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# Prevalence of Diabetes Mellitus and Associated Risk Factors Among Adults Attending at Feres Meda Health Centre, Addis Ababa, Ethiopia, 2017

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**Abstract:** Background: Diabetes is a family of disorders that is characterized by hyperglycemia. The disorders of diabetes differ in their etiology and symptoms and in the consequences of the disease. Diabetes mellitus is a high rising disease all over the world and in our country, because of some lifestyle change of the community. Therefore, this study aims to determine the prevalence of DM and its associated factors among adults in Feres Meda health center at Addis Ababa, Ethiopia. Methods: A cross-sectional study was conducted from November 2016 to March 2017. Patient demographic characteristics were collected using a pre-tested standard questionnaire format. Height, weight and blood pressure were measured physically and 5 ml fasting blood sample was collected to analyze blood glucose by glucose oxidase method using automated chemistry analyzer. Statistical analysis was performed by using Statistical software version 20. Results: Out of the 392 participants, 58.7% of them were females. The age of participants ranged from 19 to 80 years with a mean of 34.34 years. Among the study participants, 2.6% of them had DM and 6.9% of the participants had high fasting blood glucose value (pre-diabetes). Age (P = 0.048), WC (P=0.001), and family history of DM (P= 0.024) were significantly associated with the development of DM. Conclusion: High prevalence of undiagnosed diabetes mellitus was observed among study population. Therefore, regular screening of DM, particularly for those individuals having higher waist circumstance, family history of DM and older age, is mandatory to control blood glucose early.

**Keywords:** Diabetes Mellitus, Prevalence, Adults, Addis Ababa, Ethiopia

## 1. Introduction

Globally, 4.6 million deaths are attributable to diabetes annually and it ranks in the top 10 causes of disability worldwide and undermines productivity and human development. Diabetes is one of the priority non-communicable diseases identified by the WHO [1]. The number of people with diabetes is predicted to rise from over 366 million in 2011 to 552 million by 2030, or one adult in ten [2]. Diabetic Mellitus (DM) and its complications cause severe illness and economic burden and it places a serious constraint on patients' activities [3]. The WHO regional office for Africa report indicates that DM as 'emerging noncommunicable disease epidemic in Africa'. The estimated

prevalence of DM in the adult population of Ethiopia is 1.9% [4]. WHO estimated the number of diabetic cases in Ethiopia to be 1.8 million by 2030 [2]. Hospital-based studies in Addis Ababa revealed that the prevalence of DM was range from 0.5% and 1.2% [5].

Diabetes is a complex group of diseases with a variety of causes. Some of these include genetic susceptibility, obesity, and physical inactivity, abnormal glucose production by the Liver, Metabolic syndrome (insulin resistance syndrome) and Beta Cell Dysfunction [6-9].

Diabetes can be classified mainly based on the etiology and cause of the disease. Type 2 diabetes is predominantly insulin resistance with relative insulin deficiency and accounts 90 – 95% of total diabetic cases [10, 11]. Many drugs and chemicals can impair insulin secretion. These drugs may not cause diabetes by themselves, but they may precipitate diabetes in individuals with insulin resistance [12]. Diabetes mellitus is not a selective disorder, but there is a high prevalence with some group of individuals. Pregnant women, a person with a family history of diabetes, hypertensive and overweight persons are the most vulnerable groups [11, 13, 14]. Obesity has been found to contribute to approximately 55% of cases of type 2 diabetes [15].

However, there was no information about the prevalence and associated factor of DM in the study area. This critical and prevalent disorder was not getting enough attention and the associated factors were not identified well. Therefore, the aim of this study was to determine the prevalence of diabetes mellitus and the factors related to DM among adults attending Feresmeda health center, Addis Ababa, Ethiopia.

# 2. Methods and Materials

### *2.1. Study Design and Area*

A single site, cross-sectional study was employed at Feres Meda health center in Addis Ababa city administration from November 1, 2016 to March 30, 2017. Addis Ababa is the capital city of Ethiopia, with a population of 3,384,569 according to the 2007 population census and the population density is 5,165.1 per $km^2$. It has ten sub cities and ninety-nine weredas [16]. The health center proved different public health services for more 25,000 people.

### *2.2. Study Population*

The study population was all adults (>18 years old), who were attending the health center and clinically not suspected and undiagnosed for DM during the study period. Individuals taking any drugs that affect glucose metabolism, pregnant women, known diabetes patients and clinically suspected cases were excluded from the study.

### *2.3. Sample Size and Sampling Technique*

The desired sample size was determined using single population proportion formula by considering the following assumption: the proportion DM take as P = 50%, Marginal error (d) = 5%, Confidence interval = 95% and non response rate 10%.

$$N = \frac{(Z\alpha/2)^2(1-p)(p)}{d^2}$$

The final sample size was 422 which including 10% contingency.

### *2.4. Sampling Technique*

The systematic random sampling method was used to select the study participants among clients who visit Feres Meda health center during the study period.

### *2.5. Data Collection and Sample Processing*

After getting consent from selected subjects, Clinical (blood glucose level, blood pressure value, BMI, and waist circumference), socio-demographic data (age, sex, occupation, education, family history of DM), and behavioral data (physical activity, smoking habit, alcohol consumption), were collected from participants using structured questionnaires through interview by trained data collectors. Then blood sample was collected from volunteers.

#### *2.5.1. Demographic and Behavioral Information*

Socio-demographic data and behavioral information of participants were collected using a structured questionnaire. Individuals reporting regular aerobic exercise or its equivalent (e.g. walking) for at least 150 minutes per week considered as physically active. The family history of DM was considered as positive if either or both parents or sibling of individuals were diagnosed to have DM. Smoking habit was reported as non-smoker (individuals who never smoke), smoker (individuals who are currently smoking and x smokers). Alcohol consumption was rated as non-drinker (individuals who never drink or who drink any kind of alcohol not more than three days per month or ex-drinker in the past [17].

#### *2.5.2. Physical Measurements*

Height was measured by using a body mass index (BMI) meter, standing upright on a flat surface. Body weight was measured while wearing light clothes by an adjusted scale. BMI was calculated by the formula: weight in kilograms divided by height in meters squared. BMI defined <18.5kg/$m^2$ underweight, 18.5-24.9 kg/$m^2$ normal, and 25-29.9 kg/$m^2$ overweight and >30 kg/m2 obesity [18].

Blood pressure (BP) was measured in sitting position on the left arm using sphygmomanometer after > 5 min rest. Hypertension defined as systolic BP of ≥ 140 mmHg or diastolic BP of ≥ 90 mmHg was correlated with clinical data's (sign and symptom) [17].

Waist circumference was measured by using plastic meter measured the appropriate mid-point between the lower margin of the last palpable rib and the top of the iliac crest. According to WHO report the waist circumference value of men > 94 and female >80 cm was considered high [19].

#### *2.5.3. Blood Glucose Measurement*

Five-milliliter venous blood was collected by using SST tubes after an overnight fast (≥ 8hrs) at the health center. The blood samples were left at room temperature to allow clotting for 15-20 minutes and centrifuged at 1000 rpm for 5 minutes. Then the level of glucose was measured using enzymatic colorimetric assay using chemistry analyzer. The diagnosis of DM was based on the WHO 2006 with fasting blood glucose of 110 mg/dl to 125 mg/dl indicates the pre-diabetic condition and over ≥ 126 mg/dl being diagnostic for DM [19].

### *2.6. Quality Assurance*

The data collection was conducted by trained nurses. Before starting blood collection, laboratory technicians were refreshed on proper sample collection and aim of the study. After blood collection serum was separated within 30 minutes and was done immediately. May it cannot be run immediately placed the sample at 2-8°C for 24 hours. The instrument MINDRAY BS- 200E chemistry analyzer was calibrating using Calibrator (Auto Cal) and quality control samples normal and pathological were run each day before running Samples for tests.

### *2.7. Data Processing and Statistical Analysis*

Data were entered, cleaned and analyzed using SPSS (Statistical Package for Social Sciences) version 20 software. Descriptive statistics were calculated to describe data. Binary and multivariable logistic regression analyses were used to determine the presence of statistically significant associations between the outcome and the independent variables. Crude and adjusted odds ratios with 95%CI were calculated and a p-value less than 0.05 was considered statistically significant.

### *2.8. Ethical Considerations*

The study was approved by the Ethical Review Committee of Haramaya University. Permission was also secured from Addis Ababa City Administration Health Bureau and Feres Meda health center manager. Written informed consent was obtained from each study participants. All participants were informed of their right to refuse at any time and all collected information was kept confidential. No personal identifiers were kept in the database or used to report findings. In addition, the clinical specimen collected during the study period was used for the stated objectives only. For those participants who had DM or pre-DM, appropriate treatment was prescribed by physicians and health education was given to control blood glucose level.

## 3. Results

### *3.1. General Characteristics of Study Participants*

Out of the 422 randomly selected study subjects, 92.9% (392) participated in the study. Among the study participants, 58.7% of them were females, and mean age of the participants was 34 years with the rage of 19 to 80 years. Most of the participants were married (61%), office worker (40%), and high school complete and above (72%) (See table 1).

***Table 1.*** *Socio-demographic characteristics of the study participants, Nov. 2016 – March 2017, Addis Ababa, Ethiopia.*

| Variables | | Frequency (n=392) | Percent |
|---|---|---|---|
| Sex | Female | 230 | 58.7 |
| | Male | 162 | 41.3 |
| Age group | 18-30 | 195 | 49.7 |
| | 31-45 | 132 | 33.7 |
| | >45 | 65 | 16.6 |
| Occupational status | Office work | 158 | 40.3 |
| | Day laborer | 86 | 21.9 |
| | House wives | 90 | 23.0 |
| | Others | 58 | 14.8 |
| Educational status | Illiterate | 22 | 5.6 |
| | Primary school | 87 | 22.2 |
| | High school | 157 | 40.1 |
| | Collage & Above | 126 | 32.1 |
| Marital status | Single | 153 | 39.0 |
| | Married | 239 | 61.0 |

### *3.2. Anthropometric of Participants*

Regarding to anthropometric and lifestyle of the study participants 58.2% (228) were physically active, 8.7% (34) were smokers, 18.9% (74) were alcohol drinker, 24.7% (97) had high WC, 7.7% (30) had family history of DM, and 9.2% (36) were with high blood pressure. Out of 392 participants, 36.5% (143) were overweight and obese.

### *3.3. Prevalence of DM and Pre-Diabetes*

Out of the study participants, 2.6% (10) had DM and 6.9% (27) participants had high fasting blood glucose value (pre-diabetes condition). The remaining 90.6% (n=355) had normal fasting blood glucose value. There was a different prevalence of DM with the age group. The prevalence of DM was low among the age group of 18-30 years (1.5%) and the age group of 31-45 years (1.5%). The highest prevalence rate

was noticed among greater than 45 years old (7.7%). More burden of DM was noticed with females (2.6%) than males (2.5%). Regarding marital status, all the identified diabetic cases were married participants (4.2%), and among illiterate participants, 9.1% and among housewives, 7.8% of them were diabetic (See table 2).

***Table 2.*** *Distribution of pre-diabetes and diabetes case by socio-demographic, anthropometric, and lifestyle, Nov. 2016 – March 2017, Addis Ababa, Ethiopia.*

| Variables | Normal n (%) | Pre-diabetic n (%) | Diabetes n (%) | Total |
|---|---|---|---|---|
| Sex | | | | |
| Female | 210 (91.3) | 14 (6.1) | 6 (2.6) | 230 |
| Male | 145 (89.5) | 13 (8.0) | 4 (2.5) | 162 |
| Age | | | | |
| 18-30 | 190 (97.4) | 2 (1.0) | 3 (1.5) | 195 |
| 31-45 | 116 (87.9) | 14 (10.6) | 2 (1.5) | 132 |
| >45 | 49 (75.4) | 11 (16.9) | 5 (7.7) | 65 |
| Educational status | | | | |
| Illiterate | 19 (86.4) | 1 (4.5) | 2 (9.1) | 22 |
| Primary school | 73 (83.9) | 10 (11.5) | 4 (4.6) | 87 |
| High school | 144 (91.7) | 9 (5.7) | 4 (2.5) | 157 |
| College & Above | 119 (94.4) | 7 (5.6) | 0 (0) | 126 |
| Marital status | | | | |
| Single | 148 (96.7) | 5 (3.3) | 0 (0) | 153 |
| Married | 207 (86.6) | 22 (9.2) | 10 (4.2) | 239 |
| Occupation | | | | |
| Office work | 143 (90.5) | 14 (8.9) | 1 (0.6) | 158 |
| Day laborer | 84 (97.7) | 2 (2.3) | 0 (0) | 86 |
| House wife | 75 (83.3) | 8 (8.9) | 7 (7.8) | 90 |
| Others | 53 (91.4) | 3 (5.2) | 2 (3.4) | 58 |
| BMI | | | | |
| Normal | 237 (95.2) | 11 (4.4) | 1 (0.4) | 249 |
| Over weight | 118 (82.5) | 16 (11.2) | 9 (6.3) | 143 |
| Waist circumference | | | | |
| High | 71 (73.2) | 17 (17.5) | 9 (9.3) | 97 |
| Normal | 284 (96.3) | 10 (3.4) | 1 (0.3) | 295 |
| Family history of DM | | | | |
| No | 333 (92.0) | 26 (7.2) | 3 (0.8) | 362 |
| Yes | 22 (73.3) | 1 (3.3) | 7 (23.3) | 30 |
| Blood pressure | | | | |
| High | 29 (80.6) | 5 (13.9) | 2 (5.6) | 36 |
| Normal | 326 (91.6) | 22 (6.2) | 8 (2.2) | 356 |
| Alcohol consumption | | | | |
| Not Consumed | 290 (91.2) | 19 (6.0) | 9 (2.8) | 318 |
| Consumed | 65 (87.8) | 8 (10.8) | 1 (1.4) | 74 |
| Physical activity | | | | |
| Yes | 213 (93.4) | 12 (5.3) | 3 (1.3) | 228 |
| No | 142 (86.6) | 15 (9.1) | 7 (4.3) | 164 |
| Smoking Habit | | | | |
| No | 324 (90.5) | 25 (7.0) | 9 (2.5) | 358 |
| Yes | 31 (91.2) | 2 (5.9) | 1 (2.9) | 34 |

Relatively higher prevalence of DM was observed at overweighed participants (6.3%), physically inactive participants (4.3%), participants with high blood pressure (5.6%), and ParticipAnts with family history of DM (23.3%).

### *3.4. Risk Factors Associated with DM*

Bivariate logistic regression was used to identify possible explanatory (independent) variables and those variables, which have a p-value of less than 0.20, were taken to multivariate logistic regression. As a result, age (P = 0.048), WC (P=0.001), and family history of DM (P= 0.024) were significantly associated with development of DM. On the other hand, sex (P = 0.55), educational status (P = 0.67), marital status (P = 0.74), occupational status (P = 0.28), BMI (P = 0.58), blood pressure level (P = 0.86), physical activity (P= 0.61), alcohol consumption (P= 0.37), and smoking habit (P= 89) were not significantly associated with development of DM.

Participants with greater than 45 years old were about five times (AOR= 5.12; 95% CI= 1.39- 18.79; P= 0.048) more likely to develop DM than younger participants (18-30 years old). Respondents who had a family history of DM were also 4 times (AOR = 3.8; 95% CI = 1.19-11.95; P= 0.024) more likely to develop DM than those who did not have a family history of DM. Respondents who had high waist Circumference were 5 times (AOR= 4.9; 95% CI= 1.93-12.79; P=0.00) more likely to develop DM than who had normal waist Circumference (See table 3).

***Table 3.*** *Logistic regression of factors associated with pre-diabetes and diabetes, Nov. 2016 – March 2017, Addis Ababa, Ethiopia.*

| Variables | Normal | Pre-DM and DM | COR (95% CI) | AOR (95% CI) | P-value |
|---|---|---|---|---|---|
| Sex | | | | | |
| Female | 210 (91.3) | 20 (8.7) | 1 | | 0.55 |
| Male | 145 (89.5) | 17 (10.5) | 1.2 (0.62, 2.43) | | |
| Age | | | | | |
| 18-30 | 190 (97.4) | 5 (2.6) | 1 | 1 | 0.048 |
| 31-45 | 116 (87.9) | 16 (12.1) | 5.24 (1.87, 14.68) | 2.86 (0.89, 9.12) | |
| >45 | 49 (75.4) | 16 (24.6) | 12.4 (4.33, 35.53) | 5.12 (1.39, 18.79) | |
| Educational status | | | | | |
| Illiterate | 19 (86.4) | 3 (13.6) | 1 | 1 | 0.67 |
| Primary school | 73 (83.9) | 14 (16.1) | 1.22 (0.32, 4.66) | 3 (0.56, 15.98) | |
| High school | 144 (91.7) | 13 (8.3) | 0.57 (0.15, 2.19) | 1.4 (0.25, 8.43) | |
| College & Above | 119 (94.4) | 7 (5.6) | 0.37 (0.08, 1.57) | 0.45 (0.06, 3.43) | |
| Marital status | | | | | |
| Single | 148 (96.7) | 5 (3.3) | 1 | 1 | 0.74 |
| Married | 207 (86.6) | 32 (13.4) | 4.58 (1.74, 12.02) | 1.23 (0.35, 4.24) | |
| Occupation | | | | | |
| Office work | 143 (90.5) | 15 (9.5) | 1.11 (0.38, 3.21) | 1.9 (0.45, 8.00) | 0.28 |
| Day laborer | 84 (97.7) | 2 (2.3) | 0.25 (0.05, 1.35) | 0.31 (0.04, 2.22) | |
| House wife | 75 (83.3) | 15 (16.7) | 2.1 (0.73, 6.20) | 1.23 (0.30, 5.07) | |
| Others | 53 (91.4) | 5 (8.6) | 1 | 1 | |
| BMI | | | | | |
| Normal | 237 (95.2) | 12 (4.8) | 1 | 1 | 0.58 |
| Over weight | 118 (82.5) | 25 (17.5) | 4.18 (2.03, 8.62) | 1.31 (0.49, 3.44) | |
| WC | | | | | |
| High | 71 (73.2) | 26 (26.8) | 9.5 (4.46, 20.04) | 4.9 (1.93, 12.79) | 0.001 |
| Normal | 284 (96.3) | 11 (3.7) | 1 | 1 | |
| The family history of DM | | | | | |
| No | 333 (92.0) | 29 (8.0) | 1 | 1 | 0.024 |
| Yes | 22 (73.3) | 8 (26.7) | 4.17 (1.11, 10.20) | 3.8 (1.19, 11.95) | |
| Blood pressure | | | | | |
| High | 29 (80.6) | 7 (19.4) | 2.6 (1.06, 6.49) | 1.1 (0.36, 3.32) | 0.86 |
| Normal | 326 (91.6) | 30 (8.4) | 1 | 1 | |
| Alcohol consumption | | | | | |
| Not Consumed | 290 (91.2) | 28 (8.8) | 1 | | 0.37 |
| Consumed | 65 (87.8) | 9 (12.2) | 1.43 (0.64, 3.18) | | |
| Physical activity | | | | | |
| Yes | 213 (93.4) | 15 (6.6) | 1 | 1 | 0.61 |
| No | 142 (86.6) | 22 (13.4) | 2.2 (1.10, 4.38) | 1.26 (0.51, 3.12) | |
| Smoking Habit | | | | | |
| No | 324 (90.5) | 34 (9.5) | 1 | | 0.89 |
| Yes | 31 (91.2) | 3 (8.8) | 1.08 (0.31, 3.73) | | |

# 4. Discussion

The current study was conducted to determine the prevalence and associated risk factors of DM among adults at Feres Meda health center, Addis Ababa, Ethiopia. This study showed the prevalence of DM was 2.6%. This finding was nearly equivalent to another previous report from India (2.02%), Ethiopia (3.3%). The prevalence of new diagnostic DM in this study was higher than the finding from Congo (1.5%), Nigeria (0.8%), two hospitals in Addis Ababa (0.5%, 1.2%), Tikur Anbesa hospital (1.9%) and Ayder referral hospital (1.3%), Ethiopia [21-24, 5, 4]. The differences may be due to the discrepancy in the study area, study population, study designs, sample sizes used, study period, and difference in blood glucose level diagnosis method. As well as urbanization can also influence the lifestyles of people in general, and the prevalence of DM among urban dwellers is usually higher than among rural householders.

On the other hand, the current finding was lower than the report from Mizan Aman town (3.8%), Gondar town and Dabat residential districts together (5.11%), Bishoftu, Ethiopia (5%), Turkey (6.1%), and Israel (8.9%) [25-29]. The discrepancy may be due to the present study was conducted on a relatively small sample compared to the sample size of the other studies, and it was done among health center attendants. Moreover, the current study was used automated chemistry analyzer to measure plasma glucose level of participants whereas other studies used point of care devices to measure capillary blood glucose which is not as accurate and reliable as plasma glucose estimation diagnosed using a spectrophotometer/colorimeter.

The prevalence of prediabetes in the current study was 6.9%. This finding was comparable with the estimated Ethiopian national prevalence of 6–8% [30] and lower than other studies from Gilgel Gibe (9.7%) [31], and Mizan Aman town (15.9%) [25]. This suggests that the prevalence of DM in the study area may increase in the near future as there is a risk of progression of pre-diabetic condition to diabetic [30].

The current study identified that age (P = 0.048), family history of DM (P= 0.024) and waist circumference (P=0.001) were associated with the development of DM. This study revealed that participants with greater than 45 years old were about five times more likely to develop DM than younger participants (18-30 years old). This finding was inconsistent with the findings from India, Iran, and Ethiopia that showed a higher occurrence of new DM as age increases [32-34]**.**

This study found that respondents who had a family history of DM were 4 times more likely to develop DM than those who did not have a family history of DM. On the same way, significant and positive association between family history of DM and DM occurrence was reported from Pakistan, Cong, India, Turkey, and Nigeria [35, 36, 32, 28, 23].

In addition, high waist circumference was statistically significant with the occurrence of DM that respondents who had high waist circumference were 5 times more likely to develop DM than who had normal waist circumference. This finding was consistent with previous studies from Iran, Congo, Nauru, Indonesia, India, and Mizan Aman Ethiopia [33, 36-38, 32, 25]. It has been postulated that expanded abdominal fat stores affect insulin metabolism by releasing free fatty acids. Additionally, fat cells secrete signaling factors e.g. Interleukin-6 (IL-6) and tumor necrosis factor-α (TNF- α) which involved in the development of insulin resistance [39].

On the other hand, sex, educational status, marital status, occupational status, BMI, blood pressure level, physical activity, alcohol consumption, and smoking habit were not significantly associated with the occurrence of DM in this study. Previous studies also from Iran [33], Congo [36], India [32], and Mizan Aman [25] showed that marital status, educational status, physical activity, and smoking were not significantly associated with the occurrence of DM. However, some findings revealed that alcohol consumption, BMI, single, divorced and widowed statuses, were increasing the risk of developing new DM [27, 32, 34, 36, 40, 41].

Therefore, targeting the prevention strategy for these associated risk factors might reduce the prevalence of diabetes mellitus and screening of DM particularly in those individuals having older ages, high WC and family history of DM needs attention.

# 5. Conclusion and Recommendation

The study has shown that the prevalence of pre-diabetes and diabetes has increased, especially of undiagnosed cases amongst the adult population. It indicates that there might be a large number of people who have DM but are not aware of it. Increasing age, higher waist circumstance and family history of DM were found to be significant risk factors to develop DM. This indicates the need for systematic screening and awareness program to identify the undiagnosed cases in the community and offer early treatment and regular follow up.

# Limitation of the Study

The study was institutionally based might be affected by selection bias and the conclusions may not apply to the population at large. The study was not able to identify the different types of DM, and this is the other limitation of the study

# List of Abbreviations

DM: Diabetes Mellitus
WC: Waist Circumference
WHO: World Health Organization

# Ethics Approval and Consent to Participate

The study was approved by the Ethical Review Committee of Haramaya University. Permission was also secured from Feres Meda health center manager. Written informed consent was obtained from each study participants. All participants were informed of their right to refuse at any time and all collected information was kept confidential. No personal identifiers were kept in the database or used to report findings. In addition, the clinical specimen collected during the study period was used for the stated objectives only. For those participants who had DM or pre-DM, appropriate treatment was prescribed by physicians and health education was given to control blood glucose level

# Consent for Publication

Not applicable

# Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

# Competing Interests

The authors declare that they have no competing interests.

# Funding

Funding was not received for this study.

# Authors' Contributions

BWS being the principal investigator contributed to proposal write-up, study design, data analysis, interpretation of results and write-up, HA being the co-principal investigator contributed in data analysis, interpretation of results and write-up, ZA and HA had contributed to monitoring and supervision, data analysis and write-up, GG, EK, and DB, had contributed to data collection, data analysis

and write-up. All authors read and approved the manuscript.

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