NCDs

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Investigating the Impact of Selected Non-Communicable Diseases and Associated Risk Factors: Evidence from STEPS Surveys Conducted in South Asian Nations

Introduction:

Non-communicable diseases (NCDs), commonly referred to as chronic illnesses, typically persist over an extended period and arise from a complex interplay of genetic, physiological, environmental, and behavioral elements [1]. Specifically, cardiovascular diseases (including heart diseases and stroke), cancer, respiratory conditions, and diabetes mellitus are the primary contributors to the global burden of disease. Furthermore, these ailments are progressively emerging as prominent factors contributing to illness and death in low- and middle-income (LMI) nations [2]–[5]. As per the World Health Organization (WHO) assessments, non-communicable diseases (NCDs) account for 71% of total global fatalities. Approximately 85% of premature deaths resulting from NCDs take place in low- and middle-income countries (LMICs), and within this demographic, 61% of the deaths affect individuals below the age of 70 [7]. In 2012, NCDs led to a total of 277,500 fatalities, equating to a mortality rate of 564.1 per 100,000 in males and 531.9 per 100,000 in females [8].

The risk factors associated with these significant NCDs are extensively documented and commonly shared [1]. There is a significant rise in cardiovascular risk factors observed in both low- and middle-income countries [9]. Behavioral risk factors, encompassing habits like smoking, alcohol consumption, an unhealthy diet, and physical inactivity, coupled with biological risk factors such as elevated blood pressure (BP), blood glucose, and cholesterol levels, in addition to being overweight or obese, are recognized as the primary root causes of non-communicable diseases (NCDs) [10]. Furthermore, the likelihood of non-communicable diseases (NCDs) advancing is noted to escalate when multiple risk factors coexist in an individual, a phenomenon termed as clustering [11]. The World Health Report 2002 emphasized the importance of concentrating on risks and risk factors for both assessment and interventions. In response, the WHO Cross Cluster Surveillance team devised the STEPwise approach to risk factor surveillance (STEPS) in 2000. This methodology is centered on acquiring fundamental data related to established risk factors that play a pivotal role in determining the major disease burden [12].

In the adult population of South Asia, there is a clustering of risk factors for non-communicable diseases (NCDs), and this clustering becomes more apparent as individuals age. In the South-East Asia Region, cardiovascular diseases, cancer, diabetes, and chronic respiratory diseases, primarily, pose a significant and escalating challenge to health and development [13]. In Bangladesh, Bhutan, Myanmar, Nepal, and Cambodia, the most widespread risk factors are hypertension and central obesity. Vietnam and Pakistan exhibit hypertension and total cholesterol as the predominant risk factors. Timor-Leste experiences hypertension and diabetes as the most prevalent risk factors. In the Lao People's Democratic Republic, total cholesterol and overweight/obesity are the most prevalent risk factors. Sri Lanka reports hypertension and diabetes as the top two most prevalent risk factors [14]. Bangladesh is undergoing both

demographic and epidemiological transitions, resulting in a dual burden of diseases. Non-communicable diseases (NCDs) constitute 67% of the total mortality in the country [15].

The member states of the World Health Organization (WHO) have reached a consensus on 25 indicators categorized into three areas. These areas concentrate on crucial outcomes, risk factors, and the necessary national system responses for preventing and managing non-communicable diseases (NCDs). This includes one target related to mortality, six targets pertaining to risk factors, and two targets associated with national systems [16]. The STEP-wise Surveillance for NCD Risk Factors (STEPS) is a standardized framework devised by the World Health Organization (WHO) for systematically monitoring the prevalence of non-communicable disease (NCD) risk factors within a country. It involves three distinct steps: STEP 1 assesses behavioral risk factors through questionnaire evaluation, STEP 2 identifies anthropometric risk factors through physical measurements, and STEP 3 identifies biochemical risk factors through biochemical measurements [12]. According to the World Health Organization's Global Health Risks report, the primary global risk factor for non-communicable diseases (NCDs) in terms of attributable deaths is elevated blood pressure, responsible for 13% of global fatalities. Following closely are tobacco use (9%), elevated blood glucose (6%), physical inactivity (6%), and overweight/obesity (5%) [5]. In Nepal, it is estimated that NCDs constitute 66% of all deaths as of 2016 [6]. The 2019 nationwide survey using the STEPwise approach for Surveillance (STEPS) on non-communicable disease risk factors revealed elevated risks with a substantial prevalence of less than five servings of fruits and/or vegetables (96.7%), tobacco use (28.9%), overweight/obesity (24.3%), and raised blood pressure (24.5%). These findings indicate a significant potential for a future epidemic of non-communicable diseases [7]. Numerous conducted studies have determined that socio-demographic characteristics play a role in the variation of non-communicable disease (NCD) risk factors [8–12].

Assessing the prevalence of non-communicable diseases (NCDs) and identifying high-risk populations are crucial for developing community-based interventions aimed at reducing risk factors. Currently, there is inadequate information for a comprehensive nationwide comparison of NCD prevalence and associated factors in the South Asian region. Previous community-based studies in this area have been constrained to specific regions, providing a limited and potentially skewed representation of the overall NCD scenario [2]–[5], [9], [11], [14], [15], [17]. Within this context, the objective of this study is to evaluate the epidemiological patterns and influences on behavioral and biological risk factors linked to significant/selected non-communicable diseases (NCDs).

Methods

Study design and setting

We utilized data from the latest cross-sectional studies of the STEPS survey, following the standardized approach developed by the World Health Organization (WHO) for monitoring NCD risk factors in the Southeast Asia Region (SEAR). The STEPS survey is a global initiative conducted every three to five years in SEAR countries, employing a consistent protocol. The survey's scope encompasses all men and women aged 18 years or older, identifying Bangladesh

as their primary place of residence. It is noteworthy that the study considered individuals living in Bangladesh, irrespective of their citizenship status, and excluded only those temporarily visiting (e.g., tourists), residing in military bases or group quarters (e.g., dormitories), or institutionalized (e.g., hospitals, prisons, nursing homes). Essentially, the study aimed to encompass individuals residing across all geographic areas of the country [12].

Samples were gathered through a multi-stage, geographically stratified probability-based sampling method, utilizing primary sampling units (PSUs) developed by each country for their census. To ensure consistency for cross-country comparisons, STEPS surveys adhere to standardized operating protocols covering sampling, questionnaires, data collection, cleaning, coding, and analysis. Participants provided both oral and written consent. Prior to implementation, each STEPS survey proposal undergoes technical and ethical review and approval. This process ensures the survey is conducted in a technically and ethically sound manner, respects and safeguards participants' rights, and secures access to information within the sampling frame. Ethical approval is ideally sought through submission to a national ethics review committee or a relevant body. In cases where no established process exists, it is recommended to submit an application for ethical review through an ad hoc local mechanism within the Ministry of Health. Informed consent must be obtained from every survey participant before conducting interviews, and detailed guidelines can be accessed on the WHO website [12].

Data harmonization

We obtained the most recent standard STEPS survey data for six countries in the Southeast Asia Region (SEAR) from the website https://extranet.who.int/ncdsmicrodata/index.php/catalog/. Out of the potential 12 countries, we ultimately included six (Bangladesh, Maldives, Myanmar, Nepal, Sri Lanka, Timor-Leste) in our study. These countries were selected based on meeting our inclusion criteria and having current standard STEPS data. Some countries were excluded either because WHO did not conduct a STEPS survey in those areas, or their data was not available in the public domain, lacked sufficient data and relevant variables, and had unreported non-response rates. Additionally, some survey reports were either not publicly accessible or not in English.

When analyzing survey datasets, it's crucial to address issues like uneven unit selection probabilities. Sample weights play a crucial role in mitigating bias resulting from disproportionate sampling and the impacts of non-response, significantly influencing standard error calculations. Consequently, excluding weights from the study may lead to substantially biased estimates. In STATA, a singleton was introduced to handle a single primary sampling unit (PSU) within a stratum, which may occur due to reasons like missing data, posing challenges such as the inability to compute standard errors.

To address singleton PSUs in each stratum, we assessed three methods: singleton (certainty), treating every singleton unit as certainty units; singleton (scaled), using the average variances from strata with multiple sampling units as a scaling factor for singleton (certainty); and singleton (centered), centering singleton PSUs at the grand mean. Among these methods, we opted for the singleton (scaled) approach for our analysis. We ensured that all levels of

categorical explanatory variables were appropriately defined for easy interpretation and analysis. Subsequently, after extracting the study variables from each country dataset, we consolidated them into a unified dataset [12].

Outcome variables

We examined three categories of outcome variables: hypertension, diabetes, and hypercholesterolemia. Each of these outcome variables is a binary classification, designated as "YES = 1/NO = 0.

Elevated blood pressure, or hypertension, is a serious medical condition associated with an increased risk of heart, brain, kidney, and other diseases. Often referred to as a "silent killer" hypertension may go unnoticed by individuals, as it may manifest no warning signs or symptoms. An individual is classified as hypertensive if, on two consecutive occasions, their systolic blood pressure exceeds 140mm Hg, and their diastolic blood pressure is above 90mm Hg. Various factors contribute to hypertension, including unhealthy dietary habits (excessive salt consumption, high intake of saturated and trans fats, low consumption of fruits and vegetables), lack of physical activity, tobacco and alcohol use, and being overweight or obese [18].

Blood pressure measurements were conducted using a digital, automated blood pressure monitor. Participants were instructed to sit quietly and rest for 15 minutes with their legs uncrossed before the measurements. Three readings of systolic and diastolic blood pressure were taken, with participants resting for three minutes between each reading. The mean of the second and third readings was calculated, and a universal cuff size was utilized for all participants. Observations falling outside the range of systolic BP < 40 mm Hg or >300 mm Hg and Diastolic BP <30 mm Hg or > 200 mm Hg were excluded, although none of the adults' recorded readings in this range. If the third reading was deemed invalid, the average of the first two readings was considered [12].

Diabetes is a chronic metabolic disorder characterized by raised blood glucose or hyperglycemia that occurs when the pancreas does not produce sufficient insulin (Type 1 diabetes) or when the body cannot effectively use the insulin it produces (Type 2 diabetes). Over time, diabetes can cause damage to the heart, blood vessels, eyes, kidneys and nerves. Type 2 diabetes is much more common and affects older people (generally 35 years or older) around the world. An individual is considered to be hyperglycemic/diabetic if their fasting blood glucose is >7 mmol/L or >126 mg/ml 64. The risk for Type 2 diabetes arises increases among obese and physically inactive individuals Smoking also notably increases the risk of diabetes and other cardiovascular diseases [19].

Implementing straightforward lifestyle modifications proves effective in averting or delaying the onset of type 2 diabetes. These modifications encompass regular physical activity (a minimum of 30 minutes of moderate-intensity activity on most days), maintaining a healthy body weight, adopting a nutritious diet, and refraining from tobacco use. Blood glucose levels were assessed during Step 3 of the survey, involving the collection of a venous blood sample, as

detailed in the data collection section. Appropriate consent was obtained from respondents for obtaining blood samples and conducting biochemical measurements. Observations falling outside the range of fasting blood glucose < 18 mg/dL or > 630 mg/dL were excluded, although none of the adults' recorded values within this range during the survey [12].

Elevated blood cholesterol was defined as having a lipid profile (including total cholesterol, HDL, and triglycerides) equal to or greater than 190 mg/dL during the study. Alternatively, individuals with normal cholesterol levels at the time of the survey but previously diagnosed with elevated blood cholesterol and currently undergoing medication for its control were also included in this category. Hypercholesterolemia is specifically defined as a blood cholesterol level exceeding 190 mg/dL or 5 mmol/L. Increased cholesterol levels elevate the risks of heart disease and stroke, with approximately one-third of ischaemic heart disease cases globally attributed to high cholesterol [20]. To proactively address the morbidity and mortality associated with elevated cholesterol, one of the key public health strategies involves early detection through regular screening (at least annually) of healthy individuals. Observations falling outside the cholesterol level range of <75 mg/dL or >470 mg/dL were excluded from the study, though none of the adults' recorded values within this range [12].

Explanatory variables

Demographic details and various health measures, including tobacco use, fruit and vegetable consumption, alcohol and salt intake, and physical activity, were collected. Additionally, participants' height, weight, hip and waist circumference were measured. Economic status was determined through principal component analysis of the wealth index based on household assets. Data on time spent on moderate and vigorous physical activities, encompassing work, leisure time, and commuting, were transformed into minutes per week and then converted to metabolic equivalent task (MET)-minutes per week.

Information regarding the treatment of hypertension and diabetes was obtained, and prescriptions or medicine strips were verified when necessary. Participants removed shoes and heavy clothing before height (measured to the nearest centimeter) and weight (measured to the nearest 0.2 kilograms) assessments. Validated instruments were used for measurements, with participants barefoot and in light clothing. Weight was measured to the nearest 10 grams using a digital weight measuring machine, while height was measured to the nearest 0.1 centimeters using a portable stadiometer. Waist and hip circumference were measured with a tailor measuring tape. All instruments underwent routine calibration during the survey.

Data enumerators, possessing post-graduate qualifications in sociology, psychology, or anthropology, conducted interviews and physical measurements. Medical technologists with diplomas, bachelor's, or master's degrees in medical laboratory science collected and processed samples. The recruited staff received training covering all survey steps, including interactive sessions, skill development, and pilot testing.

Statistical Analysis

We conducted a comprehensive analysis of descriptive statistics for selected participants across different countries and their socio-economic backgrounds. Descriptive statistics involved percentages, while inferential statistics utilized logistic regression to discern non-communicable disease (NCD) risk factors. Background characteristics were cross-tabulated with NCD risk factors, and the significance of relationships was assessed through the X2 test. Outcome measures and group differences were calculated with a 95% confidence interval (CI) and deemed significant at a p-value <0.05. The degree of association for risk factors was evaluated using adjusted odds ratios (AOR). We conducted tests for multicollinearity and adjusted risk factors through multivariable logistic regression analysis. Informed consent was obtained from each participant before data collection, with a strict commitment to maintaining confidentiality, privacy, and data anonymity. All activities were carried out in adherence to the revised declarations of Helsinki. The reported findings in tables and figures are based on weighted estimates to accurately reflect national figures. The STROBE Statement—A Checklist, outlining items for cross-sectional study reports, was adhered to in this study [Supplementary Table S1].

Results

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