040
Physical activity					
High	24 (18.9)	1 (Reference)		1 (Reference)	
Low	86 (35.0)	2.31 (1.38–3.86)	0.001	1.04 (0.55–1.96)	0.910
BMI					
Normal/underweight	55 (24.1)	1 (Reference)		1 (Reference)	
Overweight	44 (41.9)	2.48 (1.52–4.05)	<0.001	1.78 (0.86–3.68)	0.119
Obese	11 (45.8)	2.91 (1.23–6.85)	0.015	1.53 (0.48–4.85)	0.472
High waist circumference					
No	45 (20.5)	1 (Reference)		1 (Reference)	
Yes	65 (42.5)	2.87 (1.82–4.54)	<0.001	1.46 (0.73–2.91)	0.279

HT: hypertension
DM: diabetes mellitus
BMI: body mass index
OR: odds ratio
CI: confidence interval
AOR: adjusted odds ratio

DISCUSSION

In this study, the prevalence of DM among adults of 18–79 years old in the Andkhoy District was 9.7%, which was lower than that in previous studies in urban areas of Afghanistan.[13-16] It may be because the percentage of general obesity (high BMI), and central obesity (high WC) was lower in this study compared to the previous studies. A meta-analysis of six studies on DM in urban areas of Afghanistan reported that the overall prevalence of DM was 12.1% and that associated factors were older age, HT, and obesity.[26] These results may suggest that people in rural areas have a healthier lifestyle compared to those in urban areas. Urbanization changes people's lifestyle and environment and these changes contribute to development of NCDs, especially DM, among urban residents.[27,28]

This study showed that the prevalence of HT among adults of 18–79 years old in the Andkhoy District was 29.5%, which was similar to that of some previous studies in urban areas in Afghanistan; 24.4% among adults of 25–65 years old in Jalalabad City,[16] 25.7% among adults of 18 years or older in Kabul,[15] and 32.3% among adults of 25–70 years old in Kabul.[14] In 2014, Saeed et al reported that the prevalence of HT was 46.3% among adults of 40 years or older in Kabul.[13] However, the age distribution of study participants was not the same in all the studies. Therefore, it is difficult to compare the prevalence of HT among all the studies because it can be higher when study participants included more older people. In this study, the prevalence was 9.9%, 36.1%, and 63.1% in the age group of 18–39 years old, 40–59 years old, and 60–79 years old, respectively. When the prevalence of HT among adults who are 40 or older is calculated, it was 44.3% in this study and 46.3% and 48.6% in the previous studies in Kabul.[13,14] These results suggest that almost half of adults who are 40 years or older may have HT in Afghanistan but further study should be conducted nationwide.

In this study, the factors associated with DM were being male, having a family history of DM, having never used snuff, low physical activity, and high WC. A family history of DM, physical inactivity, and central obesity were reported as risk factors for DM in previous studies.[29,30] The association between DM and being male was not found in previous studies conducted in Afghanistan.[26,31] It may be because the proportion of the age group of 60–79 years old was higher among males than females in this study. Smoking and snuff using are reported as risk factors of DM because they cause systematic inflammation and nicotine-induced insulin resistance.[32] On the other hand, a systematic review reported the association between snuff usage and malnutrition.[33] Snuff users have problems in the oral cavity, such as mouth sores, taste disorders, and toothache; therefore, they are more likely to have malnutrition and metabolic disorders due to low appetite caused by oral cavity symptoms.[34] In this study, the percentage of underweight and obese was higher among snuff users (7.1% and 16.1%) than non-users (3.8% and 4.7%). To reduce the incidence of DM in Afghanistan, lifestyle intervention for increasing physical activity and for quitting snuff usage should be introduced and health education should be promoted.[30,35]

In this study, 40 years old or older, family history of HT, and intake of palaw 3 times per week or more were associated with HT. Older age, especially 65 years or older, and family history of HT were reported to be risk factors for HT in previous studies conducted in Afghanistan[13] and other countries.[36,37] A high intake of salt, saturated fats, rice, and red meat can increase the risk of developing HT.[13,31,38-40] Palaw is Afghanistan's national food which is made from meat (often lamb), onions fried with oil, rice, salt, sugar, and others. According to STEPS in Afghanistan in 2018, the average sodium intake was 12.5g/day among males and 11.8 g/day among females.[41] In Afghanistan, 98% of salt intake is due to salt use while cooking or at the table, while processed foods are the major source of salt intake in developed countries. Reduction of salt intake at home should be promoted by health education in communities in Afghanistan

although the food-based dietary guidelines was developed in 2015, which recommended a daily salt intake of < 5 g/day.[42]

There are some limitations to this study. First, this study was conducted in a selected rural area, therefore, the findings in this study may not be generalizable to other rural areas in Afghanistan. Second, the prevalence of HT and diabetes in this study may be underestimated. In this study, the WHO's guidelines of HT were applied for the definition of HT, which was different from that of the American Heart Association (systolic BP > 130 mmHg or diastolic BP > 80 mmHg).[43] This is because Afghanistan is a low-income country and people's health condition and the level of healthcare service in Afghanistan are totally different from those in high-income countries. In this study, hemoglobin A1c levels could not be measured due to limited capacity of local laboratories and there were only 17 participants whose fasting blood sugar level was measured. Third, NCD-related biomarkers, such as dyslipidemia, could not be included in this study because cholesterol and triglyceride levels could not be measured due to a limited research budget.

In conclusion, the prevalence of DM and HT among adults in the Andkhoy District, Afghanistan was 9.7% and 29.5%, respectively. Factors associated with DM were male gender, family history of DM, low physical activity, and high WC. Factors associated with HT were age over 40 years old, family history of HT, and palaw intake of 3 times per week or more. These findings are timely and important to support the formulation and implementation of NCD-related policies and plans of action for rural population in Afghanistan. Lifestyle interventions for increasing physical activity should be introduced and health education about snuff usage and salt intake should be promoted in communities in Afghanistan.

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CONFLICT OF INTEREST

No conflicts of interest are declared.

REFERENCES

1 NCD Countdown 2030 collaborators. NCD Countdown 2030: pathways to achieving Sustainable Development Goal target 3.4. *Lancet*. 2020;396(10255):918–934. doi:10.1016/S0140-6736(20)31761-X.

2 GBD 2017 Causes of Death Collaborators. Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*. 2018;392(10159):1736–1788. doi:10.1016/S0140-6736(18)32203-7.

3 World Health Organization (WHO), ed. *Noncommunicable diseases country profiles 2018*. Geneva: WHO; 2018.

4 World Health Organization (WHO). Targets of Sustainable Development Goal 3. https://www.who.int/europe/about-us/our-work/sustainable-development-goals/targets-of-sustainable-development-goal-3. Accessed April 1, 2023.

5 Watson BM, Chiang C, Ikerdeu E, et al. Profile of non-communicable disease risk factors among adults in the Republic of Palau: findings of a national STEPS survey. *Nagoya J Med Sci*. 2015;77(4):609–619. doi:10.18999/nagjms.77.4.609.

6 Khan FA, Khalequzzaman M, Hasan M, et al. Dietary salt intake and its correlates among adults in a slum

area in Dhaka, Bangladesh: a cross-sectional study. *Nagoya J Med Sci*. 2021;83(3):589–599. doi:10.18999/nagjms.83.3.589.
7 Ramezankhani A, Azizi F, Hadaegh F, Eskandari F. Sex-specific clustering of metabolic risk factors and their association with incident cardiovascular diseases: A population-based prospective study. *Atherosclerosis*. 2017;263:249–256. doi:10.1016/j.atherosclerosis.2017.06.921.
8 Osako A, Chiang C, Ito K, et al. Disparity in metabolic risk factors of non-communicable diseases between Palauans and Filipinos living in Palau. *Nagoya J Med Sci*. 2017;79(2):157–165. doi:10.18999/nagjms.79.2.157.
9 Shah H, Garacci E, Behuria S, et al. Cardiovascular risk-enhancing factors and coronary artery calcium in South Asian American adults: The MASALA study. *Am J Prev Cardiol*. 2023;13:100453. doi:10.1016/j.ajpc.2022.100453.
10 Yanez ND, Burke GL, Manolio T, Gardin JM, Polak J; CHS Collaborative Research Group. Sibling history of myocardial infarction or stroke and risk of cardiovascular disease in the elderly: the Cardiovascular Health Study. *Ann Epidemiol*. 2009;19(12):858–866. doi:10.1016/j.annepidem.2009.07.095.
11 Martinez R, Lloyd-Sherlock P, Soliz P, et al. Trends in premature avertable mortality from non-communicable diseases for 195 countries and territories, 1990–2017: a population-based study. *Lancet Glob Health*. 2020;8(4):e511–e523. doi:10.1016/S2214-109X(20)30035-8.
12 Zarocostas J. Deaths from non-communicable diseases are highest in Afghanistan, lowest in Sweden. *BMJ*. 2011;343:d5876. doi:10.1136/bmj.d5876.
13 Saeed KM, Rasooly MH, Brown NJ. Prevalence and predictors of adult hypertension in Kabul, Afghanistan. *BMC Public Health*. 2014;14:386. doi:10.1186/1471-2458-14-386.
14 Saeed KM. Burden of Hypertension in the Capital of Afghanistan: A Cross-Sectional Study in Kabul City, 2015. *Int J Hypertens*. 2017;2017:3483872. doi:10.1155/2017/3483872.
15 Alemi S, Nakamura K, Arab AS, et al. Prevalence, determinants, and association of overweight/obesity with non-communicable disease-related biomedical indicators: A cross-sectional study in schoolteachers in Kabul, Afghanistan. *PLOS Glob Public Health*. 2023;3(3):e0001676. doi:10.1371/journal.pgph.0001676.
16 Saeed KM, Rasooly MH, Alkozai A. Prevalence of risk factors for noncommunicable diseases in Jalalabad city, Afghanistan, evaluated using the WHO STEPwise approach. *East Mediterr Health J*. 2016;21(11):783–790. doi:10.26719/2015.21.11.783.
17 Sahrai MS, Huybrechts I, Biessy C, et al. Determinants of Obesity and Metabolic Health in the Afghan Population: Protocol, Methodology, and Preliminary Results. *J Epidemiol Glob Health*. 2022;12(1):113–123. doi:10.1007/s44197-021-00026-0.
18 Frozanfar MK, Hamajima N, Fayaz SH, et al. Factors associated with pentavalent vaccine coverage among 12–23-month-old children in Afghanistan: A cross-sectional study. *PLoS One*. 2023;18(8):e0289744. doi:10.1371/journal.pone.0289744.
19 National Statistics and Information Authority of Afghanistan. *Estimated population of Afghanistan 2018–2019*. National Statistics and Information Authority of Afghanistan; 2019.
20 World Health Organization (WHO). *WHO STEPS Surveillance Manual*. Geneva: WHO; 2020.
21 Nutritionix. Afghan rice and lamb pilaf. https://www.nutritionix.com/food/afghan-rice-and-lamb-pilaf. Accessed December 10, 2023.
22 World Health Organization (WHO), ed. *Global recommendations on physical activity for health*. Geneva: WHO; 2010.
23 World Health Organization (WHO). *Obesity : preventing and managing the global epidemic : report of a WHO consultation*. Geneva: WHO; 2000.
24 World Health Organization (WHO). *Guideline for the pharmacological treatment of hypertension in adults*. Geneva: WHO; 2021.
25 American Diabetes Association Professional Practice Committee. 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2022. *Diabetes Care*. 2022;45(Suppl 1):S17–S38. doi:10.2337/dc22-S002.
26 Akhtar S, Nasir JA, Javed A, et al. The prevalence of diabetes in Afghanistan: a systematic review and meta-analysis. *BMC Public Health*. 2021;21(1):941. doi:10.1186/s12889-021-10993-5.
27 Price AJ, Crampin AC, Amberbir A, et al. Prevalence of obesity, hypertension, and diabetes, and cascade of care in sub-Saharan Africa: a cross-sectional, population-based study in rural and urban Malawi. *Lancet Diabetes Endocrinol*. 2018;6(3):208–222. doi:10.1016/S2213-8587(17)30432-1.
28 Allender S, Lacey B, Webster P, et al. Level of urbanization and noncommunicable disease risk factors in Tamil Nadu, India. *Bull World Health Organ*. 2010;88(4):297–304. doi:10.2471/BLT.09.065847.
29 Aung WP, Htet AS, Bjertness E, Stigum H, Chongsuvivatwong V, Kjøllesdal MKR. Urban-rural differences

in the prevalence of diabetes mellitus among 25–74 year-old adults of the Yangon Region, Myanmar: two cross-sectional studies. *BMJ Open*. 2018;8(3):e020406. doi:10.1136/bmjopen-2017-020406.

30 The Diabetes Prevention Program Research Group. The Diabetes Prevention Program: baseline characteristics of the randomized cohort. The Diabetes Prevention Program Research Group. *Diabetes Care*. 2000;23(11):1619–1629. doi:10.2337/diacare.23.11.1619.

31 Saeed KMI. Prevalence of Risk Factors for Non-Communicable Diseases in the Adult Population of Urban Areas in Kabul City, Afghanistan. *Cent Asian J Glob Health*. 2014;2(2):69. doi:10.5195/cajgh.2013.69.

32 Carlsson S, Andersson T, Araghi M, et al. Smokeless tobacco (snus) is associated with an increased risk of type 2 diabetes: results from five pooled cohorts. *J Intern Med*. 2017;281(4):398–406. doi:10.1111/joim.12592.

33 Saxena S, Singh PK, Singh L, Kashyap S, Singh S. Smokeless tobacco use and public health nutrition: a global systematic review. *Public Health Nutr*. 2023;26(1):46–55. doi:10.1017/S1368980022001331.

34 Sagiroglu S, Erdogan A, Doganer A, Okyay RA. Otorhinolaryngological symptoms among smokeless tobacco (Maras powder) users. *North Clin Istanb*. 2018;6(3):284–292. doi:10.14744/nci.2018.50024.

35 Knowler WC, Barrett-Connor E, Fowler SE, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002;346(6):393–403. doi:10.1056/NEJMoa012512.

36 Eghbali M, Khosravi A, Feizi A, Mansouri A, Mahaki B, Sarrafzadegan N. Prevalence, awareness, treatment, control, and risk factors of hypertension among adults: a cross-sectional study in Iran. *Epidemiol Health*. 2018;40:e2018020. doi:10.4178/epih.e2018020.

37 Rahman M, Zaman MM, Islam JY, et al. Prevalence, treatment patterns, and risk factors of hypertension and pre-hypertension among Bangladeshi adults. *J Hum Hypertens*. 2018;32(5):334–348. doi:10.1038/s41371-017-0018-x.

38 Wang L, Manson JE, Forman JP, Gaziano JM, Buring JE, Sesso HD. Dietary fatty acids and the risk of hypertension in middle-aged and older women. *Hypertension*. 2010;56(4):598–604. doi:10.1161/HYPERTENSIONAHA.110.154187.

39 Ha SK. Dietary salt intake and hypertension. *Electrolyte Blood Press*. 2014;12(1):7–18. doi:10.5049/EBP.2014.12.1.7.

40 Diarz EJ, Leyaro BJ, Kivuyo SL, et al. Red meat consumption and its association with hypertension and hyperlipidaemia among adult Maasai pastoralists of Ngorongoro Conservation Area, Tanzania. *PLoS One*. 2020;15(6):e0233777. doi:10.1371/journal.pone.0233777.

41 World Health Organization (WHO). Afghanistan STEPS Survey 2018. https://extranet.who.int/ncdsmicrodata/index.php/catalog/782/related-materials. Accessed October 16, 2023.

42 Montagnese C, Santarpia L, Iavarone F, et al. Food-Based Dietary Guidelines around the World: Eastern Mediterranean and Middle Eastern Countries. *Nutrients*. 2019;11(6):1325. doi:10.3390/nu11061325.

43 Carey RM, Whelton PK; 2017 ACC/AHA Hypertension Guideline Writing Committee. Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: Synopsis of the 2017 American College of Cardiology/American Heart Association Hypertension Guideline. *Ann Intern Med*. 2018;168(5):351–358. doi:10.7326/M17-3203.