Community-Based Findings of Magnitude of Type 2 Diabetes Mellitus among Adults in Selected Towns of Western Ethiopia

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Keywords
Community-based · Magnitude · Diabetes mellitus · West Ethiopia

Abstract

Background: The risk of diabetes mellitus (DM) is remarkably increasing globally, and it is alarmingly increasing in developing countries including Ethiopia, especially in urban residents. The present study was aimed at uncovering the magnitude of type 2 DM (T2DM) among adults residing in the selected towns of western part of Ethiopia. Methods: A community-based cross-sectional study design was conducted in towns of western Ethiopia from June 1 to June 30, 2019. Multistage and systematic random sampling techniques were employed. The data were collected using structured interviewer-administered questionnaire based on the World Health Organization STEPwise approach. Data were entered into EpiData 3.1, cleaned, and analyzed by the statistical package for social sciences software version 24. Descriptive statistics and logistic regression were used for the analysis. Results: The prevalence of T2DM was 7.0% (95% confidence interval [CI] 5.4–8.8) with 8.5% (95% CI 5.6–11.0) and 6.0% (95% CI 3.9–8.1) among males and females, respectively. Being married (AOR = 4.0, 95% CI 1.1–14.7) and divorced (AOR = 6.2, 95% CI 1.1–34.4), consumption of inadequate fruits and vegetables per day (AOR = 2.8, 95% CI 1.1–6.8), physical inactivity (AOR = 5.0, 95% CI 2.5–10.0), hypertension (AOR = 2.9, 95% CI 1.3–6.2), overweight (AOR = 2.3, 95% CI 1.1–4.9), and obesity (AOR = 19, 95% CI 4.5–50.1) were factors independently associated with T2DM. Conclusion: The prevalence of DM in the study area was found to be substantially higher than the national prevalence and other pocket studies in the country. Sociodemography and modifiable risk factors were affecting the prevalence of DM.

Introduction

Diabetes mellitus (DM) is a serious, chronic disease that occurs as a result of either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. It remains an important public health problem of the 21st century across all over the world, affecting both developed and developing countries. Evidences show that the increasing trend of
prevalence of DM was observed in developing countries. There are different types of DM, where more than 90% are categorized under type 2 DM (T2DM) [1–3].

Globally, the number of people living with DM was rising dramatically fueled by the rise in the prevalence of obesity and sedentary lifestyle. It increased from 108 million in 1980 to 422 million in 2014 and currently 463 million people (which are 9.3% of the total population in the world) aged from 20 to 70 years. The total number is predicted to rise to 578 million (10.2%) by 2030 to 700 million (10.9%) by 2045 with 51% increment [2–4].

World Health Organization (WHO) estimates that diabetes is the seventh leading cause of death in 2016. In that year, 1.6 million deaths were directly due to diabetes. Almost half of the death reported was occurred among people of age less than 70 years [1, 4].

Overweight and/or obesity, unhealthy diet, poor physical activities, harmful use of alcohol, and cigarette smoking were factors mainly causing T2DM. Once considered as a problem of high-income countries, the prevalence of overweight and obesity was nearly tripled from 1975 to 2016 in low- and middle-income countries. This is due to shifting in eating behavior, westernization, and urbanization [5, 6].

Evidences show that there is a small gender difference in the global numbers of people with diabetes with about 14 million more men than women estimated to have diabetes in 2013. In both sexes, the prevalence abruptly increases with age. According to International Diabetes Federation, the prevalence of DM is lower among 20–24 years (1.4% in 2019) and 19.9 among 75–79 years in 2019. This is predicted to rise to 20.4%–20.5% by 2030 and 2045, respectively. The report also indicated that the estimated prevalence of DM in women aged 20–79 years is slightly lower than that in men (9.0% vs. 9.6%). In 2019, there were about 17.2 million more men than women living with DM [4, 7].

It is difficult to get comprehensive national data regarding epidemiology of DM in Ethiopia. The existing literatures were limited to specific areas: single town or single health facility, in which the prevalence of DM was reported as 0.3%–10.2% from different parts of Ethiopia [8–13].

According to the noncommunicable diseases (NCD) country profile set by WHO, the national mortality rate of DM was set to be 4% by 2018 [6]. Current evidence from International Diabetes Federation shows the prevalence of DM in Ethiopia as 3.2% with the total cases to be 1,699,400 [2]. However, there are contradictory data with the available local findings. The distribution of T2DM across age and sex of the patients is also not well studied in Ethiopia. In light of this, this study focused to uncover the magnitude and associated factors of T2DM among adults of urban residents of western Ethiopia.

**Methods and Materials**

**Study Area**
The study was conducted in the selected three towns of western part of Ethiopia, having a total population of 378,340. The study areas were selected purposely as they were the towns in which majority of the people reside in western part of Ethiopia.

**Study Design and Period**
The study used a community-based cross-sectional design conducted from June 1 to June 30, 2019.

**Source Population**
All ambulatory adults aged from 18 to 69 years old residing in the selected towns of western Ethiopia.

**Study Population**
All ambulatory adults aged from 18 to 69 years old residing in the purposely selected towns who fulfilled the inclusion criteria.

**Eligibility Criteria**
All ambulatory adults aged between 18 and 69 years old [14] who were willing to participate and who can hear and speak included in the study. Unwilling individuals, critically ill, and unstable personnel were excluded from the study.

**Sample Size**
The sample size was calculated by single proportion formula considering 95% confidence interval (CI), 5% of margin of error, and proportion of 8.9% from the study conducted in the previous study for the overall prevalence of NCDs in Ethiopia [15]. Based on the WHO STEP approach, designing effect of 1.5 and parameter estimates of 2 age-groups for each sex (that is 4 age-sex estimates) were considered. The anticipated nonresponse rate of 10% was also considered. Therefore, a total of 840 subjects were participated in the study.

**Sampling Procedure**
A multistage sampling technique was used. The towns were selected purposively. Then, the zonal administrative towns were again purposively selected because of their large population density. Kebeles found in each selected town were selected by the lottery method. Finally, households were selected by systematic random sampling technique. The eligible person in the household was selected. In case where there was more than one person who can fulfill the inclusion criteria, one was selected by the lottery method.

**Data Collection Tools, Data Collectors, and Data Collection Procedures**
The WHO STEPwise approach to NCD risk factor surveillance tool was used to collect data. Steps 1, 2, and 3 were used to assess the risk factors through interviewing, physical measurement, and
biochemical tests, respectively. In each step, we used the core components [16, 17]. Two laboratory technicians, two BSc nurses, and two public health personnel were recruited as data collectors. Two senior health professionals were recruited as supervisors.

Participants' eligibility was determined by verifying the time of their last meal in order to ascertain that they have undergone an overnight fasting of at least 8 h. All the eligible participants provided a written consent. Sociodemographic data and relevant behavioral and lifestyle characteristics (step 1) were recorded in pretested questionnaires. Then, they were asked to allow physical measurements for their height, weight, waist, and hip (step 2). Finally, they were given the chance for biochemical measurements (step 3). Blood pressure was measured three times with the minimum of 5 min gaps in between by using an adult size blood pressure cuff. Plasma glucose levels were then measured using the glucose oxidase-6 phosphate dehydrogenase method using a SensoCard test strip.

**Definition of Terms**

**Low Consumption of Fruits and/or Vegetables**
Consumption of fruits and/or vegetables is <5 servings/day.

**Physically Active**
If the total physical activity MET minute/week, physically active is at least 600.

**Physically Inactive**
If the total physical activity MET minute/week, physically inactive is <600.

**Never Smoker**
Never smoker is an adult who has never smoked or who has smoked less than 100 cigarettes in his or her lifetime.

**Former Smoker**
Former smoker is an adult who has smoked at least 100 cigarettes in his or her lifetime but who had quit smoking at the time of interview.

**Current Smoker**
Current smoker is an adult who has smoked 100 cigarettes in his or her lifetime and who currently smokes cigarettes.

**Data Quality Management**
The tool was modified from the WHO STEPwise approach for NCD risk factor surveillance. A 3-day training on interviewing technique, questionnaire administration, and physical measurement techniques were given to the data collectors a week before the actual survey. Pretest was conducted on 5% of the total sample size (42 individuals) at one of the towns in east Wollega. An Afan Oromoo translated version of the questionnaire was used to collect the data. Physical measurements were recorded twice and in some case three times in order to minimize the observer error in measurements and records, whereas the rotation of data collectors was done to compare the values. The supervisors were thoroughly following all the activities each day on the spot. The glucometer device and strips were checked regularly for consistency in reference and test readings. The collected data were coded, cleaned, and recorded each day.

**Table 1.** Sociodemographic and economic status of the study participants, selected towns of Wollega zones and western Ethiopia, 2019 (n = 838)

| Variables and categories | Frequency | Percentage |
|--------------------------|-----------|------------|
| Sex                      |           |            |
| Male                     | 354       | 42.2       |
| Female                   | 484       | 57.8       |
| Age category             |           |            |
| 15–29                    | 253       | 30.2       |
| 30–44                    | 351       | 41.9       |
| 45–59                    | 158       | 18.9       |
| 60+                      | 75        | 9.0        |
| Marital status           |           |            |
| Single                   | 170       | 20.3       |
| Married                  | 586       | 69.9       |
| Divorced                 | 43        | 5.1        |
| Widowed                  | 39        | 4.7        |
| Educational level        |           |            |
| Illiterate               | 96        | 11.5       |
| Primary level            | 128       | 15.3       |
| Secondary level          | 229       | 27.3       |
| College and above        | 385       | 45.9       |
| Main work status over the past 12 months | | |
| Government employee      | 239       | 28.5       |
| Nongovernment employee   | 44        | 5.3        |
| Self-employed            | 231       | 27.6       |
| Student                  | 77        | 9.2        |
| Homemaker                | 25        | 3.0        |
| Retired                  | 37        | 4.4        |
| Unemployed (able to work)| 115       | 13.7       |
| Unemployed (unable to work)| 70    | 8.3        |
| Wealth index             |           |            |
| Poorest                  | 88        | 10.5       |
| Poor                     | 243       | 29.0       |
| Medium                   | 238       | 28.4       |
| Wealthy                  | 105       | 12.5       |
| Wealthiest               | 164       | 19.6       |

**Data Analysis**
The data were coded and entered into EpiData 3.1. Then, it was exported to SPSS software version 25 for cleaning and analysis. Frequency distributions and percentage tables were used to present sociodemographic and economic as well as behavioral characteristics. The prevalence of T2DM was shown in percentage. Cross-tabulation and 95% CI were used to present results of bivariable analysis. The multivariable logistic regression analysis was employed to control potential confounders. Associated risk factors of DM were declared statistically significant at \( p \) value <0.05 with 95% CI.

Ethical clearance was secured from the Wollega University Research Ethics Review Committee (WURERC). Personal information of the study participants was kept totally anonymous and confidentiality was assured throughout the study. The data were used only for the purpose of the study. The study was funded by the Wollega University. The funder had no role in the study design, conduct, and publishing.
Results

Sociodemographic and Economic Characteristics
Among the total respondents, 484 (57.8%) were female. The mean age was 39.1 with SD 14.4 years. Regarding marital status, about two-thirds (69.9%) of them were married. Of the total, 385 (45.9%) of the study participants attended level of college and above and 239 (28.5%) were government employers (shown in Table 1).

Behavioral Characteristics
The prevalence of cigarette smoking and alcohol use was 7.4% (95% CI 5.7–9.3) and 12.6% (95% CI 10.5–14.8), respectively. The mean age at first starting to smoke was 28.2 with SD 10.1 years.

The prevalence of current smokers was 2.5% and that of the former smokers was 0.5%. The prevalence of alcohol consumption was higher in males (8.4%) than in females (4.3%). Males whose age ranges from 30 to 44 years were more alcohol consumers than other age-groups “shown in Table 2.”

In the mean days, the respondents eat fruits and vegetables per week were 1.26 with SD 1.7 and the mean servings of fruits and/or vegetables per day was 2.49 with SD 0.9. The prevalence of the participants who did not serve adequate fruits/and vegetables per day was 19.2% (95% CI 16.0–2). Among the total study participants, 611 (72.9%) and 227 (27.1%) were physically active and physically inactive, respectively.

The mean body mass index (BMI) of the study participants was 22.69 with SD 4.1 kg/m². Twenty (2.4%) of the study participants were obese (shown in Figure 1). When explained by sex, 56 (7.0%) and 8 (1.0%) of males and 90 (11.2%) and 26 (3.2%) of females were overweight and obese, respectively.

Prevalence of T2DM
The prevalence of T2DM as measured by random blood glucose and those who were on medication during data collection were found to be 7.0% (95% CI 5.4%–8.8%). The prevalence of raised blood sugar in males and females was 8.5% (95% CI 5.6%–11.4%) and 6.0% (95% CI 3.9%–8.1%), respectively. The prevalence of DM increases as the age advanced (shown in Figure 2).

The prevalence of T2DM was about five times higher in those who married than those who were single, divorced, and widowed. The prevalence was increased in those who were government employees. Those who were overweight (12.9%) were about three times higher prevalent than those who were normal BMI (shown in Table 3). The prevalence of raised blood sugar was about six times higher in those who were physically inactive than those who were physically active (17.1% and 3.1%).

Factors Associated with T2DM
Marital status, fruits and vegetables servings per day, moderate physical activity, overall physical activity status, hypertension, and BMI were independent associated factors of T2DM. The odds of developing DM were 4 times (AOR = 4.0, 95% CI 1.1–14.7) and 6.2 times (AOR = 6.2, 95% CI 1.1–34.4) higher among married and divorced study subjects when compared to those who were single, respectively.

The odd of developing DM was 2.8 times higher (AOR = 2.8, 95% CI 1.1–6.8) in those who do not serve adequate fruits and vegetables per day when compared to their counterparts. Those who were physically inactive were 5 times (AOR = 5.0, 95% CI 2.5–10.0) higher to have T2DM when compared to their counterparts. The odd of developing DM was about 3 times (AOR = 2.9, 95% CI 1.3–6.2) higher in hypertensive patients when compared to their opponents. The odd of developing DM was 2.3 times (AOR = 2.3, 95% CI 1.1–4.9) and 19 times (AOR = 19, 95% CI 3.4–11.6) higher in those who were overweight (12.9%) and obese participants (shown in Table 2).

Table 2. Prevalence of DM among adults of towns of west Ethiopia, 2019 (n = 838)

| Prevalence of T2DM                  | Percent | 95% CI   |
|-------------------------------------|---------|----------|
| Over all (n = 838)                  | 7.0     | 5.4–8.8  |
| Among current smokers (n = 68)      | 17.7    | 8.4–27.0 |
| Among former smokers (n = 71)       | 19.7    | 10.2–29.2|
| Among ever alcohol users (n = 106)  | 11.3    | 5.2–17.5 |
| Among physically inactive participants (n = 234) | 17.1 | 12.2–22.0|
| Among participants who consumed inadequate fruits and vegetables per day (n = 161) | 7.5 | 3.4–11.6 |
| Among overweight participants (n = 132) | 12.9 | 7.1–18.7 |
| Among obese participants (n = 20)    | 30.0    | 8.0–52.0 |
| Among hypertensive patients (n = 189) | 9.5 | 5.3–13.8 |
| Among obese in waist-to-hip ratio (n = 634) | 8.5 | 6.3–10.7 |

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95% CI 4.5–50.1) higher among overweight and obese participants when compared to those who had normal BMI, respectively (shown in Figure 2).

**Discussion**

In this study, the prevalence of T2DM was found to be higher when compared to national [8, 18] as well as other small-scale studies [12, 19–25] conducted so far in Ethiopia. This could be due to different reasons. In one way, as the lifestyle of the community is dramatically transiting to westernization, adapting to the easiest and comfortability that mainly hinder physical activity and the need to work hard for food as fast and ready foods are at gate [26]. In the other way, the study was conducted among urban dwellers as people living in urban are more prone to have diabetes because of two major reasons: first, living longer (age longevity) and higher risk of having overweight and/or obesity. These two factors are prevalent among urban population and highly facilitate for the prevalence of the disease. Evidences show more than two-

![Fig. 1. BMI by the age of the study participants, towns of Wollega zones and west Ethiopia, 2019 (n = 838).](image1)

![Fig. 2. Prevalence of high blood glucose with age category, towns of Wollega zones and western Ethiopia, 2019 (n = 838).](image2)
Table 3. Logistic regression analysis of raised blood sugar among adults in selected towns of Wollega zones and western Ethiopia, 2019 (n = 838)

| Variables                          | T2DM | COR (95% CI) | AOR (95% CI) |
|------------------------------------|------|--------------|--------------|
| Sex                                |      |              |              |
| Male                               | 30 (8.5) | 1.5 (0.9–2.5) | 0.9 (0.4–2.0) |
| Female                             | 29 (6.0) | 1            | 1            |
| Age category                       |      |              |              |
| 15–29                              | 11 (4.3) | 1            | 1            |
| 30–44                              | 18 (5.2) | 1.2 (0.6–2.6) | 0.4 (0.13–1.5) |
| 45–59                              | 17 (10.8) | **2.7 (1.2–5.9)** | 0.7 (0.2–2.6) |
| 60–69                              | 13 (15.9) | **4.2 (1.8–9.7)** | 0.9 (0.2–3.7) |
| Marital status                     |      |              |              |
| Single                             | 4 (2.4) | 1            | 1            |
| Married                            | 44 (7.5) | **3.4 (1.2–9.5)** | **4.0 (1.1–14.7)*** |
| Divorced                           | 6 (14.0) | **6.7 (1.8–25.1)** | **6.2 (1.1–34.4)*** |
| Widowed                            | 5 (12.8) | **6.1 (1.6–23.9)** | 3.9 (0.7–22.4) |
| Main work status over the past 12 months |      |              |              |
| Gov’t employee                     | 17 (7.1) | 0.8 (0.3–2.2) | 0.7 (0.1–3.8) |
| NGO employee                       | 2 (4.5) | 0.5 (0.1–2.6) | 0.3 (0.02–3.5) |
| Self-employed                      | 15 (6.5) | 0.7 (0.3–2.0) | 1.2 (0.2–4.9) |
| Student                            | 2 (2.6) | 0.3 (0.1–1.5) | 0.2 (0.01–6.6) |
| Homemaker                          | 6 (24.0) | **3.4 (1.0–11.7)** | 2.8 (0.4–19.2) |
| Retired                            | 9 (24.3) | **3.4 (1.1–10.6)** | 2.2 (0.4–12.3) |
| Unemployeda                        | 2 (1.7) | 0.2 (0.04–0.96) | 0.4 (0.1–5.6) |
| Unemployedb                        | 6 (8.6) | 1            | 1            |
| Wealth index                        |      |              |              |
| Poorest                            | 17 (19.3) | **6.3 (2.4–16.7)** | **9.2 (2.6–32.3)*** |
| Poor                               | 19 (7.8) | 2.2 (0.8–5.7) | 2.3 (0.8–7.2) |
| Medium                             | 13 (5.5) | 1.5 (0.6–4.1) | 2.3 (0.7–7.4) |
| Rich                               | 4 (3.8) | 1.0 (0.3–3.8) | 1.0 (0.2–4.6) |
| Richest                            | 6 (3.7) | 1            | 1            |
| Smoking status                     |      |              |              |
| Never smoker                       | 83 (4.7) | 1            | 1            |
| Current smoker                     | 12 (17.6) | **4.3 (2.1–8.9)** | 2.7 (0.7–10.2) |
| Former smoker                      | 14 (19.7) | **5.0 (2.5–10.0)** | 3.2 (0.8–13.2) |
| Alcohol use                        |      |              |              |
| Yes                                | 12 (11.3%) | 0.54 (0.28–1.1) | 0.8 (0.3–2.2) |
| No                                 | 47 (6.4%) | 1            | 1            |
| Fruits and vegetables servings/day  |      |              |              |
| Adequate                           | 47 (6.9) | 1            | 1            |
| Inadequate                         | 12 (7.5) | 1.1 (0.6–2.1) | 2.8 (1.1–6.8)* |
| Physical activity                  |      |              |              |
| Active                             | 19 (3.0) | 1            | 1            |
| Inactive                           | 40 (18.7) | **6.3 (3.6–11.2)** | **5.0 (2.5–10.0)***** |
| Hypertensive status                |      |              |              |
| Normal                             | 41 (6.3) | 1            | 1            |
| Hypertensive                       | 18 (9.5) | 1.6 (0.9–2.8) | **2.9 (1.3–6.2)*** |
| BMI                                |      |              |              |
| Normal                             | 32 (5.2) | 1            | 1            |
| Underweight                        | 4 (5.6) | 1.1 (0.4–3.2) | 2.6 (0.7–9.5) |
| Overweight                         | 17 (12.9) | **2.7 (1.4–5.0)** | **2.3 (1.1–4.9)*** |
| Obese                              | 6 (30.0) | **7.8 (2.8–21.7)** | **19 (4.5–50.1)***** |
| WHR                                |      |              |              |
| Normal                             | 5 (2.5) | 1            | 1            |
| Obese                              | 54 (8.5) | **3.7 (1.5–9.4)** | 2.6 (0.9–7.6) |

*p value:* <0.05, **<0.01, ***<0.001. aAble to work. bUnable to work.
of developing T2DM was nineteen, five, and two times higher among obese, physically inactive, and overweight individuals. This finding coincides with studies from the same countries [11, 12, 22, 24, 37] as well as from different countries of the world [21, 22, 28, 34]. This is because of the fact that exercise regulates the blood glucose level. Physical exercise relaxes the contacting muscle that inhibits membrane permeability to glucose. It is directly related to the increase in speed of muscle glucose recovery (the speed muscle takes glucose from the bloodstream) [38].

Hypertensive patients had about three times higher chance to have T2DM, which is also supported by other findings [11, 12, 21, 22, 24, 28, 31, 32, 37]. This is due to the fact that there is a common pathway between diabetes and hypertension in both etiology and mechanism of action; both genetics and environmental factors are the known. High BP was shown to induce microvascular dysfunction, which may contribute to the pathophysiology of diabetes development. Insulin resistance constitutes a common soil for DM and hypertension [38, 39].

This study has certain limitations. First, due to the cross-sectional nature of the data, the study could not show a causal and temporal relationship between DM and the associated risk factors. Second, the study involved only town residents which make the study findings not representative for the rural residents. Finally, behavioral related data were collected by a structured questionnaire using the interviewer-administered method. Therefore, the effect of recall bias and social desirability bias cannot be ruled out.

**Conclusion**

In general, the prevalence of DM in the study area was found to be substantially higher when compared to the national level prevalence and other pocket studies in the country. Marital status, inadequate consumption of fruits and vegetables, physical inactivity, hypertension, and high BMI were associated factors of T2DM. A comprehensive lifestyle modification factors of T2DM. A comprehensive lifestyle modification strategy should be devised and provision of awareness creation campaign and consistent public health education is highly recommended.

**Acknowledgments**

The authors thank Wollega University for the financial support. The authors also thank data collectors and study participants.
Statement of Ethics

The study was reviewed and approved by the Research Ethics and Review Committee of Wollega University with a reference of WURERC 21/2019 and compiled with the Declaration of Helsinki. All the study subjects provided written informed consent.

Conflicts of Interest Statement

The authors have no conflicts of interest to declare.

Funding Sources

This study was funded by the Wollega University. The funder has no role in conceptualization, data collection, and data analysis.

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