

SCREENING FOR NON-COMMUNICABLE DISEASES AND THEIR RISK FACTORS, RESULTS OF A STUDY FROM AN URBAN CITY OF PAKISTAN

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ABSTRACT

Background: The burden of NCDs continues to rise and accounts for almost 70% of all deaths worldwide. Primary care can play an integral part in reducing this burden through effective screening mechanism. The aim of the study is to use screening for identifying NCD's among high-risk population to reduce the mortality and morbidity related to them.

Materials and Methods: This cross-sectional study was conducted during May 2025 to December 2025 in a Family Medicine clinic of Karachi, through a two-stage procedure. In stage I, high risk patients visiting family medicine clinics that is were either aged > 40 or those < 40 years with a BMI > 23 and had any of the risk factors such as physical inactivity, history of smoking or CVD, family history of diabetes were included, through a pretested questionnaire. In stage II, high-risk participants were screened for hypertension, diabetes and dyslipidemia. SPSS was used for data analysis; logistic regression was performed and number needed to screen (NNS) was calculated.

Results: Amongst 289 patients screened, majority were female (69.9%). The results showed that the overall prevalence of NCDs among participants was 73%, with 47% had one and about 25% had two NCDs. The NNS to find a new case of hypertension was 2, the NNS was 4 for DM and 7 for dyslipidemia. The multivariable analysis depicts increasing age, being obese, physically inactive, smoker, having family history of CVD or DM are risk factors for the development of NCDs.

Conclusion: The results of the study reflects' the notion that disease prevention by screening and health awareness among general population is the most effective intervention in solving health crisis of developing world. The effectiveness of such an approach and the implications to the health care delivery system needs to be evaluated further.

KEYWORDS: Non-Communicable Diseases; Hypertension; Diabetes Mellitus; Dyslipidemia; Pakistan

INTRODUCTION

Noncommunicable diseases (NCDs) are the leading causes of mortality across the globe. According to World Health Organization (WHO), globally 43 million people died of NCDs in 2021, out of these 73% deaths occur in low- and middle-income countries (LMICs).^[1, 2] Amongst these premature deaths, about 19 million accounts for cardiovascular diseases (CVD), 10 million by cancers, 4 million by chronic respiratory diseases, and 2.0 million deaths are due to diabetes.^[1, 2]

Many studies have concluded that unhealthy diet, lack of physical activity, obesity, exposure to tobacco/smoke or use of alcohol are some of the risk factors of NCD.^[3-5] Early detection, screening and health awareness among general population is the most effective intervention in solving health crisis of developing world.

Pakistan is one of the most densely inhabited country in the world. The prevalence of NCDs in Pakistan has increased rapidly over the past few decades. A recent report of Global Burden of Disease Study 2019, reports that ischemic heart disease and stroke ranked 2nd and 3rd respectively on the list of all cause deaths in Pakistan.^[6] The second National Diabetes Survey of Pakistan reported a diabetes prevalence of 26.3% in the general population.^[4] WHO reports a prevalence of hypertension to be 25%, labelling it as the most common NCD in Pakistan followed by diabetes.^[7] However, a recent study conducted by Kazmi et al on 906 adults suggests that the prevalence of hypertension have increased to 40.1%.^[3]

A poor health care delivery system and lack of resources, makes it difficult to manage NCDs, in a resource scarce country like Pakistan. Therefore, it is imperative to screen for NCDs, at an early stage. This can be achieved by using primary health care (PHC) model, which can play an effective role in decreasing morbidity and mortality associated with NCDs. Studies have reported positive effects of integration of PHC in the NCDs care model and with an effective

screening at PHC level, it can ultimately aid to reduce the burden on a fragile health care sector in Pakistan.^[8, 9] However, this system has critical gaps in the LMICs due to the shortage of trained health care personnel and lack of infrastructure, among other factors. The aim of this study is to use screening to identify NCD's among high-risk population presenting to family medicine clinics. To further improve the management of NCDs in primary care settings.

MATERIALS AND METHODS

A cross-sectional study was conducted during May 2025 to December 2025 in family medicine clinics of Karachi, which is an economic hub of Pakistan. Eligible participants were informed about the purpose of the study and written informed consent was obtained from them. Confidentiality and privacy of the study participants were ensured throughout the study.

Non-probability purposive sampling was used to recruit the participants. All the patients visiting the family medicine clinics and were either aged 40 years or above or incase below 40 years with a BMI of 23 (overweight) or above with any of the following risk factors such as physical inactivity, smoker or ex-smoker, history of CVD, history of diabetes in 1st degree relatives (mother, father, siblings), were included in the study. Whereas, patients who were diagnosed with diabetes, hypertension and dyslipidemia, had mental disabilities or refused consent, were excluded.

The participants were recruited through a two-stage process. In stage 1, a pretested structured questionnaire was administered to identify high risk patients. The questionnaire was formed after thorough literature search and was reviewed by the experts in the field. It was administered in both English and Urdu languages and was composed of two sections. The initial section included demographic details of the participants such as age, gender, marital status, education and employment status. Section two was composed of a questionnaire-based screening tool for NCDs and their risk factors including age, smoking, alcohol consumption, physical activity, height, weight (BMI), systolic, diastolic blood pressure and family history of NCDs were assessed.

In the second stage, those participants who were not at risk of NCDs were given awareness about the importance of adopting healthy lifestyle. However, the high-risk participants were then counseled to do the biochemical tests as per the hospital protocol of NCD diagnosis and management. These included HBA1c and lipid profile, which is offered at a very nominal fee at the study hospital. The participants who were diagnosed with diabetes, hypertension or dyslipidemia were then informed about their blood test reports over phone and were offered free consultation with the consultant for NCD management.

Sample size was calculated using open EPI software. By taking prevalence of hypertension at 25%, with 95% confidence interval and a margin of error at 5%. The sample size came out to be 289.

The following operational definitions were used in the study

Physical Activity: moderate intensity physical activity for 30 minutes, at least 5 days a week

BMI: Overweight: having a BMI of 23-24.9, Obese: having a BMI of 25-29.9, Morbid Obese: having a BMI of >30.

Hypertension: Hypertension was defined as blood pressure equal to or greater than 140 mm of Hg systolic and/or 90 mm of Hg diastolic. Satge:1 hypertension is defined as, 130-139 mm of Hg systolic and/or 80-89 mm of Hg diastolic.

Satge2: hypertension is defined as, 140 or above mm of Hg systolic and/or 90 mm of Hg diastolic.

Diabetes Mellitus: It was defined as Hb1ac of more than 6.5.

Dyslipidemia: High Low-Density Lipoprotein (LDL): More than 160 mg/dL

The data was entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 20. Descriptive analysis was performed, frequency and percentages were reported for categorial variables such as age, gender, marital status, employment status, family history of CVD, BMI etc. Chi square or Fischer exact test was used to study correlations between risk factors (age, gender, educational status, BMI etc.) and NCDs. Logistic regression was performed to assess associations between NCDs and risk factors. The results were expressed as unadjusted odds ratio (OR) and adjusted odds ratio (AOR) with their 95% confidence intervals (CI). A P value of less than or equal to 0.05 was considered statistically significant, throughout the analysis. Number needed to screen (NNS) was calculated for Diabetes, Hypertension and dyslipidemia.

RESULTS

Out of the 350 eligible participants approached, 289 participants who agreed and followed the study protocol were included in the final analysis; yielding a response rate of 82.6% (289/350).

Socio-demographic characteristics of the participants are presented in table 1. About half of the participants were aged between 46 to 55 years (50.2%). While, the lowest proportion of participants were more than 65 years of age (10.4%). Majority of the participants were females (69.9%). Overall, most of the participants were married (86.9%). Approximately 39.8% participants were graduate or above and about 12.1% responded that they cannot read or write. Figure 1 depicts that about 73% of the participants upon screening were diagnosed with an NCD. Out of which 47.1% had developed one, while 25.3% had two and 0.3% were diagnosed with three NCDs (Figure 2).

Numbers Needed to Screened (NNS): Total screened/number of newly diagnosed hypertensive /diabetic/dyslipidemia cases

289/168=2 individuals should be screened to identify one hypertensive patient.

289/75=4 individuals should be screened to identify one diabetic patient.
289/42=7 individuals should be screened to identify one dyslipidemia patient.

Distribution of the NCDs risk factors among study participants are presented in table 2. A very high proportion of the study participants were physically inactive (96.7%) and 39.4% were obese (BMI: 25-29.9) and almost 43% were morbidly obese (BMI: >30). Upon screening for NCDs the following results were found about one fourth (24.6%) had stage I hypertension and 33.6% had stage II hypertension, 38.1% had prediabetes, over one fourth (26%) had diabetes and 14.5% had elevated LDL.

Table 3 suggests that participants in middle years were more likely to be diagnosed with NCD (51.9%) rather than the older generation. Moreover, females were more at risk of developing NCDs (67.6%). The unadjusted odds ratio shows that those who cannot read or write were three times more at risk of developing an NCD than those who were educated (OR: 3.34; 95% CI: 1.20-9.31). Similarly, those who were physically inactive were 2.77 (95% CI: 0.78-9.84) times more at risk of diagnosing with an NCD.

Table 4 presents factors associated with NCDs among study participants. After adjusting the odds ratio with other variables, elderly (> 65 years) were 2.23 times (AOR: 2.23, 95% CI: 0.77-6.44) more likely to diagnose with an NCD than the younger generations. Educational status of participant was significantly associated with the development of NCD (AOR: 3.65; 95% CI: 1.24-10.76, p=0.004). In addition, those who were morbidly obese also had high odds of developing an NCD (AOR: 1.15; 95% CI: 0.51-2.60), though it was not statistically significant.

Table 1: Socio-demographic characteristics of study participants

Variable	Number	Percentage
Age		
25-45 years	114	39.4
46-65 years	145	50.2
More than 65 years	30	10.4
Gender		
Male	87	30.1
Female	202	69.9
Marital Status		
single/divorced/widowed	39	13.5
married	250	86.5
Educational Status		
Can't read or write	35	12.1
Up to Matriculation	115	39.8
Intermediate	30	10.4
Graduate & Above	109	37.7
Employment Status		
employed	91	31.5
un-employed	21	7.3
house-wife	177	61.2

Table 2: Clinical Characteristics and NCDs Risk Factors among the study participants

Variable	Number	Percentage
Physical Activity		
Active	10	3.5
Inactive	279	96.5
Smoking Status		
Smoker	21	7.3
Non-smoker	268	92.7
History of CVD		
Yes	3	1.0
No	286	99.0
History of PCO (n=202)		
Yes	5	2.5
No	197	97.5
Family History of DM		
Yes	179	61.9

No	110	38.1
Family History of CVD		
Yes	8	2.8
No	281	97.2
BMI		
Normal (BMI: 18-22.9)	31	10.7
Overweight (BMI: 23-24.9)	20	6.9
Obese (BMI: 25-29.9)	114	39.4
Morbid Obese (BMI: >30)	124	42.9
New Cases		
Hypertension		
Normal<120/80 mmHg	63	21.8
Elevated120-129/<80 mmHg	58	20.1
Satge1,130-139/80-89 mmHg	71	24.6
Satge2,>140/90 mmHg	97	33.6
Diabetes (HBA_{1c})		
Normal<5.7	104	36.0
Prediabets5.7-6.4	110	38.1
Diabetes>6.5	75	26.0
Lipid Profile		
High HDL	16	5.5
High LDL	42	14.5
High Triglycerides	52	18.0
High Cholesterol	26	9.0

Table 3 Risk Factors related to NCDs amongst study participants (n=289)

Risk Factors	Presence of NCD		Univariate Analysis
	Yes n (%)	No n (%)	OR (95% CI)
Age			
25-45 years	77 (36.7)	37 (46.8)	Ref
46-65 years	109 (51.9)	36 (45.6)	1.45 (0.84-2.50)
More than 65 years	24 (11.4)	6 (7.6)	1.92 (0.72-5.10)
Gender			
Male	68 (32.4)	19 (24.1)	Ref
Female	142 (67.6)	60 (75.9)	1.51 (0.83-2.73)
Educational Status			
Can't read or write	30 (14.3)	5 (6.3)	3.34 (1.20-9.31)
Up to Matriculation	89 (42.4)	26 (32.9)	1.90 (1.06-3.49)
Intermediate	21 (10.0)	9 (11.4)	1.30 (0.54-3.11)
Graduate & Above	70 (33.3)	39 (49.4)	Ref
BMI			
Normal	39 (18.6)	12 (15.2)	Ref
Obese	78 (37.1)	36 (45.6)	1.08 (0.50-2.32)
Morbid Obesity	93 (44.3)	31 (39.2)	0.72 (0.41-1.27)
Smoking Status			
Smoker	18 (8.6)	3 (3.8)	2.37 (0.68-8.29)
Non-smoker	192 (91.4)	76 (96.2)	Ref
Physical Activity			
Active	5 (2.4)	5 (6.3)	Ref
Inactive	205 (97.6)	74 (93.7)	2.77 (0.78-9.84)
History of CVD			
Yes	3 (1.4)	0 (0.0)	

No	207 (98.6)	79 (100.0)	
Family History of CVD			
Yes	5 (2.4)	3 (3.8)	1.61 (0.37-6.93)
No	205 (97.6)	76 (96.2)	Ref
Family History of DM			
Yes	131 (62.4)	48 (60.8)	1.07 (0.63-1.82)
No	79 (37.6)	31 (39.2)	Ref

Table 4 Risk Factors related to socio-demographic & clinical factors for NCDs amongst study participants

Risk Factors	Multivariate Analysis AOR (95% CI)	P-value
Age		
25-45 years	Ref	0.17
46-65 years	1.59 (0.88-2.85)	
More than 65 years	2.23 (0.77-6.44)	
Gender		
Male	1.77 (0.89-3.49)	0.10
Female	Ref	
Educational Status		
Can't read or write	3.65 (1.24-10.76)	0.04*
Up to Matriculation	1.96 (1.05-3.64)	
Intermediate	1.69 (0.67-4.24)	
Graduate & Above	Ref	
BMI		
Normal	Ref	0.51
Obese	0.81 (0.36-1.70)	
Morbid Obesity	1.15 (0.51-2.60)	
Smoking Status		
Smoker	1.99 (-0.50-7.85)	0.32
Non-smoker	Ref	
Physical Activity		
Active	Ref	0.20
Inactive	2.45 (0.61-9.83)	
Family History of DM		
Yes	1.31 (0.72-2.35)	0.36
No	Ref	

* Significant at p-value 0.05

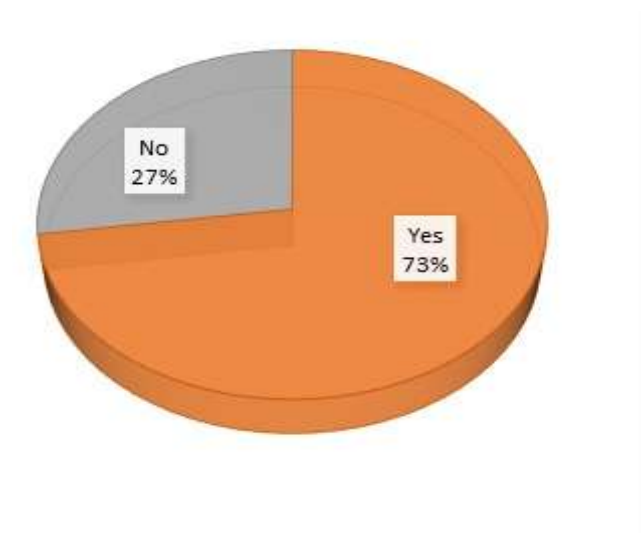


Figure 1: Presence of NCD among Study Participants

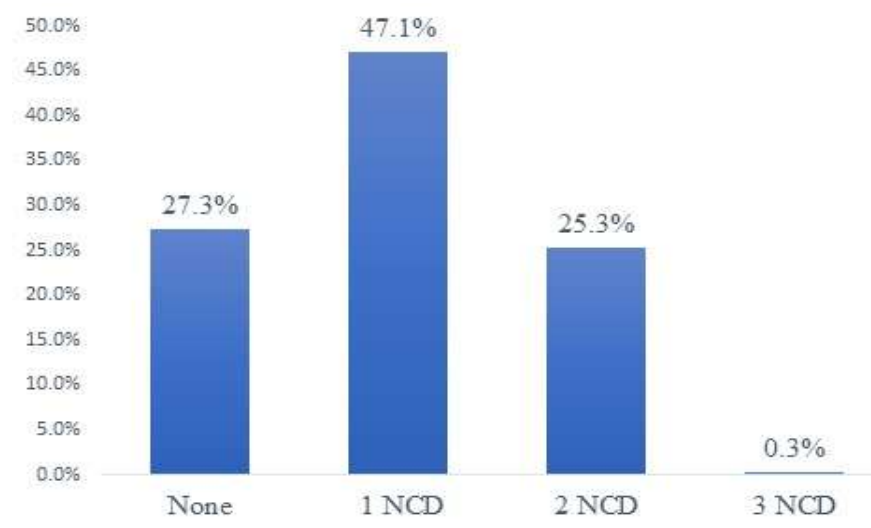


Figure 2: Diagnoses of NCD among Study Participants

DISCUSSION

The aim of this study is to use screening for identifying NCD's among high-risk population presenting to family medicine clinics of a public sector hospital. The paper also examined risk factors associated with the development of NCDs. The study found that odds of developing NCDs were higher for, older people as compared to the younger generation, females as compared to males, patients with no education, obese patients, past or current smokers, physically inactive and having a family history of diabetes were all found to be the risk factors of the development of NCDs.

In Pakistan, NCDs are among the top 10 causes of morbidity and mortality. Diabetes, hypertension, and other NCDs are common in Pakistan. In Pakistan, about 50% of the total deaths is associated with NCDs. In the current study, about 73% of the patients were diagnosed with an NCD. Out of which 47.1% had developed one, one fourth (25.4%) had two NCDs and a small proportion (0.03%) had developed three or more NCDs.

Hypertension was seen in 58.2% of our sample; 24.6% had stage 1 and 33.6% had stage II hypertension. This is comparable to a WHO Stepwise approach to surveillance (STEPS) study conducted in Sindh and Punjab (two provinces of Pakistan), which reported a prevalence of hypertension to be 53%.^[10] Moreover, National Diabetes Survey of Pakistan (NDSP) 2016–2017 conducted in all the four provinces of Pakistan reported, the rate of hypertension to be 46.2%.^[11] The current study also reported that out of every two high risk patients screened, one would be hypertensive. This result suggests that the prevalence of hypertension is rather high in Pakistan. Therefore, screening and early management of hypertension is essential to avoid complications associated with uncontrolled hypertension. A recent review on hypertension reveals that low physical activity and obesity were the main predisposing factors for development of hypertension^[12], which is also evident from the results of this study.

The number of patients with T2DM is alarmingly high worldwide. Current estimate suggests that globally 463 million adults have diabetes, and 90% of these people suffer from T2DM and this number is increasing with each passing year

[13]. According to the International Diabetes Federation (IDF), the prevalence of diabetes was 26.7% among adults in Pakistan. [14] This is similar to the rate of new T2DM cases found in this study (26%). Our findings also suggest that about 38% of the participants had pre-diabetes. We also found that four patients should be screened to identify one patient of DM. Factors that are attributed to the development of diabetes are mainly lifestyle changes. [15] These include sedentary lifestyle, obesity and the intake of processed and junk foods. These factors also account for the upsurge of pre-diabetics in Pakistan, with higher chances of becoming diabetic. [15, 16] Therefore, to control and manage diabetes the interventions should be multifaceted. Screening methods such as 'Risk Assessment of Pakistani Individuals for Diabetes (RAPID)' can be used for providing awareness to the general population. [17] Moreover, there is an urgent need to increase numbers of primary health care centers and to ensure capacity building of primary care physicians.

The study also reports the prevalence of dyslipidemia among study participants to be 14.9%. Epidemiological studies have suggested that high level of LDL is a primary risk factor for CVDs and should be targeted to reduce its burden. [18, 19] As evident from a study on 92 acute coronary syndrome patients reported, that dyslipidemia was present in majority (83.2%) of the patients [18]. It is reported that the risk of CVDs doubles for every 10-point increase in diastolic BP or every 20-point increase in systolic BP. [20]

The current study found high proportion of physical inactivity (97%) among the study participants. As expected over 97% of the physically inactive participants were diagnosed with an NCD and the odds suggest that physically inactive participants were twice at risk of developing NCDs (OR: 2.45; 95% CI: 0.61-9.83). Noncompliance with regular exercise and sedentary lifestyle is a major public health problem. Several studies have provided evidence of association between low physical activity and NCDs. [21, 22]

NCDs Risk Factor Survey 2016 of Pakistan reported that about 81% of the population were not doing any vigorous physical activity. [21] Most high-risk groups stop everyday physical activities for several reasons like joint pain, dyspnea, academic pressures, job stress, lack of time, unavailability of male family member (in case of females) and safe pedestrian roads [23]. Recreational facilities such as gyms and parks have been suggested to overcome the burden of NCDs. However, there are not many good pavements and other recreational facilities are available which is accessible and affordable to the general population. In our culture females are usually home makers and do not go out of the house without male member of the family due to cultural and security reasons. This poses females at a greater risk of developing NCDs. Health education is very essential in dealing with these issues to effectively and timely to control the spread of NCDs.

Obesity is ranked as the fifth top risk factor for mortality. Globally, 1.9 billion adults, were found to be overweight and 650 million of these were obese. [24] It is a precursor for developing NCDs and this association has been reported by several studies. [25, 26] According to WHO, the risk of type 2 diabetes, insulin resistance, or dyslipidemia is over three-fold higher in obese people [26]. Our study results also corroborate with the previously published literature and in the current study about 37.1% of the obese and 44.3% of the morbid obese participants had contracted NCD. Our study found a relatively high prevalence of obesity that is 81.4%. It is similar to a retrospective chart review conducted in Karachi-Pakistan on 613 patients records, which reported the prevalence of obesity to be 83.2%. [27] Non-nutritious food choices (junk food) and sedentary leisure time activities (computers, cell phones, and social media entertainment) are some of the predisposing factors which have resulted in such high prevalence of obesity worldwide. [26-28] This high prevalence of obesity is a serious public health problem and requires preventive strategies to be part of the health education plan and should be implemented from a very early age. Studies suggest that obesity in early childhood can increase the risk of obesity in adulthood; thereby increasing the risk of T2DM and other chronic diseases in adolescence and adulthood. [29, 30] Therefore, awareness campaigns regarding healthy lifestyle and nutrition should be held in educational institutions on regular basis. So that, the problem of obesity can be curtailed in a timely manner.

The study had several strengths. Firstly, this was a pragmatic study since the screening process was implemented within the routine system therefore, it required minimal budget for completion. Moreover, it employed prospective data collection technique, and the diagnosis of new cases were confirmed with the biochemical tests. Additionally, the study used standardized operational definitions.

The study had certain limitations. This study was conducted in a public sector hospital of Pakistan and the screening process was very feasible may be because it was conducted in a hospital where resources were available. Nonetheless, replicating the same in the community settings will have its own challenges. Therefore, the results of the study should be extrapolated with caution on other populations.

Moreover, the patients were already visiting the family medicine clinics for any disease or related symptoms may be due to this, they readily agreed to provide consent and fulfilled the other study protocols. As evident from the study data; there was minimal missing data.

CONCLUSION

This study found high prevalence of NCDs during the screening process. The presence of risk factors such as obesity, sedentary lifestyle, family history of DM and CVD along with other factors all contributes to the immense burden of NCDs in Pakistan.

It is evident that prevention alone is insufficient for reducing mortality associated with NCDs and it necessitates strengthening of primary health care system and integrating NCD management into the health care delivery system.

At the same time, it is vital to implement new strategies to cope with changing trends in NCDs, promoting awareness and management of serious complications through active referral systems. This all could help in decreasing NCDs burden in a LMIC like Pakistan.

REFERENCES

1. World Health Organization. Non communicable diseases: Key Facts. Available from: <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases> [Last accessed on 2026 January 15]
2. Abbafati C, Machado D, Cislaghi B, Salman O, Karanikolos M, McKee M, et al. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet Diabetes Endocrinology*. 2020;396:1204-22.
3. Kazmi T, Nagi M, Razzaq S, Hussnain S, Shahid N, Athar U. Burden of noncommunicable diseases in Pakistan. *Eastern Mediterranean Health Journal*. 2022;28:798-804.
4. Basit A, Fawwad A, Qureshi H, Shera A. Prevalence of diabetes, pre-diabetes and associated risk factors: second National Diabetes Survey of Pakistan (NDSP), 2016–2017. *BMJ open*. 2018;8:e020961.
5. Khowaja PA, Naz F, Khowaja N, Hussain SM, Samad A, Hayee PA, et al. The Burden of Non-Communicable Diseases in Middle Age Population of Karachi, Pakistan. *Pakistan Journal of Medical Health Sciences*. 2022;16:97-.
6. Hafeez A, Dangel WJ, Ostroff SM, Kiani AG, Glenn SD, Abbas J, et al. The state of health in Pakistan and its provinces and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet Global Health*. 2023;11:e229-e43.
7. World Health Organization. Noncommunicable diseases country profiles 2018. Available from: <file:///C:/Users/SCS/Downloads/Documents/9789241514620-eng.pdf>. [Last accessed on 2026 January 5]
8. Nair D, Thekkur P, Fernando M, Kumar AM, Satyanarayana S, Chandraratne N, et al., editors. Outcomes and Challenges in Noncommunicable Disease Care Provision in Health Facilities Supported by Primary Health Care System Strengthening Project in Sri Lanka: A Mixed-Methods Study. *Healthcare*; 2023: MDPI.
9. Varghese C, Nongkynrih B, Onakpoya I, McCall M, Barkley S, Collins TE. Better health and wellbeing for billion more people: integrating non-communicable diseases in primary care. *BMJ open*. 2019;364.
10. Rafique I, Saqib MA, Munir MA, Qureshi H, Rizwanullah KS, Khan SA, et al. Prevalence of risk factors for noncommunicable diseases in adults: key findings from the Pakistan STEPS survey. *East Mediterr Health J*. 2018;24:33-41.
11. Basit A, Tanveer S, Fawwad A, Naeem N. Prevalence and contributing risk factors for hypertension in urban and rural areas of Pakistan; a study from second National Diabetes Survey of Pakistan (NDSP) 2016–2017. *J Clinical Experimental Hypertension*. 2020;42:218-24.
12. Elahi A, Ali AA, Khan AH, Samad Z, Shahab H, Aziz N, et al. Challenges of managing hypertension in Pakistan-a review. *Clinical Hypertension*. 2023;29:1-14.
13. International Diabetes Federation. Diabetes Atlas 2019. Available from: <https://diabetesatlas.org/atlas/ninth-edition/>. [Last accessed on 2026 January 19]
14. International Diabetes Federation. Diabetes Atlas 2022. Available from: <https://diabetesatlas.org/>. [Last accessed on 2025 December 30]
15. Azeem S, Khan U, Liaquat A. The increasing rate of diabetes in Pakistan: A silent killer. *Annals of Medicine Surgery*. 2022;79.
16. Bhutta ZA, Haq ZU, Basit A. Diabetes in Pakistan: addressing the crisis. *The Lancet Diabetes Endocrinology*. 2022;10:309-10.
17. Basit A, Fawwad A, Siddiqui SA, Baqa K. Current management strategies to target the increasing incidence of diabetes within Pakistan [Corrigendum]. *Diabetes, Metabolic Syndrome Obesity: Targets Therapy*. 2019;12:851-2.
18. Muneeb M, Khan AH, Niazi AK, Khan MU, Chatha ZJ, Kazmi T, et al. Patterns of Dyslipidemia Among Acute Coronary Syndrome (ACS) Patients at a Tertiary Care Hospital in Lahore, Pakistan. *Cureus*. 2022;14.
19. Yi S-W, An SJ, Park HB, Yi J-J, Ohrr H. Association between low-density lipoprotein cholesterol and cardiovascular mortality in statin non-users: a prospective cohort study in 14.9 million Korean adults. *International Journal of Epidemiology*. 2022;51:1178-89.
20. Iqbal R, Ahmad Z, Malik F, Mahmood S, Shahzadi N, Mehwish S, et al. A statistical analysis of hypertension as cardiovascular risk factor. *Middle East J Sci Res*. 2012;12:19-22.
21. DH Q, D M, D S, I R. Non Communicable Diseases Risk Factor Survey-Pakistan. 2016. Report No.: 978-969-499-008-8.
22. Katzmarzyk PT. Expanding our understanding of the global impact of physical inactivity. *The Lancet Global Health*. 2023;11:e2-e3.
23. Reid H, Ridout AJ, Tomaz SA, Kelly P, Jones N. Benefits outweigh the risks: a consensus statement on the risks of physical activity for people living with long-term conditions. *British journal of sports medicine*. 2022;56:427-38.
24. Ahmad R, Haque M. Obesity: A Burden Borne by the Global Economy. *Bangladesh Journal of Medical Science*. 2023;22:465-71.

25. Akhter N, Begum K, Nahar P, Cooper G, Vallis D, Kasim A, et al. Risk factors for non-communicable diseases related to obesity among first-and second-generation Bangladeshi migrants living in north-east or south-east England. *International Journal of Obesity*. 2021;45:1588-98.
26. World Health Organization. Obesity: preventing and managing the global epidemic. 2000.
27. Ghaus S, Ahsan T, Sohail E, Erum U, Aijaz W, Rashid UE. Burden of Elevated Body Mass Index and Its Association With Non-Communicable Diseases in Patients Presenting to an Endocrinology Clinic. *Cureus*. 2021;13.
28. Alturki HA, Brookes DS, Davies PS. Does spending more time on electronic screen devices determine the weight outcomes in obese and normal weight Saudi Arabian children? *Saudi Medical Journal*. 2020;41:79.
29. Simmonds M, Llewellyn A, Owen CG, Woolacott N. Predicting adult obesity from childhood obesity: a systematic review and meta-analysis. *Obesity reviews*. 2016;17:95-107.
30. Sommer A, Twig G. The impact of childhood and adolescent obesity on cardiovascular risk in adulthood: a systematic review. *Current diabetes reports*. 2018;18:1-6.