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Prevalence, medication adherence, and determinants of type 2 diabetes mellitus during Coronavirus Disease 2019 pandemic among adults in Tanzania

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Abstract

Introduction: Excessive consumption of comfort foods, which are mostly high in carbs, and limitations on outdoor and gym-based physical activities, for instance, are associated with foods high in the glycemic index and raise the risk of obesity and type 2 diabetes. In pandemic and or epidemic situations, peoples' lifestyles may change significantly to lead them to non-communicable diseases. However, lifestyle changes and the occurrence of type 2 diabetes mellitus during the Coronavirus Disease 2019 pandemic among adults have not been well established in Tanzania. This study assessed the prevalence, medication adherence, and determinants of type 2 diabetes mellitus among adults in the country.

Methods: A community-based analytical cross-sectional study was conducted in Dodoma region, Tanzania between September and October 2020 of which 107 adults aged above 18 years were studied regardless of whether they were newly diagnosed with type 2 diabetes mellitus or not using a quantitative research approach. Interviewer-administered lifestyle habits and medication adherence structured questionnaires benchmarked from previous studies served as the main tools of data collection. The statistical package for social sciences computer program was used to analyze the data descriptively for frequencies and percentages and by regression analysis model to determine the association between variables with a 95% confidence interval and 5% significance level.

Results: With a mean age of 31 ± 2.527 years, 59.8% of the respondents were female. 60.7% and 11.7% of the respondents had unhealthy and moderate lifestyle choices respectively. The prevalence of type 2 diabetes mellitus accounted for 63.9% of the respondents of which 44.6% were diagnostically confirmed during the Coronavirus Disease 2019 pandemic against 19.3% of respondents who were diagnosed before the pandemic. Medication adherence among the type 2 diabetes mellitus respondents accounted for 77.9% of the study respondents. Type 2 diabetes mellitus was significantly associated with being in the 36–55 age group (AOR = 1.054; 95% CI: 0.292, 3.162; $p < 0.05$); being female (AOR = 1.398; 95% CI: 0.205, 3.048; $p < 0.05$); having a job (AOR = 2.597; 95% CI: 1.243, 4.402, $p < 0.05$); and having unhealthy lifestyle habits (AOR = 3.301; 95% CI: 1.199, 6.52; $p < 0.05$).

Conclusion: The majority of adults had type 2 diabetes mellitus of which most of them were confirmed to have the disease during the Coronavirus Disease 2019 pandemic. Few type 2 diabetes mellitus adults did not adhere to their medications as recommended. Their sociodemographic characteristics profiles and unhealthy lifestyles significantly led them to have the problem. The treatment of the disease above and health promotion activities may need to take unhealthy lifestyle choices and certain sociodemographic profiles of adults into consideration to assist in preventing the problem.

Keywords

Adults, diabetes mellitus, lifestyle behaviors, medication adherence, physical activity, post-COVID-19 pandemic

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Introduction

One of the non-communicable diseases (NCDs) that now affects a large spectrum of people worldwide and has a significant impact on morbidity and mortality rates is diabetes mellitus.[1] Individuals with NCDs become at high risk of severe cases and mortality in pandemic situations.[2] Diabetes mellitus for example is believed to be significantly high in pandemic situations as it happened during the COVID-19 pandemic, where people (especially those aged ⩾40 years) undergo significant lifestyle changes as a result of containment. They may become more sedentary and experience changes in eating, drinking, sleeping, working, and moving behaviors.[3,4] Anxiety, staying at home, oversleeping, and boredom due to being confined to one's home and either under- or over-consuming comfort foods high in sugar, as well as a lack of outdoor and gym-based physical activity, are all associated with sedentary lifestyle changes during pandemics.[5]

Nevertheless, Overindulgence in comfort meals, which are primarily high in carbohydrates, and restriction of outdoor and gym-based physical activities, for example, are related to the glycemic index foods and are linked to an increased risk of obesity (Body mass index ⩾ 40 kg/m^2), integumentary, heart, kidney, nervous system and type 2 diabetes mellitus (T2DM) problems.[6] The prevalence of T2DM in adults (20–70 years old) for example has increased dramatically over the past 3–5 decades, especially in low- and middle-income countries, where it was estimated to affect 537 million people in 2021 during the COVID-19 pandemic (compared to 422 before the COVID-19 pandemic in 2019). The risk of physically inactive people getting T2DM before the COVID-19 pandemic accounted for 42.9% against 57.3% of them during and beyond the pandemic.[7] The situation may imply that the prevalence of T2DM among people was significantly higher during the COVID-19 pandemic than before probably because of changes in peoples' lifestyles changes including lack of physical activities and indulgence in energy-dense foods.

Reports indicate that if the trend remains uninterrupted there will be approximately 541 people at increased risk of developing T2DM by 2025.[8] This is despite the global target to stop the incidences and prevalence of diabetes and obesity by 2025.[3] According to available data, one in two (240 million) persons with diabetes remain undiagnosed, meaning they may not be aware that they have the disease. Additionally, three out of every four adults with diabetes mellitus reside in low- and middle-income nations.[9] Nevertheless, with the growing trend of the disease due to lifestyle changes during the COVID-19 pandemic and other associated determinants, 643 million individuals are expected to have diabetes mellitus by 2030, and 783 million by 2045 in the globe.[10]

Over 90% of all incidences of diabetes in Sub-Saharan Africa have been reported to be T2DM; the other occurrences are believed to be type I diabetes, gestational diabetes, and other variations such as "Ketosis-prone" diabetes and malnutritional linked diabetes.[11] In sub-Saharan Africa, the prevalence of type 2 diabetes has risen significantly by 24 million cases (1 in 22 persons having the disease), with 1 in 2 (54%) of those affected going untreated. Due to changes in human behavior, lifestyle habits, and socioeconomic burden among people especially during the COVID-19 pandemic, the prevalence of T2DM is expected to quadruple to 55 million persons (129%) in African countries by 2045.[1,12] One of the 48 worldwide diabetes federations in Tanzania, where the prevalence of diabetes is expected to reach 12.3%–8% of the population after the COVID-19 pandemic, that is, in 2021 (up from 300.00% in 2011 before the COVID-19 pandemic), and the disease would be the cause of 416,000 deaths in that year.[8,12,13]

The problem affects more people (⩾40 years) in urban than rural areas, and most people who live in urban areas receive a diagnosis without realizing it is affecting them.[6] This has made it more expensive and challenging to provide healthcare services to the point that it seems that if individuals are not put at the forefront of the fight against diabetes, the government will struggle to control the condition.[14] As a chronic health issue, diabetes in Tanzania has continued to experience an increased financial burden on both the populace and the national healthcare budget, especially during the COVID-19 pandemic.[15] This is because the entire cost of direct treatment for diabetes is nearly 25% of the minimum wage, leaving 46% of patients in permanent financial hardship.[16] The pandemic situation has been claimed to decrease in- and outdoor physical activities among people by 16.6%, and increase the cost and difficulty of providing healthcare services by 32.1%.[17] it appears that the government will find it difficult to manage diabetes if people are not placed on the front lines of the fight against it.[18]

Early diagnosis of diabetes and the promotion of early initiation of treatment for those who have been diagnosed with the disease is made possible by health-related preventive and promotional interventions that explore peoples' lifestyles, screening services, and diabetes awareness/sensitization programs.[19] Nevertheless, the serving of 966 million dollars that would be used in health expenditures is strongly related to health facilities, community-based diabetic screening programs, and the early start of diabetic treatments of which 49% was before the COVID-19 pandemic against 53% after the pandemic.[17,20] This piece of data may highlight that the proportion of sick people spending on healthcare services was significantly higher during the pandemic than before it. With all Tanzanian prevention efforts against NCDs such as T2DM, it has continued to be a problem of public concern especially during and beyond the COVID-19 pandemic.[14]

Notwithstanding the negative effects of diabetes on a person's health and finances at the individual, family, community, and national levels, examining a person's lifestyle can both prevent the disease and increase that person's capacity to support the socioeconomic development of the country.[21]

Despite the contributions made by earlier academic research on T2DM, not much is known about the condition's present prevalence or incidence, nor about the traits and lifestyle choices of adults in Dodoma region, Tanzania that may contribute to its development. The region is one of three in the central region of Tanzania, which has the fifth-highest prevalence of diabetes mellitus in the nation.[7,14] There seem to be unanswered questions about, how adults with T2DM in the Dodoma region adhere to medications? How do the lifestyle habits and sociodemographic characteristic profiles of adults contribute to the prevalence of T2DM among adults in the region?

If efforts to promote health are not prioritized and widely disseminated to reach the community, the estimated number of people who will develop diabetes mellitus will be as high as the number of deaths.[22] Thus, this study aimed at determining the prevalence, medication adherence, lifestyle changes, and sociodemographic characteristics profiles of adults with T2DM in Dodoma region, Tanzania. As a recently declared city in the nation, a hub for politics, academia, and business, the area has experienced a surge in population. The study's findings may assist policymakers in enhancing the accessibility and sustainability of public spaces for physical activity, T2DM screening services, and related treatments. By doing this, it will be easier to address the issue appropriately.

Methods and materials

The present investigation was carried out in compliance with the institutional guidelines, research ethics, and standards for both undergraduate and postgraduate programs. These guidelines offer a framework for researching while adhering to ethical issues to achieve national and international research standards.[23] The research was carried out physically from 30 September to 28 October 2020, with the respondents being recruited in the study from 28 September 2020 for the 29 days of the study. Information that was used to identify specific study respondents was available to the authors either during or after data collection.

Study design

This study employed a community-based analytical cross-sectional study design that employed a quantitative research methodology to gather data at a specific point in time and determine the relationship between the variables under investigation.

Study area

One of the seven districts in the Dodoma region—the Dodoma Municipal Council—was the site of the study. The region, one of three in the central region of Tanzania, has the fifth-highest prevalence of diabetes mellitus in the nation[14]; the majority of its residents are served by the regional referral hospital located inside the Dodoma municipal council.

Inclusion criteria

The study aimed to include consenting adults aged above 18 years, living in the study area (in the community) for ⩾6 months, conversant in Swahili language, and able to read and write. The focus was to gather clear and complete information from them to establish the magnitude of T2DM, medication adherence, and lifestyle habits among those who had it regardless of whether they were newly diagnosed or not. Study respondents who reported having been diagnosed with T2DM were asked to show their medical treatment sheets (named in this work as medical records) as a strategy to confirm the disease and adherence to prescribed medications.

Sample size estimation

Based on the recommendations from previous scholars.[10,24–30] the following procedures were performed to determine the minimum sample size for the study using the formula by Cochran 1977.[31] The prevalence used to determine the sample size was obtained from the study conducted by Malindisa et al.,[14] who observed that 74.7% of the studied respondents reported being physically inactive as far as T2DM is concerned. Therefore, $n = 290$ respondents served as the minimal sample size. Nevertheless, as illustrated in Figure 1, 107 individuals ($n = 107$) fulfilled the inclusion requirements and gave their permission to take part in the research. One hundred eighty-three respondents were eliminated for various reasons, such as being involved in other research projects ($n = 54$), not wanting to participate in the study ($n = 13$), not living in the Dodoma region ($n = 9$), having visual issues ($n = 4$), and not fulfilling the inclusion requirements ($n = 103$). For a more detailed understanding of the recruiting and sample size determination processes, consult the figure.

Sampling technique

The study included only consenting adults (over the age of 18) who lived in the Dodoma region. Additionally, the survey included individuals who could communicate in Swahili. As negotiated and agreed upon by the village leaders and the study population, adults were assembled in one meeting location available in one village with administrative support from the sampling ward executive officers. Brief explanations of the objectives of each gathering were provided to each respondent, and they were allowed to choose whether or not to stay, depending on their willingness. After that, screening processes were carried out to create a list of eligible persons ($n = 290$), and adults who satisfied the inclusion criteria were chosen using a systematic sampling technique as it has been used and recommended by some previous

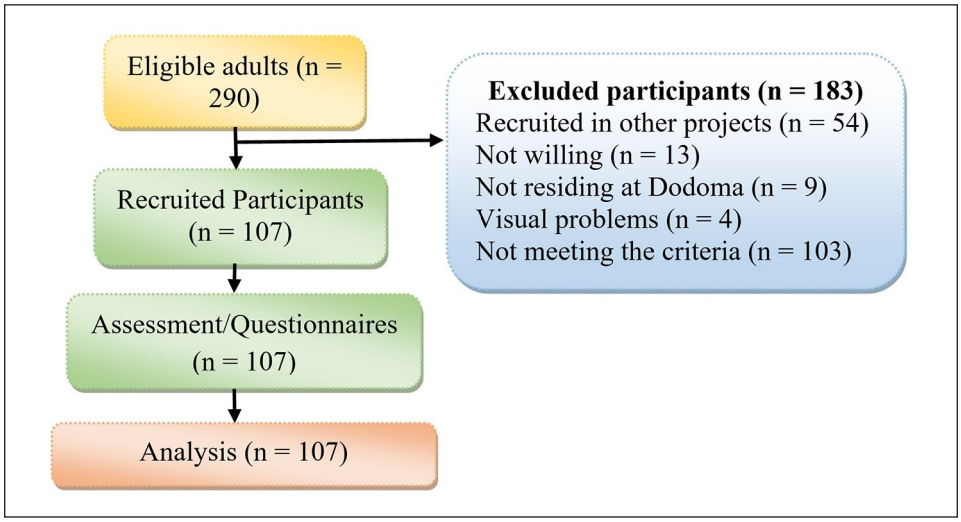

Figure 1. A flow diagram of sample size determination and recruitment.

scholars.[32] Because 290/107 = 3, a systematic sample of one in three was carried out and a random starting point was 3 using random number tables as suggested by some previous scholars.[33] The procedure continued from that on until a minimum required sample of 107 respondents was reached.

Data collection procedures

During the 4 weeks between September and October 2020 (28 days), information on the variables under investigation was obtained physically from the study respondents. Authors collected information from adults about COVID-19 in a retrospective approach considering the time they were diagnosed or not to establish the before-pandemic prevalence and that after/during it. The study relied only on when the diagnosis was made and not otherwise. To get information about the prevalence of T2DM and lifestyle choices, the lead investigator, with the help of the trained research assistants, provided medication adherence and lifestyle habits structured questionnaires to interview the study respondents. A separate, empty venue in each hamlet was utilized to provide privacy on the day of the meeting for the data collection methods, which was decided upon and planned following the sampling procedures. To reduce response sharing, copying, and pasting, respondents were placed in separate chairs from each other. The study crew was on hand to oversee, answer questions, gather completed surveys, and secure them. Before the respondents began filling out the questionnaires, they were given brief instructions. Confidentiality was ensured in the questionnaires by using codes rather than respondent names. The estimated time to finish filling out the surveys was between 30 and 45 min.

Data collection tools and data measurements

Data collection tools were developed and piloted by the research team by benchmarking some items sourced from different scholarly works including medication adherence questionnaires[33,34] and lifestyle questionnaires benchmarked from previous studies[11,35] including food frequency questionnaires[36,37] and physical activity questionnaires[9,38] were the main data collection tools to measure the variables under study. The research tool for this study was divided into three sections; the first piece dealt with the sociodemographic profiles of the study respondents, which included age, sex, education, marital status, and religion. In the second portion, study respondents were asked to report if they had been diagnosed with T2DM and if they were taking prescribed medications as required or not.

Study respondents who reported having been diagnosed with T2DM and were taking their prescribed medications were confirmed through respective individuals' prescribed treatment sheets (medical records) that were with them at their homes. In the Tanzanian context, patients who are diagnosed with NCDs such as T2DM for example are provided with a medical treatment identity number and a card that they can carry and walk with them to their homes throughout their lives. By self-reported diagnosis of T2DM, means study respondents were asked to report whether they had ever been diagnosed with T2DM and were using any prescribed medications from health facilities or not. The study did not involve any form of physical invasive procedures to the study respondents such as measuring blood glucose or Glycated Hemoglobin (HbA1c). This allowed for an assessment of the prevalence of the condition as well as treatment adherence.

In the medication adherence questionnaires, study respondents (those with T2DM diagnoses) were asked to report whether they were taking medications such as metformin, glucagon, or sulphonylureas. Moreover, based on the recommendation from previous scholarly works[33,34] study respondents were asked how often they attended diabetic clinics as advised, as well as how consistently and promptly they took their medications, whether they were injections or

tablets, and categorized whether they never adhered to the medication regimen, adhered less, or adhered as required. The replies were divided into "Yes" and "No" categories, and a binary variable was created for each category, assigning one point (0 otherwise). The respondents were divided into two groups: those who did not take their medications as prescribed (0 scores) and those who did (1 score).

The third portion examined lifestyle factors related to self-reported favorite and frequently consumed foods, such as water, fruits, vegetables, sweetened snacks, meat, eggs, groundnuts, and cashew nuts, as well as carbohydrates (rice, maize flower, etc.) and proteins (meat, eggs, groundnuts, and cashew nuts). Regular, moderate, and irregular sleep patterns were used to measure sleep, whereas low, moderate, and vigorous-intensity physical activities were used to measure physical activity, and never, smoking alone, alcohol alone, and smoking plus alcohol were used to measure drug misuse. A binary variable was created for each of those elements, assigning one point (0 otherwise) if the study participant satisfied all of the requirements, which included regular physical exercise, timely and regular sleep, abstinence from alcohol and tobacco use, and regular physical activity. Three categories were created from the responses: unhealthy (0 points), moderately healthy (1–2 scores), and healthy lifestyle (3 scores).

Validity: To ensure content validity, relevant and acceptable research instruments were developed and shared with statisticians and expert peers. These individuals provided feedback on the items' content suitability, sentence structure, language, and organization. Their responses required research tools to be translated into Swahili to blend in with the study respondents' literacy level and enhance the clarity, understanding, accuracy, and completeness of the information, while other aspects such as content appropriateness, sentence structure, and item organization remained unchanged. They received the tools again to review for their final verification, at which point there were no more inputs that needed to be changed.

Reliability: To avoid information contamination, the primary investigator pre-tested the research instruments on 10% ($n = 11$) of the calculated sample size in a place separate from the sampling study settings. Indicators including the items' applicability, the language used, its intelligibility, and how long it would take to complete the surveys. Ten independent reviewers/observers were consulted, and their opinions on the items' relevance were rated using the inter-observer rating system. Pre-test observations showed that all items had a score range of 9–10/10, which was relevant; the language used was adequate and understandable; and respondents would fill out and submit the questionnaires in between 30 and 60 min. The pre-test results were analyzed using a scale to ascertain the reliability measure of the instruments. The results showed that the items evaluating medication adherence had a Cronbach α of 0.71 for medication adherence and 0.73 for lifestyle behaviors, in line with recommendations from previous studies,[39–41] and the tools were considered reliable for the actual field data collection.

Control of bias

Referring to some previous studies,[42–48] using random sampling techniques and procedures, the study respondents were selected to guarantee that the information on the study topic was random. The study also used several research assistants who were not from the sampling study environment to lessen hallo bias. The research assistants, data analyzers, and study respondents were all divided into different groups to lessen the obedience effect in the study. To minimize remembering bias, study respondents were asked real-world questions no later than a year following the date of data collection.

Data analysis

The prevalence of T2DM and medication adherence were the dependent variables in this study whereas sociodemographic characteristics profiles and lifestyle habits were the independent variables of interests under study. Data were cleaned and descriptively analyzed using version 25 of the Statistical Package for Social Sciences (SPSS) computer software program available and accessed from the respective institution. The prevalence of T2DM, study respondents' sociodemographic profiles, as well as adherence to medicine, and lifestyle habits, were quantitatively analyzed and displayed using frequencies and percentages. The association between predictor variables and the study's desired outcomes was ascertained using a binary and multinomial logistic regression model, which was set at a 95% confidence interval and 5% significance level. Stepwise regression analysis was employed in which each determinant was added to the regression model independently and then cumulatively to adjust for the confounding variables over the outcome variables of interest. The following logistic regression model was used.

$$\left[p = \frac{1}{1 + e^{-(b_0 + b_1 x)}} \right] \left(\leq 0 \, p \leq 1 \right)$$

Where;
p: the predicted probability of an outcome
e: Exponential
b_0: Constant value
b_1: Slope
x: Predictor variable

Results

Social demographic characteristics of the study respondents

All study respondents in the study who were recruited had a response rate of 100%. Table 1's results indicate that the

Table 1. Social demographic characteristics profiles of the study respondents ($n = 107$).

Variables	*n* (%)
Age: Mean age = 31 ±2.527years	
18–35 years	22 (20.5)
36–55 years	77 (72.0)
>56 years	8 (7.5)
Gender	
Female	64 (59.8)
Male	43 (40.2)
Marital status	
Single	36 (33.6)
Married	71 (66.4)
Education level	
Non-formal	23 (21.5)
Primary	43 (40.2)
Secondary	29 (27.1)
College/University	12 (11.2)
Employment	
Formal employment	31 (29.9)
Non-formal employment	75 (70.1)
Religion	
Christians	53 (49.5)
Islamic	41 (38.3)
Pagan	13 (12.2)

average age of study respondents was 31 ± 2.527 years, with the largest age group (36–55 years) accounting for 72% ($n = 77$) and the 18–35 years age group (20.5%) coming in second. The majority (59.8%) of them were female, with 66.4% ($n = 71$), 70.1% ($n = 75$), and 21.5% ($n = 23$) having non-formal education, marriage, and unemployment, respectively. Just 11.2% of study respondents completed their college or university education, while the bulk (40.2%) just completed their primary schooling.

Proportional distributions of the prevalence of T2DM among adults

The findings shown in Figure 2 indicate that the prevalence of T2DM accounted for 63.9% of the respondents, which means that they were diagnostically confirmed to have T2DM and were taking medication for it, whereas 36.1% ($n = 39$) did not. Of the study respondents who were diagnosed with T2DM, 44.6% ($n = 30$) were confirmed after the year 2019 (during the COVID-19 pandemic) against before it (19.3%).

Proportional distributions of the prevalence of medication adherence among adults

As shown in Figure 3, the prevalence of medication adherence accounted for 77.9% ($n = 53$) of the study respondents who were diagnosed with T2DM. This means that the majority of T2DM adults adhered to their medication prescription regimens well, compared to 22.1% ($n = 15$) of them who did not.

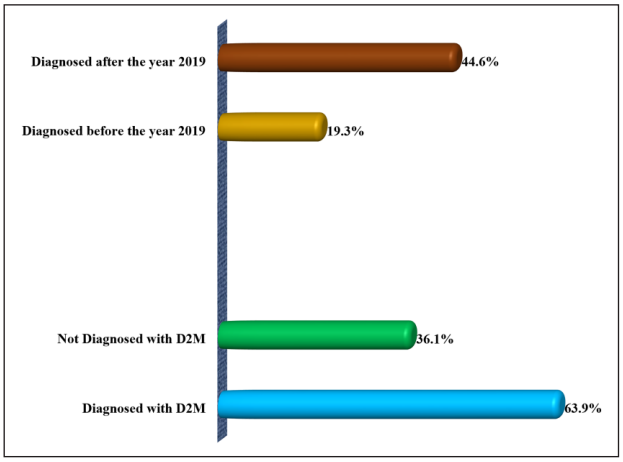

Figure 2. Proportional distributions of the prevalence of T2DM among adults ($n = 107$).

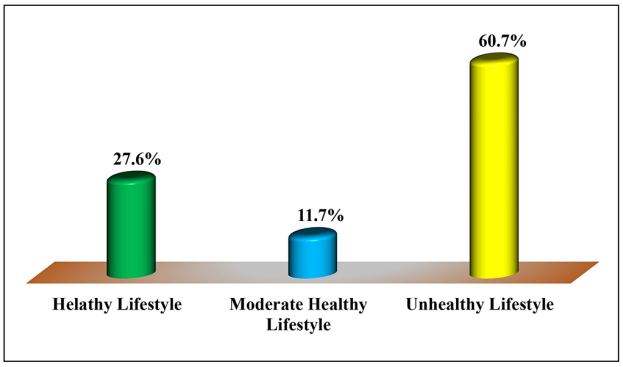

Figure 3. Proportional distribution of the prevalence of medication adherence ($n = 68$).

Proportional distributions of the lifestyle status among the study respondents

It can be shown from Figure 4 that 65.7% of the study respondents led unhealthy lifestyles, compared to 11.7% of the study respondents who led moderately healthy lifestyles and 27.6% of the study respondents who led healthy lifestyles.

Lifestyle habits among the study respondents

Item analysis was done for descriptive purpose across the domains that evaluated the study respondents' lifestyle choices. Assessments were conducted in the following domains: drug misuse, food habits, sleep patterns, and physical activity. The results, which are displayed in Table 2,

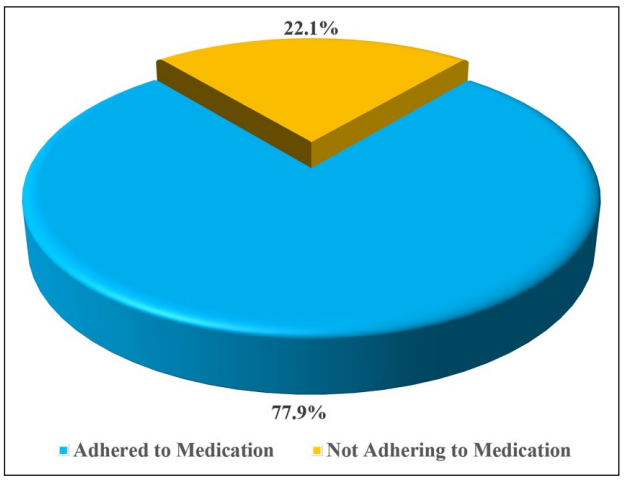

Figure 4. Proportional distribution of lifestyle status of the study respondents ($n = 107$).

indicate that most study respondents engaged in low (62.6%) to moderate (11.2%) physical activity as opposed to vigorous (62.6%) physical activity. Furthermore, results showed that the majority of them, or 30.0% and 58.9%, respectively, had moderate to irregular sleep habits. Of the study respondents, 25.2%, 13.1%, 16.8%, and 14.0% consumed more carbohydrates, dairy products, non-alcoholic beverages, and sweetened foods/snacks than any other food group. Of these, 44.9% smoked and drank alcohol.

Factors associated with T2DM among the study respondents

Table 3 indicates the findings from binary and multinomial logistic regression using the following regression model that established the association between categorical variables: $\left[p = \frac{1}{1+e^{-(b_0+b_1x)}}\right](\leq 0\, p \leq 1)$. Symbols in the model were defined as p = predicted probability of an outcome; e = an exponential value; b_0 = a constant value; b_1 = a slope and x = a predictor variable. The results showed that the study participant's odds of developing T2DM were significantly higher (AOR = 1.054; 95% CI: 0.292, 3.162; $p < 0.05$) if they were in the age group between 36 and 55 years old than if they were in other age groups, such as 18–35 years old ($p > 0.05$) or >56 years old ($p > 0.05$).

Female respondents had a substantial one-time increased risk of developing T2DM compared to male respondents (AOR = 1.398; 95% CI: 0.205, 3.048; $p < 0.05$). Further analysis revealed that those with formal paid employment had a considerably higher chance of developing T2DM—by two times, with an odds ratio of (AOR = 2.597; 95% CI: 1.243, 4.402; $p < 0.05$) compared to those without formal waged employment. It may be possible that the findings are related to work-related stress, sleep deprivation, overeating, or selecting unhealthy, high-energy foods and beverages to keep themselves hydrated while working, as well as the fact that they occasionally exhibit passivity when carrying out tasks at their workstations. The study respondents with unhealthy lifestyle habits had a threefold higher probability of developing T2DM, according to the lifestyle habit findings (AOR = 3.301; 95% CI: 1.199, 6.52; $p < 0.05$). Being single was discovered to be a significantly stronger protective factor against T2DM than being married (>0.05).

Discussion

In this study, the study respondents had a notably high frequency of T2DM of which most of them were diagnosed during the COVID-19 pandemic. Based on this data, it seems likely that the adults' pre-pandemic lifestyle choices contributed to their development of T2DM rather than the other way around. Furthermore, the pandemic appears to have contributed to a major increase in their sedentary lifestyle and altered their sleeping, working, eating, and movement habits which would likely have contributed to adults in the majority of adults in this study developing T2DM more during the COVID-19 pandemic than before. Despite being diagnosed with T2DM, many of the adults with the disease were not taking their prescribed and advised medications, even though the majority of them had the diagnosis and confirmation of the illness.

Receiving a diagnosis of the illness but failing to take prescribed drugs could indicate that individuals thought the illness would not affect their health, that it was not serious, or that the costs of treatment were too expensive for them. If someone believes that having diabetes will not harm their health, it could mean that they do not know much about it and that they could run a higher chance of dying from diabetic ketoacidosis, hyperglycemia, heart attacks, strokes, kidney failure, or other health-related complications. The frequency was highest in women, those between the ages of 36 and 55, single persons, and adults with formal waged employment. It may be possible that the findings are related to work-related stress, sleep deprivation, overeating, or selecting unhealthy, high-energy foods and beverages to keep themselves hydrated while working, as well as the fact that they occasionally exhibit passivity when carrying out tasks at their workstations. However, results showed that T2DM in adults was significantly associated with the female sex, having formal waged employment rather than being unemployed formally, being aged above 56 years, and exhibiting unhealthy lifestyles.

The bulk of adults were found to have unhealthy eating habits, with carbohydrates, dairy products, non-alcoholic beverages, and sweetened snacks being the most commonly consumed available and preferred items. These observed survey findings were likely accurate as it was revealed that even though the majority of adults had low to moderate physical activity levels, they nevertheless had poor eating

Table 2. Lifestyle habits among the study respondents ($n = 107$).

Item	Measurements/categories	*n* (%)
Physical activity (non-digital works, outdoor activities, and out-gym activities, etc.)	Low	67 (62.6)
	Moderate	12 (11.2)
	Vigorous-intensity	28 (26.2)
Sleep	Regular	13 (12.1)
	Moderate	31 (30.0)
	Irregular	63 (58.9)
Drug abuse	Never	16 (14.9)
	Smoking only	14 (13.1)
	Alcohol only	29 (27.1)
	Smoking + alcohol	48 (44.9)
Eating habits (types of foods)	Carbohydrates	27 (25.2)
	Proteins (Meat, eggs, groundnuts, cashew nuts, etc.)	9 (8.4)
	Dairy products (Milk, yogurts, ice creams, etc.)	14 (13.1)
	Fruits	7 (6.5)
	Water	11 (10.3)
	Vegetables	6 (5.6)
	Non-alcoholic beverages (Soda, canned juices, etc.)	18 (16.8)
	Sweetened foods/snacks (Candy, biscuits, chocolates, etc.)	15 (14.0)

Table 3. Factors associated with T2DM among the study respondents ($n = 107$).

Variables	Crude odds ratio	*p*-Value	95% CI		Adjusted odds ratio	*p*-Value	95% CI	
			Lower	Upper			Lower	Upper
Age								
18–35 years	1.214	0.082	0.307	3.920	1.735	0.106	0.434	4.117
30–55 years	1.080	0.019	0.243	2.791	1.054	**0.021**	0.292	3.162
>56 years	1				1			
Gender								
Female	1.486	0.022	0.217	3.085	1.398	**0.037**	0.205	3.748
Male	1				1			
Marital status								
Single	1.980	0.185	0.732	2.806	1.753	0.223	0.953	4.021
Married	1				1			
Employment								
Employed	1.607	0.013	0.158	3.427	2.597	**0.028**	1.243	4.402
Unemployed	1				1			
Lifestyle								
Healthy	1				1			
Unhealthy	4.333	0.001	0.097	7.521	3.301	**0.006**	1.199	6.261

habits. Sometimes, women and employed individuals spend the majority of their working hours in a sedentary manner as directed by their workstations. They occasionally do not exercise to the same extent as men in their age group, which is a major risk factor for T2DM since it does not cause them to perspire or burn fat or calories. Being exposed to sedentary lives by indulging in sugary foods and not engaging in physical activities highlights that most adults in the region were at risk of being obese and thus getting other diseases such as T2DM, heart problems, kidney diseases, and respiratory problems, which sometimes resulted in death.

Similarly, those who work for themselves could not get sick as much since they are constantly under stress, get less sleep, and become agitated when battling for food to feed the family on the side. As a result, they would be active for most of the day, keeping their bodies from storing fat and averting the development of T2DM and the associated health-related complications mentioned above. The results of this study also showed that moderate to irregular sleeping patterns were associated with adult individuals' habits of either consuming alcohol, smoking, or both. Adults in this study would likely be more likely to develop T2DM due to the strong

correlation between drug abuse and the development of NCDs.

The results of this investigation are consistent with those of other earlier investigations, including the work of Malindisa et al.,[14] who investigated the prevalence of T2DM and the factors that contribute to it in Mwanza, Tanzania, and found that a significant proportion of the study population (7.8%) had the disease, which was explained by some of their sociodemographic traits including age and sex. However, the research that Endris et al.,[49] carried out in Ethiopia found a prevalence of 6.8% T2DM among young adults which was significantly higher than the one found in this study. They found that smoking habits were associated with it as compared to other factors. Moreover, the work done by Shrestha et al.,[4] in Nepal revealed that the prevalence of diabetes mellitus was 8.5%, which was significantly high based on the studied population while factors such as advanced age were found to be associated with the disease.

Although these studies differ in terms of study sites and some independent and outcome variables of interest, there may be similarities in the findings between them because they all focused on adult populations and used analytical cross-sectional study methods. Findings of the lifestyle behaviors found in this study are in agreement with those found by Di Renzo et al.,[3] in Italy, and Ushula et al.,[38] in Australia, which showed that adults become subjected to an increased risk of developing diabetes mellitus because they are physically inactive, eating comfort foods, smoking, drinking alcohol, and sleeping less. Moreover, Althumiri et al.,[5] conducted a cross-sectional survey on healthy lifestyles in Saudi Arabia and discovered that 70.1% of study respondents showed a tendency to self-weigh to track their weight increase or decrease to identify any health issues early on that would require medical attention. These studies' populations, study methodologies, and/or characteristics may account for their similarities.

Strength of the study

In response to Sustainable Development Goal 3, this study focused on NCD in the health sector, which is a critical public health concern against incidences of morbidity and mortality as well as limiting healthcare spending at the individual, family, community, and national levels, respectively.

Implications for practices and future research

Tanzanian health facility administrative organs, policymakers, training institutions, and the global community can use the results of this study to find new and creative ways to empower adults with cognitive and behavioral change soft skills and encourage them to adopt healthy lifestyle habits. The results of this study will offer a pertinent base of facts and information regarding the subjects being studied for extensive interventions or future research if they are published in various scientific journals.

Limitations of the study

Even though this study showed several positives, some research-based drawbacks should be taken into account when interpreting the results as recommended by previous scholars.[50] A limitation of the study was the small sample size, which may require a cautious interpretation of the results as it would not support the representation and generalization of the findings to the entire population in the study area or other areas within or outside the country. Moreover, there was a lack of statistically significant triangulation in the data collection instruments to establish real-life experiences of adults on their lifestyle habits such as eating and physical activities, and medication adherence; thus, findings of this study may be biased to the quantification only rather than qualitative. Furthermore, there may be a need for additional operational research because the factors under investigation—drug addiction, eating habits, physical activity, sleep patterns, and medication adherence—were not examined in detail. The study was limited in scope, thus its conclusions might not apply to adults in other parts of Tanzania or even to other countries, than those from the Dodoma region, Tanzania. The results of this study should also be viewed cautiously since adults may have had difficulty recalling and discussing their prior medication adherence and lifestyle habits. Having the option to rate oneself has been criticized for potentially influencing someone to report inaccurate or accurate behaviors or information. For this reason, care must be taken when evaluating the study's findings.

Conclusion

The study's primary conclusions show that T2DM is rather a common non-communicable health problem in the adult population in the region, with the majority of cases having been diagnosed during the COVID-19 epidemic. Findings have shown a substantial correlation between the prevalence of type 2 diabetes (T2DM) and individual-related factors such as age, sex, work status, and poor lifestyle choices. Findings revealed that most adults do not lead healthy lives; they reported eating more carbohydrates, dairy products, sweetened snacks, and/or non-alcoholic beverages; they also reported not exercising; and they sleep seldom or never at all. Some adults with type 2 diabetes did not follow their specified diabetic treatment plan, even though a high number of them complied with medication.

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Authors contribution

I.M.Y.: Conceptualization, methodology, investigation, resources. W.C.M.: Conceptualization, methodology, supervision, data curation, formal analysis, original draft and writing, review and editing

the final work. P.Z.H.: methodology, formal analysis, original draft and writing, review the final work.

Availability of data and materials

Data will be available under special request at walter.millanzi@udom.ac.tz or wcleo87@gmail.com

Declaration of conflicting interests

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Ethics approval and consent to participate

This study was not an intervention that involved experiments on live vertebrates and/or higher vertebrates. The study adhered to the institution's guidelines and the University of Dodoma (UDOM) Institutional Research Review Ethics Committee (IRREC) approved it with an approval letter referenced DJ.432/328/0-81. The principal investigator collected written informed consent from the participating respondents as one of the criteria to join the study after describing the advantages, disadvantages, their roles during the study, and rights to withdraw from it at any time. Consent from the illiterate respondents was collected from the legally authorized representatives.

Informed consent

Written informed consent was obtained from all subjects before the study.

Trial registration

Not applicable.

Consent for publication

Not applicable.

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Supplemental material

Supplemental material for this article is available online.

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