Original Article

Prevalence of Diabetes Among Adults 18 Years and Older in Addis Ababa, Ethiopia: A Community-Based Study

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Abstract

Background: Diabetes Mellitus (DM) is a chronic metabolic disease characterized by elevated blood glucose levels that cause significant damage to major organs over time. Ethiopia is one of the most densely populated countries in Africa and has the highest number of diabetes cases. However, there is little empirical evidence on DM in Ethiopia, particularly in the country's capital. Therefore, the aim of this study was to investigate the prevalence and associated factors of DM in adults aged 18 years and older in Addis Ababa, Ethiopia.

Methods: A cross-sectional community-based study was conducted in Addis Ababa City from June 1 to October 31, 2018. A multi-stage random sampling technique was used to capture adults aged 18 years and above.. Face-to-face interviews were conducted using the WHO-STEPwise approach to monitor risk factors for non-communicable diseases. Physical and biochemical measurements were also collected following standard procedures.We performed binary and multiple logistic regressions to identify associated factors. Results are presented as adjusted odds ratios (AOR) with 95% confidence intervals (CI).

Results: In this study, a total of 602 participants were included.The overall prevalence of DM was 14.3% (95% CI: 11.5–17.1), with 70.9% of the cases diagnosed for the first time during the study. Age 50 years and above (AOR: 3.89, 95% CI: 1.59–9.48), overweight (AOR: 2.28, 95% CI: 1.24–4.18), obesity (AOR: 4.55, 95% CI: 2.24–9.25), abdominal obesity (AOR: 2.14, 95% CI: 1.03–4.44), hypertriglyceridemia (AOR: 1.99, 95% CI: 1.17–3.38), and low HDL-C level (AOR: 2.74, 95% CI: 1.59–4.71) were significantly associated with DM.

Conclusion: The prevalence of DM was higher in the population of Addis Ababa. DM was significantly associated with increasing age, overweight, obesity, abdominal obesity, hypertriglyceridemia, and a low HDL-C level. Our findings recommend the development of a strategy for the health system to implement selective screening programs and interventions targeting modifiable risk factors. [*Ethiop. J. Health Dev.* 2024; 38(3): 00-00]

Keywords: Diabetes mellitus, prevalence, risk factors

Introduction

Diabetes Mellitus (DM) is a chronic metabolic disorder characterized by elevated blood glucose (or blood sugar) levels that,over time, severely damage body organs, particularly the heart, blood vessels, eyes, kidneys, and nerves(1, 2).There are two reasons: the pancreas does not produce enough insulin hormones, or the body does not use them effectively(2, 3).Diabetes is a complex group of diseases with numerous causal factors, including obesity, physical inactivity, glucose production abnormalities, beta-cell dysfunction, and genetic susceptibility. Besides age, gender, alcohol intake, smoking, hypertension, family history, living in an urban area, and lipid profile values have been identified as factors that cause diabetes(4, 5).

Diabetes is one of the four most common non-communicable diseases (NCDs) causing death world-wide. It is recognized as a vital cause of premature death (deaths occurring before the age of 70) and disability in the twenty-first century (6, 7). The International Diabetes Federation estimated that more than half a billion adults aged 20 to 79 world-wide (10.5% of all adults in this age group) have Diabetes (2). Diabetes was the direct cause of 1.5 million deaths in 2019, with 48% of all deaths under the age of 70 attributable to Diabetes. It was also the world's seventh leading cause of mortality and disability combined (7, 8). It is estimated that the number of Diabetes-related deaths will rise to over 6.7 million people aged 20 to 79 in 2021(2).

Diabetes causes 58% of premature deaths in Africa, more than the global average of 48%. Meanwhile, the age-standardised diabetes death rate in the region is 48 per 100,000 people, more than double the global rate of 23 per 100,000 (9). In 2022, 24 million adults were affected by Diabetes resulting in 416,000 deaths in 2021. It is estimated that this number will increase by 129% to 55 million by 2045, the largest predicted increase of any region. Besides, the proportion of undiagnosed diabeties is the highest in the regions at 53.6(2).

Currently, more people in the Sub-Saharan Africa (SSA) region are living in urban areas, resulting in less emphasis on chronic diseases such as Diabetes. However, due to an increasing mismatch in the demand and supply of diabetes care resources, which affects the overall quality of care, Diabetes has become more prevalent in the region than ever (10, 11). Ethiopia, an SSA country, is one of the top five countries with the highest number of people aged 20 to 79 who have Diabetes (2). Diabetes affected roughly 1.7 million people in the country in 2019, with an age-adjusted diabetes prevalence of 4.3 (3.1–8.2). It is also estimated that by 2045, the nation will have 14.7 (11.6-

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31.1) million people with impaired glucose tolerance (12).

The first national steps survey in Ethiopia was conducted in 2015, reporting a 5.9% prevalence of raised blood glucose levels among adults aged 15 and above (13). Meanwhile, another regional study revealed a 14.8% prevalence of DM in public institutions in Addis Ababa (14). Other Ethiopian studies also found that the proportion of undiagnosed Diabetes ranged from 63% to 88.5% (15-17). The substantial proportion of undiagnosed persons, along with the rising number of newly referred diabetics experiencing complications, heightened the need for early detection since the disease has a long and latent asymptomatic period (18).

Despite the sharp rise in the prevalence of Diabetes, its complications, and the detrimental impact on quality of life and the health system, community-based studies are scarce in Ethiopia, particularly in Addis Ababa.By understanding its prevalence and associated factors, policymakers can design effective diabetes prevention, early detection, and intervention programs. Besides, given that Addis Ababa is Ethiopia's largest urban center, accounting for approximately 25% of the nation's urban population at risk of Diabetes, it is worthwhile to assess the magnitude of the disease in the area (2, 4, 19).Therefore, the purpose of this study was to assess the prevalence and related factors of diabetes mellitus among adults in the city of Addis Ababa.

Methods

Study design and setting

This study is part of a larger project that has multiple objectives. In this study, we conducted a cross-sectional survey between June 1and October 31, 2018, in Addis Ababa, the capital of Ethiopia's. Administratively, the city was divided into ten sub-cities (currently eleven) and 116 Weredas(20). According to the Ethiopian Central Statistical Agency, Addis Ababa had a population of 3,433,999 in 2017 (21).

Selection of the study participants

We calculated a sample size of 3,341 using the single population proportion formula, considering a 5.1% prevalence of Diabetes from a prior Ethiopian study(15), a 95% confidence interval (CI), of 95%, a margin of error of 1, a 1.5 design effect, and a 20% possible non-response rate. We also calculated the sample size for the risk factors using two population proportion formulas, with the single population proportion formula yielding the largest sample size.

A multi-stage cluster sampling technique was employed by first identifying seven of the ten sub-cities based on pre-established criteria, including geography, population density, and socioeconomic status. Then, one wereda was randomly chosen from each of the selected sub-cities.Following that, two 'ketenas' (the smallest geographical units in the weredas) were chosen randomly from the selected weredas. Finally, from each ketena, the first household was randomly selected, while subsequent households were included based on proximity to the first and the preceding household.All adults in the selected households who fulfilled the eligibility criteria were included. The total sample size of each sub-city was also determined using probability proportional to size (PPS).

Survey response and physical measurements were performed on all 3,341 participants, while the biochemical measurements were taken from 20% of the selected respondents (n=602) interviewees using a simple random sampling technique. For biochemical measurements, the World Health Organization (WHO) recommended 20% of the total sample size for resource-limited countries (22, 23).

Study population

Inclusion criteria

All adults aged 18 years and above

Residing in Addis Ababa for 6 months and above

Exclusion criteria

Pregnant and lactating women up to 6 weeks postpartum

Individuals who were non-cooperative or refused to provide the necessary information

Study participants who are bedridden and disabled do not meet the criteria for physical measurements (weight and height).

Individuals who were absent during the data collection process.

Data collection instruments and measurements

As part of the core and expanded modules, we used all three tools, including socio-demographic, behavioral, physical, and biochemical measures (23). Face-to-face interviews were conducted using the WHO STEPwise approach to non-communicable disease risk factor surveillance; following the interview and physical assessments, selected respondents were asked to fast for at least 8 hours after dinner to obtain biochemical measurements. Five milliliters of venous blood was drawn from each study participant to calculate plasma glucose, cholesterol, HDL-C, and triglyceride levels. The serum was separated from the sample, centrifuged, and transferred to a tertiary hospital for analysis using conventional methods. At the Armed Forces Comprehensive Specialized Hospital, samples were analyzed using the enzymatic colorimetric method on the Mindray BS-200 Chemistry Analyzer.

A trained graduate nurse conducted in-person interviews while laboratory technicians (phlebotomists) took blood samples. Diabetes mellitus and dyslipidemia were defined according to the criteria of the International Diabetes Federation and the third report of the National Cholesterol Education Program Adult Treatment Panel (NCEP ATP III), respectively(2, 24).

Operational definitions

Diabetes mellitus: a fasting blood glucose value ≥ 7.0 mmol/l (≥126 mg/dl) or a previous history of Diabetes (2).

Waist-to-hip ratio: This is computed by dividing waist circumference in centimeters by hip circumference in centimeters and was used to assess abdominal obesity. Abdominal obesity is defined as a waist-to-hip ratio of 0.94 m in men and 0.80 m in women (25).

Body Mass Index (BMI): calculated as weight in kilograms divided by height in meters squared (weight (kg)/height (m2). BMI was categorized as per the World Health Organization guidelines: underweight (BMI <18.5), normal (BMI ≥ 18.5 to ≤ 24.9), overweight (BMI ≥ 25.0 to ≤ 29.9), or obese (BMI ≥ 30.0).

Data analysis

The double entry was performed with the statistical software EpiData 3.1, and the analyses were performed with the software IBM SPSS 23. The Hosmer-Lemeshow goodness-of-fit statistic was used to assess whether the necessary assumptions for the application of multiple logistic regression were met. After the assumptions were ensured, we performed multivariable logistic regression to examine the factors predicting diabetes. A p-value of less than 0.20 in the bivariate regression was considered in the selection of variables for the multivariable model. The results of the regression analysis are presented as adjusted odds ratio (AOR) and 95% confidence interval (CI). A p-value of less than 0.05 was considered statistically significant for all tests.

Ethical clearance

Ethical clearance was obtained from the Addis Ababa University, College of Health Sciences Institutional Review Board (IRB), and the city government of Addis Ababa Health Bureau Ethical Review Committee (ERC). Permission letter obtained from selected sub-city health offices. Respondents were fully informed about the purpose of the study and gave their verbal and written consent. During the study, participants with high blood pressure, high plasma glucose levels, and/or abnormal lipid profiles were informed and referred to nearby health facilities for further diagnosis and treatment.

Results

Description of the study participants

Study participants ranged in age from 18 to 95 years old, with a mean age of 43.8 ±16.5 years and nearly half (43.5%) between the ages of 30-49. The majority of the participants were female (71.8%), Orthodox Christians (77.6%), and currently married (60.3%). One-third were housewives (33.2%) and had a primary education (32.6%) (Table 1).

Table 1.**Socio-demographic characteristics of the study participants. Addis Ababa, Ethiopia, October 2018**

Characteristics	Frequency	Percent
Sex		
Male	170	28.2
Female	432	71.8
Age		
18-29	129	21.4
30-49	262	43.5
50 and above(50-95)	211	35.0
Marital status		
Never married	113	18.8
Currently married	363	60.3
Separated	14	2.3
Divorced	31	5.1
Widowed	79	13.1
Non response	2	0.3
Religion		
Orthodox	467	77.6
Muslim	76	12.6
Protestant	51	8.5
Catholic	6	1.0
Other	2	0.4
Employment status		
Government employee	87	14.5

Non-government employee	29	4.8
Self-employed	158	26.2
Student	27	4.5
House wife	200	33.2
Daily laborer	6	1.0
Merchant	7	1.2
Unemployed (able to work)	32	5.3
Unemployed (unable to work)	9	1.5
Retired (pensioner)	47	7.8
Highest education level		
Primary	196	32.6
Secondary	86	14.3
Preparatory	76	12.6
Technique	13	2.2
College and above	86	14.3
Not attended formal education	145	24.1
Family size		
1-4	343	57.0
≥5	259	43.0
Family history of DM		
Yes	100	16.6
No	485	80.6
Do not know	17	2.8

Behavioral and physiological characteristics of the study participants: A relatively small proportion of respondents reported currently smoking (1.8%) and chewing khat (Cataedulis) (3.3%), while almost a third (29.9%) reported consuming alcohol for over a year. Nearly all participants (96.5%) consume fruits and or vegetables less than five times a day, whereas only 38.2% reported using vegetable oils, with palm oils accounting for the majority (60.5 %). While slightly above a quarter of participants (27.2%) engaged in low-level physical activity, almost half (46.0%) were overweight or obese (Table 2).

Table 2. **Behavioral and physiological characteristics of the study participants, Addis Ababa, Ethiopia, October 2018**

Variables	Number	Percent
Smoking		
Current smoker	11	1.8
Ex-smoker	11	1.8
Never smoker	580	96.3
Khat		
Yes	20	3.3
No	582	96.7
Alcohol consumption		
Current drinker	180	29.9
No drinking	422	70.1
5+serving fruit/veg. per day		
Yes	21	3.5
No	581	96.5
Type of oil used in cooking		
Sunflower	230	38.2
Palm	364	60.5
Don't know 8		1.3
Level of physical activity		
High	54	9.0
Moderate	384	63.8
Low	164	27.2
BodyMass Index[1]		
Normal(18.5-24.9)	280	46.5
Underweight(<18.5)	43	7.1
Overweight(25.0-29.9)	195	32.4

Obese(>=30)	82	13.6

Prevalence of Diabetes mellitus

The overall mean fasting blood glucose level was 116.5 ±36.5, with males having a higher level (119.6 ± 42.7) than females (115.3±33.7). The mean fasting blood glucose levels (for both genders) rise with age. Except for those aged 18-29, men have higher plasma glucose levels than women (Figure 1).

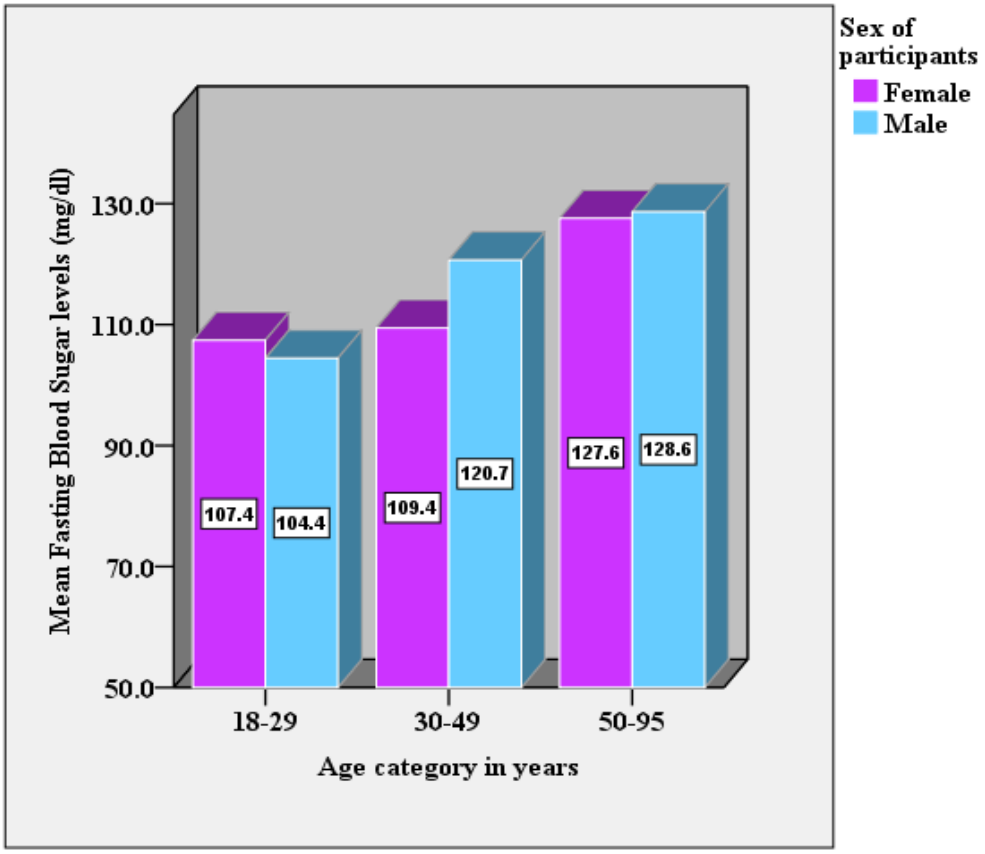

Figure 1. **Fasting blood glucose of the study population, according to gender and age. Addis Ababa, Ethiopia, October 2018**

The overall prevalence of DM was 14.3% (95% CI: 11.5–17.1), with men (16.5%, 95% CI: 10.8-22.1) and more commonly affected than women (13.4%, 95% CI: 10.2-16.7), although the difference was not statistically significant ($\chi 2$=0.92, p=0.33). Of the eighty-six diabetic participants, 70.9% were newly diagnosed during the survey.

Factors associated with Diabetes mellitus

In multivariable logistic regression, age (non-modifiable factor) and four other modifiable factors (BMI, abdominal obesity, high triglyceridemia, and low HDL-C) were associated with DM.The odds of developing DM increased almost fourfold (AOR = 3.89; 95% CI: 1.59-9.48) among respondents aged 50 years and above compared to those 18–22. Meanwhile, the odds of developing DM was higher among overweight (AOR=4.55; 95% CI: 2.24-9.25), obese (AOR =2.28 (95% CI: 1.24-4.18), abdominal obesity (AOR=2.14; 95% CI: 1.03-4.44), low HDL-C (AOR=2.74; 95% CI: 1.59-4.71) and higher triglyceridemia (AOR = 1.99; 95% CI: 1.17-3.38) compared to their peers .On the other hand, education, marital status, alcohol consumption , excessive intake of sweet foods, family history of DM, and hypertension were not significantly associated with Diabetes (Table 3).

Table 3. **Binary and multivariable logistic regression analysis of factors associated with diabetes mellitus among study participants in Addis Ababa city, October 2018**

Variable	Diabetes mellitus		Crude OR(95%CI)	Adjusted OR(95%CI)	P-value
	Yes (N=86)	No (N=516)			
Agein years					
18-29	7	122	1.00	1.00	
30-49	22	240	1.59(0.66-3.84)	0.88(0.34-2.28)	0.79
≥50	57	154	6.45(2.84-14.65)	3.89(1.59-9.48)	0.003*

Marital status [1]					
Never married	7	106	1.00	1.00	
Married	78	409	0.35(0.16-0.77)	1.04(0.39-2.77)	0.93
Education					
Primary	24	172	1.00	1.00	
2ry & preparatory	22	140	1.13(0.61-2.09)	1.47(0.71-3.06)	0.29
Technique & college	7	92	0.55(0.23-1.31)	0.71 (0.26-1.95)	0.51
Not attended formal education	33	112	2.11(1.19-3.76)	1.49 (0.76-2.92)	0.24
Consumption of alcohol					
No	69	353	1.00	1.00	
Yes	17	163	0.53(0.30-0.94)	0.56(0.29-1.05)	0.07
Frequent consumption of sweets					
No	72	374	1.00	1.00	
Yes	14	142	0.51(0.28-0.94)	0.61(0.31-1.22)	0.16
Family history of Diabetes mellitus					
No	64	421	1.00	1.00	
Yes	19	81	1.54(0.88-2.71)	1.62(0.85-3.08)	0.15
BodyMass Index(kg/m^2)					
< 25	25	298	1.00	1.00	
25–29.9	34	161	2.52(1.45-4.37)	2.28(1.24-4.18)	0.008*
≥30	27	55	5.85(3.16-10.83)	4.55(2.24-9.25)	<0.001**
Abdominal obesity(≥94 cm for males and ≥80 cm for females)					
No	12	169	1.00	1.00	
Yes	74	347	3.00(1.59-5.68)	2.14(1.03-4.44)	0.04*
Triglyceride level (≥150mg/dl)					
No	34	307	1.00	1.00	
Yes	52	189	2.48(1.56-3.97)	1.99(1.17-3.38)	0.01*
HDL-C(<40mg/dl for men and <50mg/dl for women)					
No	35	308	1.00	1.00	
Yes	51	188	2.39(1.49-3.81)	2.74(1.59-4.71)	<0.001**
Hypertension					
No	39	326	1.00	1.00	
Yes	47	190	2.07(1.30-3.28)	0.95(0.54-1.68)	0.86

*p <0.05 and **p <0.001.

Discussion

In Ethiopia, preventive and curative care for diabetes mellitus relies heavily on hospital care. Unfortunately, this approach proves to be prohibitively expensive and fails to make a substantial impact on reducing the prevalence of the disease. It is worth noting that the symptoms of Diabetes usually go unrecognized until the disease has advanced to a stage where complications occur. Consequently, our research findings reveal a concerning lack of awareness among the majority of study participants regarding the presence of this condition.

This population-based cross-sectional study reveals that approximately one in seven adults aged 18 and over is diabetic. This finding aligns with similar studies conducted in Oman, Tanzania, and Eastern Ethiopia (26-28).

However, our reported prevalence is lower than the studies conducted in Bangladesh and Saudi Arabia (29, 30). One possible explanation for this discrepancy could be the older age group of participants in the cited studies. In the Bangladeshi study, respondents were over 35 years old, while two-thirds of the Saudi respondents were over 40 years old, a significant risk factor for DM(2).Furthermore, the higher overweight and obesity observed in both studies, combined with the variable genetic predisposition to DM among different population groups, may also contribute to the observed disparity (3). On the other hand, the prevalence reported in our study is higher than that of two similar community-based studies conducted in Ethiopia (4.6% and 5.1%), as well as the WHO's estimate for Ethiopia (4%) and a study conducted in Benin (6.7%)(6, 15, 31, 32). The higher incidence in our report may be due to the variation in study settings, as we conducted the study in an urban area where Diabetes is likely to be more prevalent due to varied lifestyles (2, 15).

In this study, age was significantly associated with Diabetes. Specifically, the mean fasting glucose level increased with age in both males and females. These findings further support the recommendations of the American Diabetes Association (ADA), which emphasizes the importance of testing individuals aged 45 years and older, highlighting age as a significant risk factor for Diabetes (33).Our findings also align with previous studies conducted in Ethiopia, which

have also reported an increased likelihood of developing Diabetes with advancing age(15, 28, 32). Moreover, our results are consistent with two additional studies conducted in Bangladesh and Tanzania. The study conducted in Bangladesh revealed a twofold increase in the odds of Diabetes among individuals aged 55 to 59 years(34). Similarly, the study conducted in Tanzania demonstrated sevenfold higher odds of Diabetes among respondents aged 40 and above (27).

Obesity has been linked to metabolic alterations in the body, leading to the increased release of fatty acids, glycerol, hormones, pro-inflammatory cytokines, and other factors that play a crucial role in developing insulin resistance (35). The current study has demonstrated a significant association between overweight and obesity with DM. Our finding is congruent with the reports by the WHO and the ADA(3, 33). Similarly, other studies conducted in Southwest Ethiopia, Bangladesh, and Saudi Arabia have identified obesity as an independent risk factor for DM(30, 34).Meanwhile, the current study has revealed a significant association between central obesity and DM, which aligns with the findings of a previous Ethiopian study(36), reports by the WHO and the ADA(3, 33), and a study conducted in Oman(26).

Our study has uncovered that hypercholesterolemia is not typically observed in populations with Diabetes. However, hypertriglyceridemia and low-density lipoprotein (HDL-C) levels are more prevalent(37). Furthermore, our study found a significant association between hypertriglyceridemia, low HDL-C levels, and DM. These findings align with previous studies conducted in Oman and Saudi Arabia (26, 30).

Finally, we found no significant association between DM and various factors, such as marital status, level of education, alcohol consumption, family history of DM, and hypertension. This lack of association could be attributed to the relatively low prevalence of these factors within the study population.

Conclusion

In conclusion, 14.3% of the adult population aged 18 years and above in Addis Ababa city have diabetes mellitus. Specifically, individuals who are 50 years and older, obese, have abdominal obesity, hypertriglyceridemia, or low HDL-C levels are significantly more likely to have diabetes mellitus. Based on these findings, we strongly recommend that the health system develop a strategy to implement a selective screening program for Diabetes mellitus in this community. It is crucial to prioritize screening programs for DM, particularly among individuals in high-risk groups such as the elderly, obese, and centrally obese. Additionally, intervention measures should be implemented to target weight reduction among obese and overweight participants. Further prospective studies may be necessary to explore the association in more depth.

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