## Research Article

# Risk Factors among Persons with Pre-Diabetes and Untreated Diabetes in Myanmar and Increased Burden for Non-Communicable Diseases

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## Abstract

**Context:** Non-Communicable diseases (NCDs) are major global public health challenges accounting for the majority of disease burden and mortality globally and in Myanmar. When uncontrolled, consequences for health can be devastating, amplified in developing countries such as Myanmar where they are also serious barriers to poverty alleviation and sustainable development. An understanding of trends in behavioural and metabolic risk factor is needed to guide NCD prevention and management policies.

**Aims:** This study aims at identifying risk factors among individuals in Myanmar at risk for NCDs.

**Study design:** This study identifies prevalence of risk factors among pre-diabetic and untreated diabetic people using secondary data from the Myanmar STEPS 2014 survey.

**Methods:** IBM SPSS Statistics 25 was used for data analysis and application of descriptive statistics.

**Results:** Findings of this study indicate that out of the population diagnosed with pre-diabetes, over one third of persons are not doing enough physical exercise (39.1%), are obese or overweight (33.1%), and/or have high blood pressure (41.4%) or high cholesterol levels (47.3%).

Similar trends, and higher numbers, are found for untreated diabetic people, where more than half of the population has a high BMI (55.3%), raised blood pressure (58.5%), and/or raised cholesterol (69%). Overall, 52.4% of pre-diabetic people and 71.3% of persons with untreated diabetes are living with three or more risk factors.

**Conclusion:** Identifying high-risk individuals for diabetes and other NCDs and scaling up on interventions aimed at reducing incidence of risk factors among these populations are needed to reduce the burden of NCDs.

**Keywords:** Non-communicable diseases; Diabetes; Public health policies; Myanmar; Prevention

## 1. Introduction

Non-communicable diseases (NCDs), also known as chronic diseases, are caused by genetic, physiological, environmental, and behavioral factors, and are driven by rapid urbanization, globalization of unhealthy lifestyles, and population ageing [1]. According to the Global Health Observatory, 71% of 56.9 million global deaths in 2016 were caused by NCDs. In 2016, leading causes of NCD deaths were cardiovascular diseases (44% of all NCD deaths), cancers (22% of all NCD deaths), and respiratory diseases, including asthma and chronic obstructive pulmonary disease (9% of all NCD deaths).

Diabetes accounted for 4% of all NCD deaths, causing 1.6 million deaths. Globally, the number of people living with diabetes has increased over the past decades. In over three decades, from 1980 to 2014, the number of adults living with diabetes went from 108 million to 422 million, increasing the global prevalence from 4.7% to 8.5% [2].

Diabetes is especially alarming as it can lead to additional health complications and increases the overall risk of premature death. In 2019, 1.5 million deaths were directly due to diabetes. High blood glucose is estimated to cause more deaths by increasing risk for other diseases (including cardiovascular and kidney disease and tuberculosis); in 2012 (latest available figure), high blood glucose caused 2.2 million deaths [3]. Diabetes and its complications have severe economic consequences, especially on the world's poorest, by draining household resources due to the high and lengthy costs of diabetes care and treatment [4].

In addition to the costs for households, costs of diabetes are also felt on national economies, through decreased productivity and loss of wages. Such challenges contribute to serious barriers in achieving sustainable development goals [5]. People of all ages can be exposed to NCD risk factors, including unhealthy diets, physical inactivity, tobacco consumption, and excessive use of alcohol, and the vulnerable and socially disadvantaged groups are even more likely to be exposed while having limited access to services [4]. Lower-socio economic groups are more likely to be exposed to NCD risks due to exposure to pollutants, the prevalence is high in low and middle-income countries. In 2016, NCDs caused 31.5 million deaths in these areas – that is 75% of global NCD deaths [4]. In the South-East Asian Region (SEAR), four major NCDs, including diabetes, are the leading cause of illness and death. Of the estimated 13.7 million total deaths in 2016 in SEAR, 8.5 million were due to NCDs [6]. In Myanmar NCDs accounted for 59% of total deaths in 2014, and the burden of NCDs increased to 68% in 2018; diabetes accounted for 3% of deaths in 2014, and increased to 4% in 2018 [7]. Diabetes was ranked number one for health problems causing the most disability in the country in 2017 [8], and a study reported overall diabetes prevalence at 10.5%; higher for women (11.8%) than for men (9.1%) and increasing with age [9].

The study also identified varying prevalence in the 14 states and regions of Myanmar, where prevalence was the highest in Yangon region (18.2%) and lowest in Nay Pyi Taw (4.2%) [9]. A study established in Yangon Region of Myanmar found differences in uptake of healthcare services between urban and rural areas; only 26.4% of participants had had their blood glucose measured by a doctor or health worker in rural areas, as compared to 43.1% in urban areas. Additionally, the study found that the proportion of controlled diabetic cases was higher in urban areas; 45.8% as compared to 32% in rural areas [10]. In the 2014 STEPS survey, of the individuals previously diagnosed with diabetes, 76.3% were taking oral anti-diabetic drugs, while 8.7% were taking insulin [11]. Risk factors contributing to NCDs and diabetes, including tobacco use, dietary risks, high blood pressure, high BMI, and alcohol use were all ranked as top 10 factors driving the most death and disability combined in 2017. Harmful use of alcohol intake, defined as the total alcohol per capita consumed by adults aged 15 and over, increased by 0.7 litres from 2010 to 5 litres in 2016, with men constantly engaging in heavier drinking than women. Obesity rates also increased from 4% in 2008 to 6% in 2016. WHO also projected obesity and raised blood pressure trends to continue increasing through 2025 [7].

Barriers and inequalities in the healthcare delivery system remain important reasons for untreated or uncontrolled illness. In fact, over the past years, investments in rural health services were too low, and funding has been inadequate for expansion of universal health coverage, leaving significant gaps at the primary care level. In addition, significant gaps remain between rural and urban areas, and services do not always reach the poor and disadvantaged groups. Essential medication and diagnosis services are often not available in rural health facilities, as the majority of physicians and diabetologists are often located in urban areas [12]. Further, challenges in rural areas remain in terms of health seeking behaviour issues,

including preference for traditional medicine, and lifestyle and diet issues and issues pertaining to religion and environment [13].

Policymakers have had the tendency to focus their efforts on diabetic patients, while little attention has been raised on the importance of identifying and of reducing risk factors for at-risk individuals for management of diabetes and other NCDs. However, identifying risk factors among individuals at risk for diabetes and other NCDs is becoming increasingly important to reduce incidence and onset of such illnesses. The objective of this study is to explore prevalence of risk factors among persons with pre-diabetes and untreated diabetes using STEPS 2014 survey data.

## 2. Methods

### 2.1 Data source

Secondary data was used for this study from the National Diabetes and NCD Risk Factors Survey conducted in 2014 (STEPS 2014) that selected a nationally representative sample of 8,575 participants from 52 townships (out of 332 townships across the country). The study was approved by the Ethical Committee of the Department of Medical Research (41/Ethics/2013), and informed consent was obtained from all participants in the survey. Individuals were asked about their history of diabetes (if they had ever been diagnosed, and if so whether they were on treatment or not).

Further, respondents were also screened for diabetes and prediabetes by applying fasting plasma glucose and the level of glucose 2 hours after 75g glucose load. Questionnaires were carried out to explore

demographic and lifestyle behaviors. Anthropometric measurements were also taken by using stadiometer, weighing scale, measuring tape, and blood pressure monitor measuring devices. IBM SPSS Statistics 25 was used for survey data analysis and application of descriptive statistics.

### 2.2 Variables and definitions

Individuals were identified as persons with pre-diabetes, or Impaired Glucose Tolerance (IGT) if their plasma 2-hour glucose value was equal or above 6.1 mmol/L (140 mg/dl) and equal of below 11.0 mmol/L (199 mg/dl). Persons with untreated diabetes were defined as individuals having ever been diagnosed with raised blood glucose levels, and who responded not having had consumed any drugs for diabetes prescribed by a doctor over the past two weeks.

In terms of risk factors, four behavioural risk factors (diet, alcohol and tobacco consumption, and physical activity) and three metabolic risk factors (BMI, blood pressure, and cholesterol), were included based on WHO definitions for NCD risk factors. Dietary habits were measured by looking at number of fruits and vegetables servings were consumed on average in a day. Individuals who reported consuming less than 5 servings of vegetables consumption of fruits and vegetables daily, based on WHO recommendations, were considered at risk for this factor. Alcohol and tobacco consumption were also investigated. Individuals who were currently smoking any tobacco products on daily basis, at the time of survey, were identified as current users of tobacco. Respondents having had had any alcohol product (such as beer, wine, spirits, fermented toddy palm sac) in the past 30 days were identified at risk. Lastly, individuals were

asked about the intensity of their physical activity at work, in leisure time, and for traveling purposes.

Information was compiled for moderate-intensity and vigorous-intensity activities and individuals who did not meet the WHO recommendation for sufficient physical activity "doing at least 150 minutes of moderate-intensity physical activity per week, or equivalent (75 minutes of vigorous-intensity physical activity or an equivalent combination of moderate and vigorous intensity physical activity achieving at least 600 MET-minutes)" were identified. In terms of metabolic risk factors, two physical measurements (BMI, and blood pressure), and one biomedical measurement (cholesterol levels) were included.

Physical measurements included height and weight, and BMI was determined. Individuals who were overweight (defined as having a BMI of 25.0-29.9) and/or obese (BMI of 30 or higher) were considered for this risk factor. Blood pressure measurements were taken in the STEPS survey using automatic digital blood pressure monitor. Individuals with high blood pressure, or hypertension, were defined as those with systolic blood pressure of 140 mm Hg or more, and/or diastolic blood pressure of 90 mm Hg or more, or currently on medication for raised blood pressure. Lastly, cholesterol levels were measured on site at time with finger-prick blood draw. Individuals with raised total cholesterol were defined as those who had cholesterol levels equal or more than 190mg/dl. Individuals, who had ever been diagnosed with high cholesterol previously, were also considered for this risk factor.

STEPS survey included 8757 respondents. Out of the 7594 individuals whose fasting blood glucose value were taken,19.4% (1477) had impaired glucose tolerance, and out of the total 495 individuals ever having been diagnosed as diabetic, 26.6% (132) reported not taking any treatment over the past two weeks. In terms of sex distribution, most persons with pre-diabetes, and untreated diabetes were females; 73 and 77% respectively.

Distribution of individuals by level of highest education achieved was similar across groups. Between 70 and 80% of population were educated at primary school level or less, and only 6% of population had completed higher education (college, university, or post-graduate degree). In terms of income, majority of population across samples were in the lower income, as defined by less than 300,000 MMK (Myanmar Kyats) per month (approximately 200USD monthly).

| | Persons with pre-diabetes | | Persons with untreated diabetes | | Total sample | |
|---|---|---|---|---|---|---|
| | | | | | | |
| Total sample | 1477 | | 132 | | 8757 | |
| Mean age (years) | 46.4 | | 51.6 | | 44.7 | |
| Sex | | | | | | |
| Male | 401 | 27.1% | 30 | 22.7% | 3079 | 35% |
| Female | 1076 | 72.9% | 102 | 77.2% | 5678 | 65% |
| Mean years of school | 5.9 | | 7.8 | | 5.7 | |
| Educational Level | | | | | | |
| No formal schooling or less than primary | 572 | 38.7% | 38 | 28.8% | 3282 | 37.5% |
| Primary school | 555 | 37.6% | 51 | 38.6% | 3258 | 37.2% |
| Secondary school | 258 | 17.5% | 34 | 25.8% | 1631 | 18.6% |
| Higher education | 90 | 6.1% | 8 | 6.1% | 564 | 6.4% |
| Does not wish to respond | 2 | 0.1% | 1 | 0.8% | 22 | 0.2% |
| Work status | | | | | | |
| Employed | 991 | 67.1% | 70 | 53.0% | 6258 | 71.5% |
| Homemaker | 304 | 20.6% | 49 | 37.1% | 1623 | 18.5% |
| Retired | 38 | 2.6% | 6 | 4.5% | 217 | 2.4% |
| Student or unpaid | 31 | 2.1% | 3 | 2.3% | 189 | 2.2% |
| Unemployed | 112 | 7.6% | 4 | 3.0% | 465 | 5.3% |
| Does not wish to answer | 1 | 0.1% | 0 | 0% | 5 | 0.1% |
| Income range (monthly income in MMK) | | | | | | |
| Lower income (less than 300,000) | 1081 | 73.2% | 92 | 69.7% | 6571 | 75.0% |
| Low-middle income (300,000 – 600,000) | 179 | 12.1% | 22 | 16.7% | 959 | 10.9% |
| Middle income (600,000 – 900,000) | 17 | 1.2% | 0 | 0% | 113 | 1.3% |
| Middle-high income (900,000 – 1,250,000) | 10 | 0.7% | 0 | 0% | 57 | 0.7% |
| High income (1,250,000 and above) | 3 | 0.2% | 0 | 0% | 30 | 0.3% |
| No answer | 187 | 12.7% | 18 | 13.6% | 1027 | 11.7% |

**Table 1:** Demographic profile of persons with pre-diabetes and untreated diabetes.

## 3. Results

In terms of risk factors, over one third of persons with pre-diabetes and untreated diabetes were not doing enough physical activity. In addition, over one third of the people with pre-diabetes, and over half of those with untreated diabetes were overweight or obese, while prevalence of overweight and obese in the total STEPS survey population was lower (22.4%) [11]. Across all groups very few individuals were following the WHO recommendations for servings of fruits and vegetables. Additionally, higher percentage of pre-diabetic and untreated diabetic patients, respective of their group, were at increased risk for NCDs in terms of metabolic risk factors; 41% of the persons with pre-diabetes and 58.5% of those with untreated diabetes had raised blood pressure. In addition, nearly half of the population or more in each group had raised total cholesterol levels, whereas in the STEPS survey, out of the total survey population, only 37% had raised cholesterol [11].

| | | Persons with pre-diabetes | | Persons with untreated diabetes | | STEPS 2014 findings (total population) Total sample | |
|---|---|---|---|---|---|---|---|
| | | Count | Percent[a] | Count | Percent[a] | Count | Percent[a] |
| Behavioral risk factors | Inappropriate diet | 1100 | 74.5% | 102 | 77 .3% | 7584 | 86.6% |
| | Tobacco use | 251 | 16.9% | 17 | 12.9% | 1813 | 20.7% |
| | Alcohol consumption | 171 | 11.6% | 15 | 11.4% | 1734 | 19.8% |
| | Insufficient physical activity | 577 | 39.1% | 46 | 34.8% | 1375 | 15.7% |
| Metabolic risk factors | High Body-Mass Index (BMI) | 489 | 33.1% | 73 | 55.3% | 1962 | 22.4% |
| | Raised blood pressure[b] | 609 | 41.4% | 76 | 58.5% | 2312 | 26.4% |
| | Raised total cholesterol[c] | 651 | 47.3% | 78 | 69.0% | 3214 | 36.7% |
| Total | | 1477 | | 132 | | 8757 | |

[a] Total does not add to 100% due to multiple responses
[b] For persons with pre-diabetes, 6 values were missing, and for persons with untreated diabetes, 2 values were missing
[c] For persons with pre-diabetes, 101 values were missing, and for persons with untreated diabetes, 19 values were missing

**Table 2:** Results for risk factors for total sample, persons with pre-diabetes, and persons with untreated diabetes.

| | | Persons with pre-diabetes | | Persons with untreated diabetes | |
|---|---|---|---|---|---|
| | | Count | Percent | Count | Percent |
| Combined risk factors (behavioral and metabolic) | Seven | 0 | 0% | 1 | 0.8% |
| | Six | 8 | 0.5% | 3 | 2.3% |
| | Five | 88 | 5.9% | 6 | 4.5% |
| | Four | 263 | 17.8% | 36 | 27.3% |
| | Three | 417 | 28.2% | 48 | 36.4% |
| | Two | 410 | 27.8% | 28 | 21.1% |
| | One | 237 | 16.0% | 8 | 6.1% |
| | None | 54 | 3.7% | 2 | 1.5% |
| Total | | 1477 | | 132 | |

**Table 3:** Summary of combined risk factors (behavioral and metabolic).

Based on the definitions of risk factors, 52.4% of persons with pre-diabetes, and 71.3% of persons with untreated diabetes were living with three or more risk factors. Lastly, out of the persons with pre-diabetes only 3.7% and only 1.5% of those with untreated diabetes were living with no risk factors.

## 4. Discussion

The STEPS survey revealed that diabetes affects 10.5% of adults in Myanmar, with a higher prevalence among women (11.8%) compared to men (9.1%) and increasing with age (21.6% of persons aged 55-64 had diabetes compared to 4.1% of persons aged 25-34), and that approximately 19.5% of the population had pre-diabetes, again with a higher prevalence among women (23.9% vs. 15.2% for men) and increasing with age where prevalence among individuals aged 55-64 is 28.7% as compared to 13.4% for individuals aged 25-34. Out of those with diabetes, 26.6% reported not haven taken any

treatment over the past two weeks. This study looked at the prevalence of risk factors among patients with pre-diabetes and person with untreated diabetes respondents. Based on our knowledge, this is the first study trying to identify such trends among these two at-risk groups for diabetes in Myanmar. Results indicated high prevalence of metabolic risk factors among the two groups, such as obesity, raised total cholesterol, and raised blood pressure, which all increase the risk for diabetes and other NCDs. In addition, high percentages of the populations had several behavioral risk factors. Most individuals did not meet the WHO recommendations daily fruit and vegetable intake and did not engage in sufficient physical activity. Understanding and identifying such risk factors is important as modifiable behavioral risk factors have a causal association with metabolic ones.

For diabetic patients, the illness is not reversible, however if individuals are screened and referred for

treatment and engage in risk reducing behaviors risks, diabetic complications can be managed, and risks for other NCDs can be reduced. On the other hand, for pre-diabetics the illness can be prevented. Certain risk factors, such as elevated plasma glucose concentrations, or over-weight, that contribute to the chances of developing diabetes, and increase risks for other NCDs, are potentially reversible. For instance, regular physical activity can reduce the risk of diabetes, other NCDs such as ischemic heart disease, stroke, and even breast and colon cancer [4]. Studies have shown that lifestyle interventions aimed at increasing physical activity and reducing weight are also effective in reducing the incidence of type 2 diabetes [14]. Such interventions have been scaled up to the wider parts of the population in some high-income countries, such as in the US [14, 15], in Australia [16], and Finland [17, 18]. In low- and middle-income countries identifying high-risk people for such interventions can be time consuming and expensive, and context-appropriate interventions are needed. Community programs in neighbor countries have proven to be cost-effective and could set the example for the Myanmar. In Bangladesh, the D-magic project aimed mobilizing and building capacity among communities to identify on their own and address factors that increase their risks of diabetes [19]. In a Lancet study, this intervention has proved highly effective in raising knowledge and awareness, and ultimately in reducing prevalence of type 2 diabetes and intermediate hyperglycaemia [20]. A similar intervention in Thailand was proven effective in preventing or delaying diabetes among populations with impaired glucose tolerance [21]. These studies highlight the efficiency and effectiveness of integrated programs at the community and primary care level for

the detection and management of metabolic risk factors leading to diabetes and other NCD, especially in the context of low-middle income countries. Nevertheless, population-wide policies are also needed in Myanmar. A study assessing the changing face of risk factors for NCDs in Myanmar between 2009 and 2014, also based on the STEPS surveys, found that tobacco and alcohol consumption had increased [22]. Tobacco control is difficult to apply in Myanmar, namely due to delays in implementation of regulations aimed at restricting smoking in public places, prohibiting tobacco product advertising and promotion, and introducing health warnings on packages [23]. Alcohol control faces a similar situation, as the national policy is not yet formulated. Further, alcohol is still widely available in restaurants throughout the country and is easily accessible to all adults 18 years and above [24]. This highlights the need for stronger policies to control tobacco and alcohol consumption in Myanmar.

Conclusively, the findings of this study and the facts highlighted above, raise the importance of community interventions aimed at improving health literacy as well as health seeking behavior, and mobilizing at-risk populations for lifestyles changes, more frequent screening, and improved adherence to treatment. At the same time, creating a sustainable referral system between the community and primary health care, is crucial for early diagnosis and management of the disease. Improving health facilities, as well as capacity of health staff in managing NCDs, and health information at the primary health care level and higher levels is also crucial for tackling the burden of diabetes [25]. Population-wide policies combined with community interventions to address these

modifiable risk factors will be crucial to achieve this target, and to reduce the burden of NCDs. Additional research is needed to evaluate the effectiveness of interventions to prevent diabetes and its complications in Myanmar.

When considering policy implications of this study it is important to keep in mind certain limitations of the paper. First, certain risk factor indicators could be improved by refining the definition. For instance, in terms of dietary habits, we only included intake of fruits and vegetables, nevertheless excess consumption of dietary sodium plays an important role as it is associated with increased risk of hypertension and cardiovascular disease. In terms of alcohol consumption, the paper looked at individuals having had consumed alcohol within the past 30 days, however WHO defines the risk factor as "harmful intake of alcohol".

For further research, more information on drinking habits could be included. Though in this paper we look at smoking prevalence, smokeless tobacco, or betel nut chewing is highly prevalent in Myanmar, especially in rural areas [26] and has been proven to be correlated with type 2 diabetes mellitus [27, 28]. Second, a common limitation across studies using behavioral data analysis is the likelihood of respondents under reporting risky behaviors which could lead to underestimation of prevalence of risk factors. Lastly data for this study was based on the survey conducted in 2014. A new STEPS survey is being implemented in 2019. For further research, and for evidence-based policy making, looking at evolution in risk behaviors for NCDs, and in the prevalence of pre-diabetic and diabetic untreated will

be important. In addition, monitoring such trends and prevalence of risk factors among these groups will be crucial for contributing to the reduction of other NCDs and for diabetes management.

## 5. Conclusion

The burden of NCDs especially diabetes is increasing in Myanmar, and many individuals with pre-diabetes and untreated diabetes are living with three or more risk factors for diabetes and other NCDs. Behavioral, or modifiable risk factors are linked with metabolic risk factors and have causal association. Health literacy is needed among communities for improving both the knowledge on risk factors for NCDs and on the importance of screening. Improving knowledge and healthy lifestyles and ultimately changing risk behavior could help in reducing the prevalence of metabolic risk factors, hence, could reduce risks for getting diabetes and other NCDs.

Furthermore, interventions aimed at mobilizing communities and improving health seeking behaviors and integrating with an improved care at the primary level, could help in early diagnosis of diabetes, and hence improve control of the illness. Lastly, changes in national policies are also needed in Myanmar to better control the supply and demand of tobacco and alcohol products.

These findings have important policy implications for Myanmar. Identifying and targeting high-risk individuals for diabetes and other NCDs and increasing and improving interventions aimed at reducing incidence of risk factors among these populations are crucial to reduce the NCD burden.

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## Declaration of Competing Interests

We have no competing interest to disclose.

## Ethical Approval

We use secondary data from the STEPS survey for which the study was approved by the Ethical Committee of the Department of Medical Research (41/Ethics/2013), and informed consent was obtained from all participants in the survey

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