

# Burden of noncommunicable diseases in Pakistan

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## Abstract

**Background:** Cases of noncommunicable (NCD) diseases are increasing in Pakistan. They are responsible for 58% of all deaths and information on the risk factors is lacking.

**Aims:** To determine the prevalence of diabetes, hypertension and abnormal heart rate and their risk factors in a multiethnic, low-income area of Lahore.

**Methods:** This was a cross-sectional study conducted in an urban settlement of Lahore in 2018–2019. Eligible participants were aged  $\geq 30$  years and resident in selected settlements. We used a modified World Health Organization stepwise approach to NCD risk factor surveillance (STEPS) questionnaire to collect data from a random sample of 906 residents. The modified questionnaire had a Cronbach alpha of 80.0%. Participants were interviewed in their homes and their height, weight, heart rate, and hip circumference were measured.

**Results:** Most of the respondents were women (64.5%). The greatest proportion of the participants were aged 30–39 years (42.4%). Of all the respondents, 40.1% had hypertension, 15.8% had diabetes and 17.0% had ischaemic heart disease. Of the risk factors examined, 68.8% of the respondents were overweight or obese, 37.0% had pre-hypertension, 13.6% used tobacco, and 1.8% used alcohol. Age was the most significant risk factor for noncommunicable diseases. Body mass index was significantly associated with diabetes in women, while family history of diabetes was significantly associated with diabetes in men.

**Conclusion:** The prevalence of hypertension and diabetes was higher among our study participants in Lahore than reported in the national statistics. Significant proportions of the respondents had pre-hypertension and pre-diabetes, making them vulnerable to serious complications of hypertension and diabetes.

Keywords: noncommunicable diseases, hypertension, diabetes, prevalence, risk factors, Pakistan.

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## Introduction

The burden of noncommunicable diseases (NCDs) continues to rise and they have become the leading cause of morbidity and mortality globally, accounting for almost 70.0% of all the deaths worldwide (1). The leading NCDs such as diabetes, chronic respiratory disease, cardiovascular disease and cancer jointly accounted for about 79.0% of all NCD deaths all over the world in 2018 (2). The estimated number of deaths globally caused by NCDs was 26.6 million in 1990 (3), which increased to 34.5 million in 2010 and to about 40.5 million in 2016.

Because of the rapid change in lifestyle and advanced urbanization, low- and middle-income countries suffer from a great burden of NCDs (4–6). Deaths caused by NCDs in low- and middle-income countries was 78.0% in 2016. This high burden of NCDs is due to the limited number of facilities and limited resources available for this kind of diseases (3).

Pakistan is the fifth most populated country worldwide with a population of 207.7 million (7). The country is facing a double burden of communicable diseases and NCDs (8). Adoption of a sedentary lifestyle and changes in diet have resulted in a surge in NCDs in

Pakistan (9). Hypertension is the most common NCD with a prevalence of 38.7%, followed by diabetes with a prevalence of 14.6% (10). The National Health Survey of Pakistan reported a diabetes prevalence of 11.0% in the general population (11). In 2013–2014, a large-scale survey was conducted in Sindh and Punjab provinces, to determine the prevalence of NCDs and risk factors using the WHO STEPS instrument (12). Hypertension was seen in 53% of the sample which is higher than other South Asian countries (12). The main factors affecting the level of hypertension in Pakistan were: lack of proper healthcare guidelines; absence of patient safety measures; drug misuse; limited public health research; lack of enforcement of policies; and limited resources (13).

Several other risk factors for common NCDs exist, the most common being obesity, pre-hypertension, use of tobacco products and poor diet. Obesity was a risk factor for hypertension and diabetes in a study conducted using WHO STEPS instrument (14), with the prevalence of obesity reported as 31.2% (14). Another study in Kathmandu reported the obesity or over-weight prevalence as 52.2% (15).

The main objective of our study was to determine the overall prevalence of common NCDs in the general population in Lahore, Pakistan. For data collection, we modified the WHO STEPS questionnaire and determined its internal validity as the secondary objective.

## Methods

### Study design and setting

This was a cross-sectional study carried out in urban settlements of Union Councils 120 and 122 of Lahore, Punjab from September 2018 to September 2019. Union councils are the fifth tier of government in Pakistan; each union council has 13 elected members or councilors. The two union councils were selected from Shalamar and Gulberg zones.

### Study sample

The minimum sample size calculated was 882 using the WHO sample size calculator with 95% confidence interval (CI) and 49.0% as the prevalence of NCDs in Pakistan (10).

We used a two-stage cluster sampling method to collect data. The union councils were the primary unit. Blocks were the secondary units and were made up of about 2000 houses in the two union councils. One block was randomly selected from each union council. We started with a randomly selected household within the block and then selected every fifth house in that block. Eligibility criteria were: age  $\geq 30$  years and resident in these union councils. Exclusion criteria were: refusal to participate; self-reported severe comorbid conditions with life expectancy of less than 1 year; or other self-reported serious conditions likely to interfere with study participation or with the ability to complete the study (e.g. terminal cancer, HIV or tuberculosis). All eligible individuals present in each household were interviewed. If any individual declined to participate, the whole household was excluded and the next household was selected.

### Data collection

Data were collected through face-to-face, door-to-door interviews with all the eligible participants. The WHO STEPS questionnaire, modified to suit the setting with more detailed items excluded, was used to collect the data. The modified version was developed in English. Data were collected by nurses and doctors trained to conduct the interviews and complete the questionnaires. If any data were later found missing, the household was revisited to complete the information.

The demographic information collected was age, sex, marital status, educational level and occupation. A few response categories were changed for some variables. The other sections of the WHO STEPS questionnaire were limited to basic information such as consumption of tobacco, alcohol, fruits and vegetables, and intensity of physical activity (mild, moderate or intense). Physical characteristics (height, weight, heart rate and hip circumference) were measured by trained nurses (male

and female). Information on history of hypertension, diabetes, stroke and ischaemic heart disease (chest pain, angina and shortness of breath) was also collected. A few items on history of raised blood pressure, diabetes, raised cholesterol and cardiovascular disease were included in the modified version.

### Statistical analysis

Data analysis was done using SPSS, version 26. Socioeconomic and demographic factors were cross-tabulated with age group and sex. The chi-square test or Fisher's exact test was used to evaluate significant differences.

The reliability of the questionnaire was assessed and the Cronbach alpha determined was 80%. We used exploratory factor analysis to assess the internal structure of the questionnaire. Principal component analysis was used with varimax rotation. Factors with Eigen values  $> 1.0$  were extracted.

The prevalence of the main NCDs was determined and the association between various risk factors and common NCDs was examined.

### Ethical considerations

The study was approved by the institutional review board of Shalamar Institute of Health Sciences (SMDC/IRB/11-12/140). Verbal consent was obtained before entering any household and written consent was obtained before starting the interview.

## Results

Data were collected from 906 participants who lived in Union Councils 120 and 121. The internal reliability of 34 items was 80% using Cronbach alpha. These items were related to tobacco use, dietary pattern, physical activity, raised blood pressure and physical measurements. With regard to history of NCDs, 38.2% (346/906) of the participants had a family history of high blood pressure, 41.9% (380/906) had a family history of diabetes and 7.9% (72/906) had a history of stroke. With regard to the risk factors, 68.8% (623/906) of the sample was overweight or obese, 37.0% (335/906) had pre-hypertension, 13.6% (123/906) were tobacco users, 5.6% (51/906) had pre-diabetes and 1.8% drank alcohol regularly (16/906). The prevalence of hypertension, diabetes and ischaemic heart disease was 40.1% (363/906), 15.8% (143/906) and 17.0% (154/906), respectively. The prevalence of ischaemic heart disease was the same in male and female respondents.

The greatest proportion of the participants were in the age group 30–39 years (42.5% [385/906]), and 64.5% (584/906) were female (Table 1). Age was significantly associated with sex ( $P < 0.001$ ). Marital status, educational level and occupation were all significantly associated with age and sex ( $P < 0.001$ ; Table 1).

With regard to the internal structure of the questionnaire, the Kaiser–Meyer–Olkin measure of sampling adequacy and the Bartlett test of sphericity had values of 0.49 and 1248.07, respectively, ( $P < 0.001$ ),

**Table 1** Baseline characteristics of the study participants

Characteristic	No.				$\chi^2$ (P-value) <sup>a</sup>	No.		$\chi^2$ (P-value) <sup>a</sup>
	Age, in years					Sex		
	30–39	40–49	50–59	≥ 60		Male	Female	
<b>Marital status</b>					71.501 (< 0.001)			23.535 (< 0.001)
Never married	30	9	2	0		19	22	
Married	351	188	158	119		298	518	
Separated	0	1	0	1		2	0	
Widowed	3	7	14	21		3	42	
No response	1	0	1	0		0	2	
<b>Education level</b>					73.203 (< 0.001)			15.346 (0.036)
No schooling	107	62	78	66		97	216	
Less than primary	53	30	27	33		45	98	
Primary	16	14	16	4		19	31	
Secondary	69	30	24	20		67	76	
High school	84	48	22	16		62	108	
University	39	14	7	1		19	42	
Postgraduate	16	6	0	1		12	11	
No response	1	1	1	0		1	2	
<b>Ethnicity</b>					13.398 (0.144)			0.514 (0.916)
Punjabi	142	84	86	69		139	242	
Urdu speaking	169	86	61	50		127	239	
Pashtun	54	23	16	16		37	72	
Other	20	12	12	6		19	31	
<b>Socioeconomic status</b>					10.307 (0.112)			4.723 (0.094)
Low	144	71	47	55		103	214	
Middle	197	113	98	71		170	309	
High	44	21	30	15		49	61	
<b>Occupation</b>					176.379 (< 0.001)			603.380 (< 0.001)
Government employee	35	21	35	12		84	19	
Non-government employee	68	45	24	16		125	28	
Self-employed	18	15	12	8		46	07	
Student	32	0	0	0		2	1	
Retired	2	2	0	27		29	2	
Unemployed (can work)	10	5	4	8		11	16	
Unemployed (disabled)	3	2	6	8		13	6	
House work	245	115	93	62		12	503	
No response	1	0	1	0		0	2	
Total	385	205	175	141		322	584	

<sup>a</sup> Fisher exact test.

allowing for exploratory factor analysis. The threshold for factor loadings was 0.3. Maximum factor loading for each item in the principal component analysis was used to assign that item in a particular factor. Twelve factors were extracted with about 76.1% of the variance explained (Table 2).

Age was the most significant risk factor for NCDs. A statistically significant association was observed for body mass index and diabetes in females ( $P = 0.02$ ). Family history of diabetes was significantly associated with diabetes in males ( $P < 0.001$ ). In male participants,

occupation was significantly associated with abnormal heart rate (less than 60 beats/minute (bradycardia) or more than 100 beats/minute (tachycardia;  $P = 0.05$ ). Income, family history of ischaemic heart disease, family history of hypertension and regular walking were not significantly associated with common NCDs (Table 3). The prevalence of diabetes was same for male and female participants but varied with age: 4.5% in participants aged 30–39 years, 16.0% in participants aged 40–49 years, 19.6% in participants aged 50–59 years and 23.8% in participants aged 60 years and older.

**Table 2 Exploratory factor analysis of the modified WHO STEPS questionnaire and principal component analysis with varimax rotated loadings**

Factor	Eigen value	Explained variation, %	Item	Factor loading
Factor I: BP monitoring	5.3	15.7	In a week, how many days do you eat fruit?	0.316
			Systolic BP-1	0.836
			Diastolic BP-1	0.520
			Systolic BP-2	0.829
			Diastolic BP-2	0.876
Factor II: Raised BP	3.4	9.9	Have you ever had your BP measured by a doctor?	0.737
			Have you ever been told by a doctor that you have raised BP or hypertension in past 12 months?	0.769
			Have you ever had your cholesterol measured by a doctor?	0.731
			Have you ever been told by a doctor that you have raised cholesterol?	0.666
Factor III: Smoking behaviour	2.6	7.6	Smoking	0.950
			Regular smoking	0.891
			During the last 12 months, have you tried to stop smoking?	0.569
Factor IV: Heart rate	2.4	6.9	Heart rate-1	0.939
			Heart rate-2	0.960
			Baseline blood sugar level	0.152
Factor V: Physical measurements	2.1	6.3	Weight	0.747
			Waist circumference	0.715
			Hip circumference	0.738
Factor VI: Dietary fats	1.9	5.5	Oil and fats used for the preparation of meal	0.796
			Have you ever taken any allopathic antihypertensive medication in past 2 weeks?	0.628
Factor VII: NCDs	1.6	4.7	Ischaemic heart disease	0.622
			Hypertension	0.777
			Diabetes	0.670
Factor VIII: Diabetes	1.6	4.7	Have you ever had your blood sugar measured by doctor?	0.681
			Have you ever been told by doctor that you have raised blood sugar or diabetes?	0.783
			Height	0.396
Factor IX: Diet & exercise	1.5	4.3	In a typical week, on how many days do you eat vegetables?	0.793
			Do you walk or bicycle for at least 10 minutes daily	0.423
Factor X: Cardiac risk factors	1.3	3.7	Do you currently use any smokeless tobacco?	0.563
			Does your work involve low intensity activity?	0.139
			Have you ever had a heart attack or chest pain?	0.810
Factor XI: Physical activity	1.2	3.5	Does your work involve moderate intensity activity?	0.397
			Have you ever been told by doctor that you have raised blood pressure or hypertension?	0.735
Factor XII: Stroke	1.1	3.3	Stroke	0.792

WHO: World Health Organization; BP: blood pressure; NCD: noncommunicable disease.

## Discussion

We used exploratory factor analysis of the modified WHO STEPS questionnaire to assess the validity of the modified version. We could not use the original version of the STEPS questionnaire because it included questions on behavioural measurements, medical

check-ups, tradition and background. The WHO STEPS questionnaire was designed to be applied to any community, we modified it according to our socioeconomic and demographic conditions. Another study on the burden of NCDs developed and validated the tool extracted from a past research questionnaire

**Table 3 Risk factors for three noncommunicable diseases, by sex, southern Lahore, Pakistan**

Risk factor	Females			Males		
	Abnormal heart rate <sup>a</sup>	Diabetes	Hypertension	Abnormal heart rate <sup>a</sup>	Diabetes	Hypertension
	Test statistics (P-value)	Test statistics (P-value)	Test statistics (P-value)	Test statistics (P-value)	Test statistics (P-value)	Test statistics (P-value)
Age	17.69 (< 0.001)*	24.63 (< 0.001)*	10.10 (< 0.001)*	10.39 (0.11)	8.82 (0.03)*	6.72 (0.08)
Occupation	14.42 (0.19)	7.81 (0.35)	6.80 (0.45)	20.82 (0.05)*	3.52 (0.74)	3.46 (0.750)
Body mass index	4.68 (0.59)	9.55 (0.02)*	5.78 (0.12)	0.81 (0.67)	3.09 (0.38)	5.68 (0.13)
Income	6.08 (0.190)	0.27 (0.87)	2.28 (0.32)	4.70 (0.32)	0.01 (1.00)	0.81 (0.67)
Regular walking	9.15 (0.68)	4.07 (0.54)	8.61 (0.20)	3.32 (0.77)	3.36 (0.34)	1.51 (0.68)
History of ischaemic heart disease	3.03 (0.22)	1.94 (0.11)	2.92 (0.11)	0.19 (0.91)	0.00 (1.00)	0.44 (0.49)
Family history of hypertension	4.60 (0.10)	0.07 (0.44)	0.72 (0.45)	1.77 (0.41)	0.10 (0.86)	0.50 (0.57)
Family history of diabetes	0.24 (0.89)	9.32 (< 0.001)*	0.06 (0.90)	0.88 (0.65)	17.23 (< 0.001)*	1.17 (0.35)

\*Statistically significant at  $P < 0.05$ .

<sup>a</sup>Less than 60 beats/minute (bradycardia) or more than 100 beats/minute (tachycardia).

(16). In this study, the questionnaire was based on an 85-item questionnaire designed to assess cardiovascular disease risk (17). Exploratory factor analysis was used to determine the validity of the newly designed 21-item questionnaire together with confirmatory factor analysis (16).

Our study also aimed to assess the prevalence of NCDs by ethnicity and other demographic characteristics. Of all the NCDs examined, hypertension had the highest prevalence, followed by diabetes. This finding concurs with other studies in Pakistan on NCDs where hypertension or raised blood pressure was the most common NCD (10).

The prevalence of hypertension in our study was 40.1%, which is similar to a 2016 study in Pakistan (10). A study in Myanmar found an inverse association between years of schooling and hypertension (16), which is similar to our finding that the prevalence of hypertension differed by educational level. A study based on samples from 29 countries concluded that an additional year of education was associated with a 0.13 mmHg reduction in systolic blood pressure for men (18). A cross-sectional study conducted in Swaziland found an overall hypertension prevalence of 48.3% (19).

In our study the prevalence of diabetes was same for male and female participants. In other studies, the prevalence of diabetes ranged from 4.6% to 15% (10,20). In general, the prevalence of diabetes was higher in older respondents. However, diabetes was most commonly seen among women (14). The prevalence of diabetes varied by ethnicity, and this warrants further investigation; and a qualitative study to investigate the differences and interventions to reduce the prevalence of NCDs. We found no difference in the prevalence of diabetes according to occupation, which differs from a

study in Sweden, which found that diabetes prevalence was higher among labourers, clerks, heavy machinery operators and drivers (21).

The most common risk factor was pre-hypertension, with a prevalence of 37.0%. The prevalence of tobacco use was low in our study at 13.6%. Tobacco use is a leading risk factor for morbidity and mortality globally (22). A study in different districts of Pakistan reported that 37.7% of participants used tobacco (23), a higher figure than we found. About 1.8% of our sample drank alcohol regularly, which was considerably lower than the other risk factors. The risk of hypertension has been shown to increase with excessive use of alcohol (24). Overweight and obesity is another risk factor for many NCDs (14) and it was high in our study (68.8%).

The prevalence of ischaemic heart disease was 17.0% in our study. A large-scale study in 53 cities of Punjab, Pakistan showed that 17.5% of the population had cardiovascular disease (25), which concurs with our finding. However, another study reported a lower prevalence of 6.2% for ischaemic heart disease and among those most were male participants (26). The prevalence of ischaemic heart disease was same in male and female respondents.

A strength of our study is that it was conducted in a multi-ethnic setting and covered almost all the economic classes. Two union councils were selected to remove the confounding of socioeconomic class. While the study was limited to one city, the sample size was large and representative. The important risk factors found in the study can be used to guide the development of policies to control NCDs.

**Funding:** None.

**Competing interests:** None declared.

## Charge des maladies non transmissibles au Pakistan

### Résumé

**Contexte :** Les cas de maladies non transmissibles (MNT) sont en augmentation au Pakistan. Ces dernières sont responsables de 58 % de tous les décès ; par ailleurs, les informations sur les facteurs de risque font défaut.

**Objectifs :** Déterminer la prévalence du diabète, de l'hypertension et de l'arythmie cardiaque ainsi que leurs facteurs de risque dans une zone multiethnique à faible revenu de Lahore.

**Méthodes :** Il s'agissait d'une étude transversale menée dans un établissement urbain de Lahore en 2018-2019. Les participants admissibles étaient âgés de 30 ans ou plus et résidaient dans les établissements sélectionnés. Nous avons utilisé une approche par étapes modifiée de l'Organisation mondiale de la Santé pour le questionnaire de surveillance des facteurs de risque des maladies non transmissibles (STEPS) afin de recueillir des données auprès d'un échantillon aléatoire de 906 résidents. Le questionnaire modifié présentait un alpha de Cronbach de 80,0 %. Les participants ont été interrogés à leur domicile, leur taille et leur poids ont été consignés et leur fréquence cardiaque et la circonférence de leurs hanches ont été mesurées.

**Résultats :** La plupart des répondants étaient des femmes (64,5 %). La plus grande proportion des participants étaient âgés de 30 à 39 ans (42,4 %). Sur l'ensemble des personnes interrogées, 40,1 % présentaient une hypertension, 15,8 % un diabète et 17,0 % des cardiopathies ischémiques. Parmi les facteurs de risque examinés, 68,8 % des répondants étaient en surpoids ou obèses, 37,0 % avaient une préhypertension, 13,6 % consommaient du tabac et 1,8 % de l'alcool. L'âge était le facteur de risque le plus important pour les maladies non transmissibles. L'indice de masse corporelle était significativement associé au diabète chez les femmes, tandis que les antécédents familiaux de diabète étaient significativement associés au diabète chez les hommes.

**Conclusion :** La prévalence de l'hypertension et du diabète était plus élevée parmi les participants de notre étude à Lahore que celle rapportée dans les statistiques nationales. Des proportions significatives des personnes interrogées présentaient une préhypertension et un prédiabète, ce qui les rendait plus à risque de développer de graves complications liées à l'hypertension et au diabète.

### عبء الأمراض غير السارية في باكستان

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#### الخلاصة

**الخلفية:** تتزايد الأمراض غير السارية في باكستان، وهي السبب في 58٪ من جميع الوفيات، ولكن لا تتوفر معلومات عن عوامل الخطر للإصابة بها. **الأهداف:** هدفت هذه الدراسة إلى تحديد معدل انتشار أمراض السكري وارتفاع ضغط الدم واضطراب سرعة القلب وعوامل الخطر المرتبطة بها، في منطقة لاهور التي تتسم بتعدد الأعراق وانخفاض مستوى الدخل.

**طرق البحث:** أُجريت هذه الدراسة المقطعية في الحضر في لاهور في عامي 2018-2019. ولقد اختير المشاركون المؤهلون ممن لا تقل أعمارهم عن 30 عامًا من سكان المدن المختارة. وقد استخدمنا استبيان نهج منظمة الصحة العالمية التدريجي لترصد عوامل الخطر للأمراض غير السارية، بعد تعديله لجمع البيانات من عينة عشوائية ضمت 906 من السكان. وقد بلغ معامل ألفا كرونباخ للاستبيان المعدل 80.0٪. وقد أُجريت مقابلات مع المشاركين في منازلهم، مع قياس الطول والوزن وسرعة القلب ومحيط الجسم عند الورك.

**النتائج:** كان معظم من أجاب عن الاستبيان من النساء (64.5٪)، وتراوحت أعمار النسبة الأكبر من المشاركين (42.4٪) بين 30 و 39 عامًا. ومن بين من أجابوا عن الاستبيان، كان 40.1٪ مصابين بارتفاع ضغط الدم، و 15.8٪ مصابين بالسكري، و 17٪ مصابين بمرض القلب الإقفاري. ومن بين عوامل الخطر التي بحثتها الدراسة، كان 68.8٪ ممن أجابوا عن الاستبيان يعانون من زيادة الوزن أو السمنة، و 37.0٪ منهم يعانون من مقدمات ارتفاع ضغط الدم، و 13.6٪ يتعاطون التبغ، و 1.8٪ يتعاطون المشروبات الكحولية. وكان العمر هو أهم عامل خطر للإصابة بالأمراض غير السارية. أما السكري تحديداً، فقد كان هناك ارتباط كبير بين منسب كتلة الجسم والإصابة به لدى النساء، وارتباط كبير بين وجود إصابات بالسكري في العائلة والإصابة به لدى الرجال.

**الاستنتاجات:** كان معدل انتشار ارتفاع ضغط الدم والسكري بين المشاركين في الدراسة في لاهور أعلى من معدلاته الواردة في الإحصاءات الوطنية. وكانت نسبة كبيرة ممن أجابوا على الاستبيان مصابين بمقدمات ارتفاع ضغط الدم ومقدمات السكري، مما يجعلهم عرضة للمضاعفات الخطيرة لارتفاع ضغط الدم والسكري.

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