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Research Article

# High Prevalence of Pre-diabetes and Diabetes in Asymptomatic Patients Attending an Endocrine Clinic in a Tertiary Care Institute in Colombo

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## ABSTRACT

**Background:** The prevalence of pre-diabetes and diabetes has risen exponentially in the recent past. Though the symptomatic patients frequently undergo testing for the diagnosis of the disease, asymptomatic individuals are not routinely subjected to diagnostic testing. Thus, data on asymptomatic people are still lacking. We have studied the prevalence of pre-diabetes and diabetes in asymptomatic subjects attending the Endocrinology clinic in a tertiary care institute in Sri Lanka.

**Methods:** A descriptive cross sectional study was conducted from January 2020 to August 2020 at the endocrinology unit of the national hospital of Sri Lanka. Systematic sampling was done recruiting non diabetic patients aged more than 40 years, attending the clinic for other endocrine diseases. After obtaining informed written consent, the data was collected using an interviewer administered questionnaire. Pre-diabetes or diabetes was diagnosed according to the ADA-2020 diagnostic criteria.

**Results:** The study enrolled hundred and nine patients. The mean age was 53.9 years (range 40-76) and 90.8% were females. The mean weight was 62.1(SD=11.3) kg and Body Mass Index (BMI) was 26.6 (SD=4.6) $kg/m^{-2}$. Forty six percent had a family history of first degree relative being affected with type-2 diabetes. All the patients were asymptomatic of classic symptoms of hyperglycemia. Patients were evaluated with fasting blood glucose levels and Hemoglobin A1c (HbA1c) values. Forty nine patients (45%) were diagnosed with diabetes or pre-diabetes with either one or both values "being impaired range". Out of that, six patients (5.5%) were diagnosed with type-2 diabetes and 43 patients (39.4%) were diagnosed with pre-diabetes. Out of the patients diagnosed with pre-diabetes and diabetes (n=49), sixty four percent did not had a family history of first degree relative being affected with type-2 diabetes. Out of the pre-diabetes and diabetes patients 32% had their BMI<25 $kgm^{-2}$.

**Conclusion:** The prevalence of pre-diabetes and diabetes are much higher than expected in asymptomatic individuals. Hence, the likely patients should be regularly screened to diagnose asymptomatic phase of the disease. This is important as the prevalence has escalated in the immediate past, and diagnosing and treating early will improve long term outcome of the disease. Further large scale studies including community studies are needed to recognize the current prevalence and the rising trend both in urban and rural regions.

**Keywords:** Pre-diabetes; Diabetes; Prevalence; Asymptomatic; Family history

## INTRODUCTION

Rapid urbanization and globalization has greatly contributed to the escalating growth of non-communicable diseases in the current era. Being part of the metabolic syndrome, the prevalence of pre-diabetes and diabetes has also followed the same trend. Globally, 8.8% of the population aged 20-79 year is affected while 10.7% of Sri Lankans are enduring the disease [1]. Urban population in Sri Lanka seem to be affected more at a value of 57.9% of pre-diabetes and diabetes, which can be related to the urbanization, rapid change in the pattern of diet and exercise [2]. Similar trends can be seen in South Asian populations as well as in South Asians living in developed western countries [3]. "Compared to other ethnic groups, South Asians" living in Asia as well as affluent countries seem to have a high risk compared to other ethnic groups [3]. After age adjustment, the prevalence of diabetes in Asians was seen at least 3.8 times higher than that in Europeans living in London [3]. Patients aged between 40 and 64 years are being affected at a rate of five times higher when compared to other Caucasians in the same study [3]. Importantly, South Asians affected with diabetes living in Europe seem to be younger and having a lesser Body Mass Index (BMI) compared to Caucasians [4]. Furthermore, with time glycaemic control deteriorated more rapidly at a rate of 1.31% in

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Asians *vs.* 0.82% in Europeans [4]. Moreover, patients with type-2 diabetes mellitus from Asia had a higher incidence of renal complications and ischemic stroke as depicted in the Action in Diabetes and Vascular Disease (ADVANCE) study necessitating early and aggressive interventions [5].

Non communicable diseases, primarily, diabetes mellitus remains a significant health concern globally as well as regionally. The impact is more as it is associated with a huge economical expense. The total cost of diabetes care at a value of $245 billion in 2012 has risen to $327 billion in 2017 which is a 26% increase spanning over a five-year period [6]. Most of the South Asian countries are still under development and the economic burden incurred by the disease burden will significantly hinder the countries' advancement. Thus, risk factor prevention, early detection and aggressive care started in the initial disease period will make significant changes in the economy, mainly in South Asian regions. Though the patients who are symptomatic of hyperglycemia often seek medical care, detecting asymptomatic individuals may be challenging. Several risk factors and scoring systems are available to determine the population at risk who needs regular screening. A recently done regional study has detected that in 33.7% of the asymptomatic individuals are having diabetes indicated by HbA1c>7 percent [7]. Approximately, progression to diabetes is seen in about 5-10% of pre-diabetes per year and as high as 70% patients with pre-diabetes will develop clinical diabetes within their lifetime [8,9]. Pre-diabetes, nonetheless may be reversible at a rate of 5%-10% per year achieving normoglycaemia through aggressive lifestyle modification and treatment if needed [8,10].

Several large scale studies has been done to detect the prevalence of pre-diabetes and diabetes in the community as well as regionally [7,11]. Though Sri Lankan data is available on the community prevalence, the recent trends allow us to surmise a higher rates of pre-diabetes and diabetes in asymptomatic individuals than detected [2,12]. The present study plans to discuss the latest prevalence of pre-diabetes and diabetes among asymptomatic adults in Sri Lanka and explore the socio-demographic factors associated with the disease.

## MATERIALS AND METHODS

Adult males and females aged >40 years who are attending the Endocrinology clinic at National Hospital of Sri Lanka was recruited to the study. The clinical assessments and tests were performed in accordance with relevant guidelines and regulations of the ethical review committee of the National Hospital of Sri Lanka. The urban and suburban residents living in Colombo attend the above clinic and the study sample represents the above population.

### Sample size

Sample size of 100 was calculated using the Lwanga and Lameshow 1991 formula of $n=z2p(100-p)D/d^2$. Studies done in the recent past to assess the prevalence of diabetes and pre-diabetes has demonstrated varying prevalence among different populations [2,12]. A prevalence of 60% was considered when calculating the sample size and the desired level of precision was taken as 5% (0.05) with a 95% confidence interval. The sample size calculation was done using the EPI 6 sample calculation software. Hundred and nine patients were enlisted to the study over a period of six months in 2020.

### Sampling technique

Males and females aged >40 years who does not have a past history of diabetes were considered to be recruited to the study. Pregnant females and patients who are unable to give consent or not giving consent were excluded. The participants were selected using systematic sampling. Every 10$^{th}$ patient who is meeting the above mentioned inclusion and exclusion criteria was recruited to the study.

### Data collection

The selected asymptomatic participants who are attending the endocrine clinic at the National Hospital of Sri Lanka was educated regarding the study by a team of medical officers to explain about the research and to invite them for the study. Informed written consent was taken by the interviewer and the data was collected with the aid of an interviewer administered questionnaire administered by trained interviewers and by measurement of anthropometric measures (weight, height). Subsequently, BMI was calculated by dividing weight in kilograms by height in meters squared (kg/m$^2$). All the participants were evaluated with Fasting Plasma Glucose (FPG) (GOD- PAP5 method, Abbott architect analyser) and glycated haemoglobin levels (HPLC method, HPLC analyser). The diagnosis of pre-diabetes and diabetes was made according to the American Diabetes Association 2020 criteria [13]. The diagnosis of pre-diabetes was made if, FPG 100 to 125 mg/dL (5.6 to 6.9 mmol/L) known as Impaired Fasting Glucose (IFG), or 2-hour post-load glucose on the 75 g Oral Glucose Tolerance Test (OGTT) was 140 to 199 mg/dL (7.8 to 11.0 mmol/L) known as impaired glucose tolerance (IGT) or glycated haemoglobin (HbA1C) 5.7 to 6.4% (39 to 46 mmol/mol). The presence of diabetes was diagnosed if FPG ≥ 126 mg/dL (7.0 mmol/L), or 2 hour plasma glucose ≥ 200 mg/dL (11.1 mmol/L) during an OGTT or HbA1C ≥ 6.5%.

### Statistical analysis

Data was analyzed using Statistical Package for Social Sciences 18. The prevalence is given in percentage with 95% confidence interval. Descriptive data was used to describe the population characteristics. Two sample t-tests were used to assess the differences in continuous variables, while a chi-square test was used for categorical variables. Multiple regression analysis was used to investigate the factors associated with diabetes status and stepwise selection method was adopted to select significant variables. P value of 0.05 was considered as significant.

### Ethical issues

Ethical approval was obtained from the Ethical Review committee of the National Hospital of Sri Lanka. Documents were encoded with numerical values to avoid personal identification. All the measures were taken to ensure confidentiality of subjects.

## RESULTS

109 subjects were recruited in to the study after taking informed written consent. Majority were females (90.8%). Mean age was 53.9 (SD ± 9.25) years and ranged from 40 -76 years. The mean

weight was 62.1 (SD ± 11.3) kg and BMI was 26.6 (SD ± 4.6) kg/m$^{-2}$. Table 1 summarizes the study group characteristics (Table 1).

**Table 1:** Study group characteristics.

| Mean characterstics | Both sexes (N=109) | Males (N=10) | Females (N=99) |
|---|---|---|---|
| Mean age (SD) years | 53.9 (9.25) | 50.2 (5.3) | 54.4 (9.5) |
| Mean Height (SD) cm | 152.6 (7.6) | 159.6 (8.2) | 152.6 (7.2) |
| Mean Weight (SD) kg | 62.1 (11.3) | 64.3 (8.7) | 61.8 (11.5) |
| Mean BMI (SD) kg/m$^2$ | 26.7 (4.7) | 25.8 (5.3) | 26.7 (4.6) |

BMI was categorized according to the WHO global and Asian cutoffs [14]. According to the global cutoffs majority were overweight (36.9 %) while 24.3 % were in the obesity range. Asian cutoffs categorized 41.7 %, which is the majority, as obese (Figure 1).

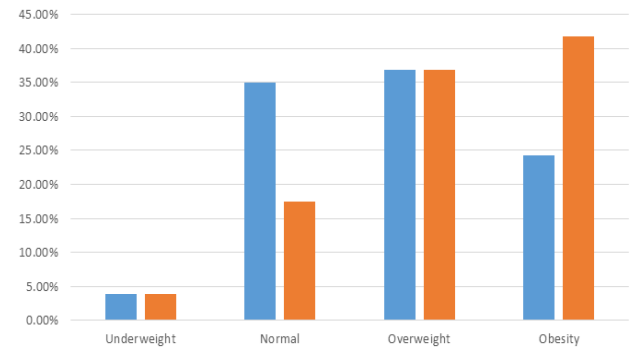


**Figure 1:** Prevalence (%) of underweight, normal weight, overweight and obesity according to Global and Asian cutoffs. **Note:** ( ■ ) Global BMI cutoffs; ( ■ ) Asian BMI cutoffs.

All the patients were asymptomatic of classic symptoms of hyperglycemia such as polydipsia, polyuria, nocturia, and weight loss. Patients were evaluated with Fasting Plasma Glucose (FPG) levels and HbA1c values. The mean FPG of the population was 92.5 mg/dL and mean HbA1C was 5.6%. Forty six percent subjects had a positive family history of diabetes in the first degree relatives (Table 2).

**Table 2:** Glycaemic indices of the study population.

| Glycaemic factors | Both sexes (N=109) | Males (N=10) | Females (N=99) |
|---|---|---|---|
| FPG (mg/dL) (SD) | 92.5 (14.9) | 88.7 (9.2) | 92.2 (13.5) |
| HbA1C (%) (SD) | 5.6 (0.56) | 5.4 (0.42) | 5.6 (0.57) |
| Family history of diabetes (%) | 45.6 | 44.4 | 45.7 |

Forty nine patients (45%) were diagnosed with diabetes or pre-diabetes with either one or both values being impaired range. Out of that, six patients (5.5%) were diagnosed with type-2 diabetes and 43 patients (39.4%) were diagnosed with pre-diabetes as shown in Figure 1. All the six patients diagnosed with diabetes were females (Table 3). Increased prevalence of pre-diabetes and diabetes was seen with increasing age, though the values were not significant (Table 4 and Figure 2).

**Table 3:** Prevalence of pre-diabetes and diabetes according to the gender.

| Prevalence category | Males (N=10) | Females (N=99) |
|---|---|---|
| Normal | 80% (N=8) | 52.5% (N=52) |
| Pre-diabetes | 20% (N=2) | 41.4% (N=41) |
| Diabetes | 0% (N=0) | 6.1% (N=6) |
| Cumulative pre-diabetes and diabetes | 20.00% | 47.50% |

**Table 4:** Prevalence of pre-diabetes and diabetes according to age categories.

| Prevalence category | 40-49 years (N=45) | 50-59 years (N=31) | 60-69 years (N=28) | ≥ 70 years (N=5) |
|---|---|---|---|---|
| Normal | 71.1% (N=32) | 41.9% (N=13) | 50.0 % (N=14) | 20.0% (N=4) |
| Pre-diabetes | 22.2% (N=10) | 58.1% (N=18) | 39.3% (N=11) | 80.0% (N=5) |
| Diabetes | 6.7% (N=3) | 0 % (N=0) | 10.7% (N=3) | 0% (N=0) |
| Cumulative pre-diabetes and diabetes | 28.90% | 58.10% | 50.00% | 80.00% |

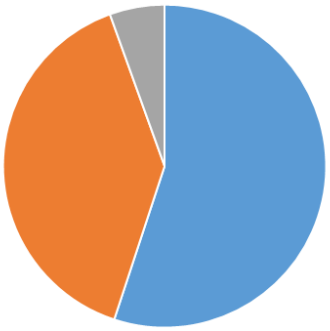

**Figure 2:** Prevalence of Pre-diabetes and Diabetes. **Note:** ( ■ ) Normal; ( ■ ) Pre-diabetes; ( ■ ) diabetes.

Out of the patients diagnosed with pre-diabetes and diabetes (n=49), sixty four percent did not had a family history of first degree relative being affected with type-2 diabetes. Out of the pre-diabetes and diabetes patients 32% had their BMI<25 kgm$^{-2}$. According to Asian cutoffs, 17% patients had their BMI<23 kgm$^{-2}$ (Table 5).

**Table 5:** Family history of diabetes and BMI according to glycaemic values.

| Category | Glycaemic range | Normal (N=60) | Pre-diabetes and diabetes (N=49) |
|---|---|---|---|
| Family history of diabetes in the first degree relative (%) | Present | 52.9 | 35.9 |
| | Absent | 47.1 | 64.1 |
| BMI (%) | <25 kgm$^{-2}$ | 44.6 | 31.9 |
| | ≥ 25 kgm$^{-2}$ | 55.4 | 68.1 |
| | <23 kgm$^{-2}$ | 25.00 | 17.00 |
| | ≥ 23 kgm$^{-2}$ | 75.00 | 83.00 |

Multiple linear regression analysis was performed to determine the predictors of development of pre-diabetes and diabetes. On analysis, increasing age had a significant association with pre diabetes and diabetes ($F=4.2$, $p<0.05$). BMI and family history did not demonstrate any significant association with glycaemic indices in the analysis.

## DISCUSSION

As depicted in recent studies, the prevalence of pre-diabetes and diabetes has risen markedly. The global data as well as regional data suggest an escalating growth in the numbers. According to latest data, 8.8% of the world population between 20 to 79 years is affected with diabetes [1]. South Asian countries like India, Pakistan, Bangladesh has prevalence data ranging from 9.2-19.9%. A prevalence of pre-diabetes in 30.3% and diabetes in 27.6% was seen in an urban community in 2015 which is an alarmingly high value compared to the available data regionally and globally [2]. The current study has demonstrated a cumulative prevalence of pre-diabetes and diabetes in 45% asymptomatic patients which is a quite high value as this does not include patients already diagnosed with diabetes or patients having hyperglycaemic symptoms such as polydipsia, polyuria and nocturia.

Urbanization and globalization that has rapidly spread across South Asia has partly contributed to the rapid rise in the diabetic epidemic as seen in the present study. Demographic-epidemiological transition which is characteristically descended form developed countries has changed the lifestyle patterns in Asians. Demographic transition has occurred due to increasing urbanization and industrialization which has resulted in improved education and medical care, leading to low fertility rates and increasing life expectancy culminating in an aging population. Nevertheless, the Asian population is still expanding due to persistently high reproductive rates. Thus, due to high fertility and increased life expectancy population in Asia is still growing at a rapid rate. Simultaneously, there is a change in mortality patterns due to a shift from infectious diseases to non-communicable diseases resulting in an epidemiological transition. Hence understanding the ongoing evolution of causes attributable to increased disease burden and mortality will be helpful in policy making and resource allocation in the country.

In this study the prevalence of pre-diabetes in the asymptomatic individuals is 39.4% which will go undetected if not regularly screened. This should be an eye-opener for health care providers as the need for early; regular screening should be the core in combating the epidemic of diabetes as well as other non-communicable diseases. This high prevalence of pre-diabetes indicated by Impaired Fasting Glucose (IFG) and deranged glycated haemoglobin highlights the progression of the epidemic in the South Asian region.

Several factors are known to be associated with increased risk of diabetes in South Asians. Family history, advancing age, male sex and high BMI are among known risk factors [15]. Our study also demonstrated advancing age as a significant contributor with 58.1 % between 50-59 years, 50.0% between 60-69 years and 80.0% more than 70 years being affected with pre-diabetes and diabetes. Contradictorily, our study detected pre-diabetes and diabetes more in female patients at a value of 47.5% compared to males (20.0%). Moreover, in contrast to previous evidence, family history of diabetes in the first degree relative or high BMI does not seem to be significantly associated with the disease development. Sixty four percent (64%) patients diagnosed with pre-diabetes and diabetes did not have a significant family history of diabetes. This will be important in risk factor evaluation as patients who do not have a first degree relative being affected with diabetes also should undergo extensive regular screening.

Furthermore, in our population, according to global cutoffs 61.2% had their BMI in the range of overweight or obesity whereas according to Asian cutoffs 78.6% had their BMI in the same range which is significant public health concern. Out of the patients diagnosed with pre-diabetes and diabetes 32% had their BMI<25 $kgm^{-2}$ and 17% had their BMI<23 $kgm^{-2}$. This indicates that aggressive interventions are crucial to combat the overgrowing overweight and obesity. Unplanned urbanization, physical inactivity, overcrowding, poor dietary habits, rural to urban migration has increased the obesity epidemic as detected in many recent studies [16,17]. Furthermore, in contrast to previous studies which has demonstrated the high BMI as a strong determinant of development of diabetes, a significant percentage in our study has developed the disease even at so called healthy BMI [2,18].

This study has several limitations. Multiple key determinants such as dietary patterns, physical activity, literacy and financial status etc. have not been explored in this study and future large scale studies with more comprehensive risk factor evaluation will be needed.

## CONCLUSION

The present study has detected alarmingly high rate of pre-diabetes and diabetes in asymptomatic individuals. Furthermore, the detected rates of over-weight and obesity rates are concerning and predict the pandemic of metabolic diseases that will develop in the next few years if not intervened as early as possible. This study enlightens us to be more vigilant on the rising crisis of non-communicable diseases and the necessity for urgent preventive and curative strategies. The detection of a higher proportion of pre-diabetes is an indicator of the future disease burden which will likely strain the economy of the country. Further large scale community studies will be needed to evaluate the risk factors in more detail and to make necessary sustainable changes in the health system for primary prevention of metabolic diseases in high risk populations.

## ETHICAL APPROVAL

Ethical approval was obtained from the Ethical Review committee of the National Hospital of Sri Lanka.

## COMPETING INTERESTS

None of the authors have any financial or non-financial competing interests to disclose.

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## CONSENT

All participants who enrolled in the study signed an informed consent form.

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