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RESEARCH ARTICLE

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MJM BIOLABS

Dietary Practices of Type 2 Diabetic Patients Attending Diabetic Clinic at Nakuru Level 6 Hospital, Kenya

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Abstract

Global DM prevalence is 425 million cases, 16 million of which emanate from Africa, and 458,900 from Kenya. Expected global rise is 48% and 156% in Africa by 2045. DM complications are severe and increases risk of death, with one death reported every eight seconds. The financial implications are adverse, with $825 billion spent globally and $3.3 billion in Africa; Kenya spends $234 per DM case. Of the cost-effective interventions, dietary intervention is the most effective. Despite dietary practices, being effective in the management of DM is still a challenge. Against this backdrop, it is reasonable to determine the T2DM patients' dietary practices in order to develop an effective intervention strategy.

This study adopted a descriptive cross-sectional study design. Fisher formula 1998, was used to determine the sample size. Pretest was carried out at Naivasha Hospital where 10% of the respondents participated. Data was analyzed using SPSS version 24 and Nutri-survey. Statistical parameters used were Mean, SD, Percentages, and Chi-square. All research and ethical approvals and permits were obtained before the commencement of the study.

262(96%) T2DM patients participated, the majority were male (58.8%), aged 41-50 years (35.9%), married (79.8%), and had secondary education (42.7%). The main source of income was business (31.7%), they earned a household income of between Kshs 10001-20000; (31.3%), and a family history of DM 59.9%. Starches (40.3%) and cooking oil (96.9%) were consumed daily. Most participants (71.8%) had high DDS. Most participants exceeded their adequacy levels for Energy, Carbohydrates, and proteins, adequacy levels for fats and fiber were low. Most respondents had three meals (55.3%). (48.1%) of the respondents' RBS was >11.0 mmol/l. Household income and DDS ($P \leq 0.018$) had a significant. Whereas, respondents' RBS had a significant association with carbohydrate ($P \leq 0.034$) and Fiber consumption ($P \leq 0.016$).

T2DM patients consume a highly diverse diet, but carbohydrates and fats frequently. They exceed adequacy levels for energy and carbohydrates, adequacy for fiber is poor. T2DM patients have poor glycemic control. T2DM patient's household income is a predictor of dietary diversity. Whereas, carbohydrate and fiber intake are determinate of patients' RBS.

More emphasis should be placed on the quantity of the macronutrients consumed by encouraging the patients to consume a moderate amount of carbohydrates and proteins, but increase their consumption of fiber-rich diet; this is beneficial in glycemic control.

Keywords: Type 2 diabetes mellitus, nutrition knowledge, dietary practice, diabetes, Nutrition status, glycemic control

I. INTRODUCTION

DM is a disorder characterized the body's inability to produce any or enough insulin in response to elevated blood glucose levels (DeFronzo et al., 2015). DM is classified into three categories: type 1, type 2 and gestational diabetes. Type 1 and gestational diabetes accounting for approximately 10% of the cases, whereas, T2DM accounts for close to 90% of all the diabetic cases (Stumvoll, Goldstein & Haeften, 2005).

Type 2 cases are on the rise and are a great public health concern (Khan et al., 2019). The estimated global prevalence of Diabetes Mellitus (DM) is 425 million, with a projected rise to 629 million. The African continent has a prevalence of 16 million cases, with an expected rise in prevalence to 41 million by 2045. The Kenya prevalence is estimated at 458,900 (2.0%) of the diagnosed diabetic cases ({IDF}, 2017). Nakuru County, in Kenya, has a DM prevalence of 6.6%, which is significantly higher than the national prevalence (Mathenge *et al*., 2010).

Diabetes complications: retinopathy, nephropathy, neuropathy, and cardiovascular systems dysfunction are severe. Moreover, during pregnancy, it is known to increase the risk of maternal and fetal complications (Saran *et al*., 2015). If unmanaged DM leads to at least one death every eight seconds ({WHO}, 2018). These deaths are reported among people of reproductive age (<60 years). DM deaths are estimated at 69.2% in Africa but more so in Kenya at > 80% (IDF, 2017). These spirals the medical cost and eventually compromise the quality of life of the DM patient. The cost of managing DM globally is United States Dollars (USD) 825 billion (Forouzanfar et al., 2016). Whereas in Africa it was USD 3.3 billion which is further projected to increase to USD 6.0 billion by 2045 (IDF, 2017). DM patients in Kenyans attending public Hospitals spend approximately USD 234 (Subramanian *et al*., 2018).

A series of cost-effective interventions can improve health outcomes (IDF, 2016). This involves the use of an appropriate diet, engaging in physical activity health education, and use of medication and Knowledge provision, but dietary management is the most important intervention (Kurnia et al., 2017; ADA, 2015).

In view of the increasing prevalence, severe consequences, and increased risk of death from DM in Africa and Kenya in particular, and in view of the role that diet plays in improving the prognosis of diabetic patients, the need for more reliable and up-to-date data on nutrition knowledge, dietary practices and nutrition status of T2DM patients cannot be overstated. This study, therefore, assessed the dietary practices of T2DM patients attending the diabetic clinic at Nakuru Level 6 Hospital.

II. METHODS

This was a descriptive cross-sectional study of T2DM patients attending Nakuru level 6 Hospital diabetic clinic, Nakuru county between November 2021 and January 2022. This design was relevant to this study because it was cost-effective and fast for the description and explanation of variables (Setia, 2016). It is also suitable for examining the burden of the disease or condition and useful for healthcare service planning (Pandis, 2014). In this study, the number of T2DM patients was determined using scientifically sound methods and recruited for the study between November 2021 and January 2022.

Fisher formula 1998 (Mugenda & Mugenda, 2003), was used to determine the sample size: 273 study participants were selected using simple random sampling.

A pretest was carried out at Naivasha County Referral Hospital at the outpatient department diabetic clinic. The location was chosen because it has similar characteristics to the study location. 10% of the total number of participants were randomly selected for the purpose of the pretest. The participants

were not to be part of the main study but had similar characteristics as those in the main study. This was conducted in order to make the necessary adjustments to the tools and instruments, test for validity and reliability, and to assess if patients had difficulties addressing certain questions, for the purposes of rephrasing them. Data from the pretest were then analyzed using SPSS version 24 software.

A. Data Analysis

The collected data was taken through a data cleaning process to check for completeness and consistency of information, it was then coded and entered into a Microsoft office excel spreadsheet. The data was exported from excel to SPSS version 24 software. 24 hour recall data was analysed using nutria-survey in order to determine the amounts consumed per nutrient. Statistical parameters that were used to describe the data on dietary practices include Mean, Standard deviation, Percentages, and Chi-square. The dietary diversity data of participants was analyzed as a dichotomous variable according to the global dietary diversity indicator for women (the Minimum Dietary Diversity for Women by (FAO, 2011). The dietary diversity scores (DDS) of the participants were established based on their consumption of the different food groups. The study participant's dietary practice was then categorized as being: low, moderate, or High; this will then be converted to the percentage of each category. Data on the 24-hour recall were analyzed using nutri-survey software. The analyzed data was then presented using graphical methods and by use of frequency distribution tables.

Table 3.1:
Data Analysis Matrix

Objectives	Variables	Nature of variables	Statistical analysis
Demographic and socio-economic characteristics of DM patients	Age, sex, marital Status, Education level, Income source, Individual income, Household income	Continuous Categorical	Descriptive statistics e.g. Mean, Standard deviation, Percentages
Dietary practices of DM patients	Dietary diversity, Food frequency, Daily meals, Adequacy	Continuous	Descriptive statistics e.g. Percentages
Glycemic control among DM patients	Blood glucose levels	Continuous	Descriptive statistics e.g. Percentages
Association between study variables	Nutrition knowledge, DDS, Glucose Levels	Continuous Categorical	Pearson's Chi-square

B. Inclusion and Exclusion Criteria

Patients were included in the study participants if they met the following criteria: were ≥ 40 years of age, had attended the diabetic clinic for at least 2 sessions, must have been diagnosed for at least a period of 6 months and gave their consent to participate in the study. They were however, excluded from the study if they were critically ill or had type 1 diabetes were also excluded from the study.

C. Data collection Procedure

Prior to the commencement of the study; Approval to conduct the study was sought from Graduate school and clearance was sought from Kabarak University Research and Ethics Committee. Permit was obtained from National Commission for Science, Technology and Innovation (NACOSTI), the county government health director and Nakuru level 6 Hospital management. Written consent from the DM patients was sought prior to conducting the study; a pre-visit was then done at Naivasha County

Referral Hospital in order to test the research instruments. Research assistants were then, trained and orient on the various aspects of the research including the research tools and instruments. T2DM patients were then identified and recruited into the study; this was done only after obtaining a duly signed written consent from them. Data was then collected from the eligible participants using a semi-structured questionnaire.

Data on demographic and socio-economic characteristics, nutrition knowledge and dietary practices and nutrition status was collected. The nutrition status of the diabetic patients was determined using Random Blood glucose levels.

Dietary practice was determined using: dietary diversity score, food frequency questionnaire, and 24-hour recall; In order to establish the nutrient adequacy of the participants, the 24 hour dietary recall was conducted on two separate occasions. The 24-hour recall entailed asking the participants to list all the foods and beverages consumed in the past 24 hours. If the participants forgot any foods and beverages from the list of items consumed, a list of food items were solicited. Starting with the first food item on the list, participants were probed for details of the food items in terms of type of food, quantity, ingredients used and preparation method. Food models, pictures and volume cups were used to estimate the quantities of food and beverages consumed. The standard procedures employed to collect 24-hour recall data were as recommended by other studies (Boushey et al., 2013; Steyn & Nel, 2006).

D. Ethical consideration

Approval to conduct the study was first sought from the Institute of Post Graduate Studies of Kabarak University (IPGS). Study clearance was then sought from Kabarak University Research and Ethics Committee. A License to conduct research was consequently obtained from National Commission for Science, Technology, and Innovation. Permission to conduct research was further obtained from the County Director of Health Services, and finally, Nakuru Level 6 Hospital management. A duly signed written consent from T2DM patients was sought prior to conducting the research.

III. RESULTS

A. Demographic and Socio-Economic characteristics of T2DM Patients Attending Diabetic Clinic at Nakuru Level 6 Hospital

Out of the expected 273 study participants, only 262 T2DM patients were interviewed, representing a 96% response rate. The majority of the respondents in this study were male 154 (58.8%) being males. The majority of the respondents 94(35.9%) were within the age group of 41-50, with a mean age of 56.6 and an SD of 12.8. A majority of respondents 209(79.8%) were married, and 112 (42.7%) had attended secondary school. The main source of income for the majority of the study participants 83 (31.7%) was business, However, 41(15.6%) were still fully dependent on others. The majority of the respondents 82(31.3%) earned a household income of Kshs 10001-20000; the mean ± SD income amount being 23400±13731 and a median of 20000. Finally, 59.9% of the respondents indicated having a family history of DM as shown in Table 4. 1.

Table 4. 1:
Demographic Characteristics of Type 2 Diabetic Patients Attending Diabetic Clinic at Nakuru Level 6 Hospital

Variable	Category	N(262)	
		N	**%**
Gender	Female	154	58.8*
	Male	108	41.2
Age	≤40	14	5.3
	41-50	94	35.9*
	51-60	62	23.7
	61-70	48	18.3
	71-80	35	13.4
	>80	9	3.4
	Mean ± SD	56.6±12.8	
Marital status	Married	209	79.8*
	Not Married	53	20.2
Level of Education	No formal education	27	10.3
	Primary education	59	22.5
	Secondary education	112	42.7*
	Tertiary education	64	24.4
Source of Income	Dependent on others	41	15.6
	Informal employment	33	12.6
	Formal employment	46	17.6
	Business	83	31.7*
	Farming	59	22.5
Household income	0-10000	56	21.4
	10001-20000	82	31.3*
	20001-30000	63	24.0
	30001-40000	33	12.6
	40001-50000	22	8.4
	>50000	6	5.9
	Mean ± SD	23400±13731	
Family history of diabetes	**Yes**	157	59.1*
	No	105	40.1

B. *Food Consumption Frequency of T2DM Patients Attending Diabetic Clinic at Nakuru Level 6 Hospital*

Starches and cooking oil were the most consumed with a daily consumption rate of (40.3%) and (96.9%), respectively. Sugars and sweets however were mostly never consumed 87.3%. Vegetables (41.4%), fruits (36.8%), legumes (37.2%), animal products (34.4%), roots, and tubers (33.1%) were mostly consumed once a week, as shown in Table 4.2.

Table 4. 2:
Food Consumption Frequency Of Type 2 Diabetic Patients Attending Diabetic Clinic At Nakuru Level 6 Hospital

	Everyday	Twice a week	Once a week	Once a month	Seasonally	Never
	%	%	%	%	%	%
Vegetables	13.3	36.0	41.4	5.2	2.3	1.8
Fruits	1.9	20.0	36.8	15.4	10.9	15.0
Legumes	9.3	27.6	37.2	17.0	6.4	2.5
Animal products	23.5	30.2	34.4	7.4	3.3	1.3
Starch	40.3	26.0	18.4	5.3	4.7	5.2
Roots and tubers	5.6	22.8	33.1	21.6	11.8	5.1
Cooking oil	96.9	0.0	0.4	0.0	0.0	2.7
Sugars and sweets	1.0	0.6	0.5	3.2	7.4	87.3

C. Dietary Diversity score of T2DM Patients Attending Diabetic Clinic at Nakuru Level 6 Hospital

The majority of the participants 188(71.8%) had a high dietary diversity score; this was followed closely by participants who had a moderate dietary diversity score at 70 (26.7%), Only 4 (1.5%) had low dietary diversity score, as Shown in Table 4.3.

Table 4. 3:
Dietary Diversity Score of Type 2 Diabetic Patients Attending Diabetic Clinic at Nakuru Level 6 Hospital

Category	Frequency	Percent
<4 (Low)	4	1.5
4-5 (Moderate)	70	26.7
>5 (High)	188	71.8*

D. Dietary Adequacy Among T2DM Patients Attending Diabetic Clinic at Nakuru Level 6 Hospital

The mean energy consumption was 2204 ±433.4 for male participants and 2170.3491.0± for female participants, with the majority of participants mean adequacy: male (110%) and female (121%) exceeding the recommendation for energy intake. The mean ± SD (g) consumption of Carbohydrates, proteins, and fats was: (303.259.6±) for male and (298.467.5±) female participants, (82.716.3±) male and (81.418.4±) female participants, (73.514.4±) male and (72.316.4±) female participants, respectively. The mean adequacy for carbohydrate intake was: (233%) for male and (230%) for female participants. Similarly, the protein was: (148%) for male and (177%) for female participants. However, adequacy for fats was: (42%) for male and (41%) for female participants. Mean Adequacy levels for fiber were: (63%) for male and (62%) for female participants. The mean ± SD consumption being (4.3±22.1) for male participants and (21.74.9±) for female participants as shown in Table 4.4.

Table 4. 4:

24-Hour Dietary Recall of Type 2 Diabetic Patients Attending Diabetic Clinic at Nakuru Level 6 Hospital

	RDA**		Intake (Mean ± SD)		Adequacy (%)	
	Male	Female	Male	Female	Male	Female
Energy (Kcal)	2000-2350	1800-2000	2204433.4±	2170.3491.0±	110	121
Carbohydrates (g)	130	130	303.259.6±	298.467.5±	233	230
Proteins (g)	56	46	82.716.3±	81.418.4±	148	177
Fats (g)	100-175	100-175	73.514.4±	72.316.4±	74*	72*
Dietary Fiber (g)	20-35	20-35	22.14.3±	21.74.9±	63*	62*

**Did not meet the adequacy levels*

***RDA values were obtained from National Health and Medical Research Council (2005) Nutrient Reference Values for Australia and New Zealand.*

E. Number of Daily Meals Consumed by T2DM Patients Attending Diabetic Clinic at Nakuru Level 6 Hospital

The results from this study showed that the majority of the respondents had three meals daily 145(55.3%), similarly, a significant number of respondents also had more than three meals daily 99 (37.8%), However, a few respondents had 2 daily meals 17 (6%) and only 1(0.4%) participant had 1 meal per day, as shown in Table 4.5.

Table 4. 5:

Daily Meal Frequency of Type 2 Diabetic Patients Attending Diabetic Clinic at Nakuru Level 6 Hospital

Number of daily meals	Frequency (n)	Percent (%)
1	1	0.4
2	17	6.5
3	145	55.3*
>3	99	37.8
Total	262	100.0

F. Glycemic Control among T2DM Patients Attending Diabetic Clinic at Nakuru Level 6 Hospital

Most of the respondents 126(48.1%), had a random blood sugar (RBS) level of >11.0, an equal number of respondents had an RBS of 3.5-7.8 and 7.8-11.0 mmol/l 67(25.6%). Only 2 (0.8%) presented with hypoglycemia (< 3.5 mmol/l). The Mean and standard deviation was 12.3 and 6.1, respectively, as shown in Table 4.9.

Random Blood Sugar (mmol/l)	Frequency (n)	Percentage (%)
<3.5	2	0.8
3.5-7.8	67	25.6
7.8-11.0	67	25.6
>11.0	126	48.1*
Mean	12.3±6.1	

**Majority*

G. *Association between study variables among T2DM patients attending clinic at Nakuru Level 6 Hospital*

Study participants' household income (P≤0.018) and BMI (P≤0.022) had a significant association with dietary diversity. Their random blood sugar levels had a significant association with the participant's carbohydrate (P≤0.034) and Fiber consumption (P≤0.016).

Table 4.7:

Association Between Study Variables Among Type 2 Diabetic Patients Attending Diabetic Clinic At Nakuru Level 6 Hospital

Variables	Categories	Dietary Diversity		P-Value (<0.05)
		High	Low	
Level of education	No formal Education	21(8.0%)	6(2.3%)	
	Formal education	167(63.7%)	68(26.0%)	0.09
Household income	<20000	138(52.7%)	50(19.1%)	
	≥20000 50(19.1%)		24(9.2%)	0.018*
Nutrition Knowledge	Poor	11(4.2%)	1(0.4%)	
	Good	177(67.5%)	73(27.9%)	0.338
BMI	Normal	74(28.2%)	29(11.1%)	
	Malnourished	114(43.5%)	45(17.2%)	0.022*
Variables	**Categories**	**Glycemic Control**		**P-Value (<0.05)**
		Good	**Poor**	
Age (Years)	>45	54	148	
	<45	13	47	0.043
DDS	High	54	155	
	Low	13	40	0.366
Carbohydrates	Adequate	1	0	
	Inadequate	66	195	0.034*
Fiber	Adequate	38	132	
	Inadequate	29	63	0.016*

** Significant P=<0.05*

IV. RESULTS

DM is a chronic disease requiring lifestyle modification, of which nutritional intervention is an integral part in management plan. Secondary school level of education was reported which was contrary to a study done in Brazil that reported that the majority 175 (51.8%) of its study, respondents had not completed the primary level of education (Assunção et al., 2017). Income from business related activities seem to be the most common with 83 (31.7%) of the respondents reporting so. On the contrary, another study reported most of its respondents 54(8%) being formally employed (Bano et al., 2017). Low-income earners were more 99(37.8%) and earned an income of between Kshs 0-10000. This finding are in agreement with results from a study done by Wahome et al. (2018) whose respondents earned Ksh <20000 per month. Finally, this study reported 59.9% of the respondents as having a family history of DM. These results are consistent with another study that showed that 72% of their study participants had a history of diabetes (El-Khawaga & Abdel-Wahab, 2015). These findings are however in contrast with other similar findings; Berhe et al. (2014) for instance reported 232 (77.3%) of their study participants had no family history of diabetes. Bano et al., (2014) similarly demonstrated that a majority 95 (66.9%) of the respondents had no family history of diabetes. These studies seem to demonstrate that most T2DM patients are mostly less educated, earn a small income and have a family history of DM.

Consumption of a highly diverse diet was reported among 188 (71.8%) of the respondeds. These is consistent with findings from another study that showed a majority 35.9% of the respondents had good dietary diversity (Demilew et al., 2018). The high dietary diversity may be due to the good nutrition knowledge that the participants have. Starches and cooking oil are mostly consumed on daily basis 40.3% and 96.9% respectively. Vegetables (41.4%), fruits (36.8%), and animal proteins are consumed once a week. Similarly, another study showed that the majority of their respondents (52.9%) mostly consumed starches and cooking oil (82.4%), and this is attributable to their role in the cooking of foods (Wahome et al., 2018). Another study also reported that animal protein consumption was less frequent and that only (27.7%) ate meat. Ozcariz, reported that, vegetables were consumed by approximately (80%) of the study participants (Ozcariz et al., 2015). The finding from this study clearly demonstrates a gap between knowledge and practice in that unlike what is recommended for diabetic patients, they consume mostly starch than vegetables.

The mean energy consumption for male participants is reported at 2204 ±433.4 whereas female participants is 2170.3491.0± both of which are high, Mean adequacy levels for energy, carbohydrates and proteins among T2DM patients are equally high, whereas for fiber and fat it was below the recommended. Adequacy levels were energy (110%) male, (121%) female, carbohydrate (233%) male, (230%) female, protein (148%) male, and (177%) female. Those below the adequacy levels were: fats (42%) male, and (41%) female and fiber (63%) male and (62%) female participants, this was below the expected adequacy level. A similar study showed that the mean energy consumption from total food intake was 1919.03 ± 364.70 Kcal per person with almost a quarter of the study participants meeting the RDA. The mean protein consumption was 61.67 ± 11.96 g, with only 8.5% of the participants meeting the RDA. Mean dietary fiber intake was (20.09 ± 5.50 g/day) with only 15.2% of the participants meeting the RDA (Miyoba, 2018). Another study done in the US showed that the majority of the study respondents consumed a moderate amount of carbohydrates averaging at approximately 45% of total energy intake (Franz, Boucher & Evert, 2014). T2DM patients in this study consumed three daily meals 145(55.3%). On the contrary, Mbututi et al. (2016), reported that 39% of T2DM patients eat at least seven meals daily. These findings clearly demonstrate that these study participants either do not know or choose not to follow the recommended dietary practices required of a diabetic patient. Consumption of three meals daily is not recommended for a diabetic patient and thus the introduction of snacks in between meals is necessary for this study's participants.

Glycemic control is proving a challenge to most T2DM patients, with 126 (48.1%) of the respondents recording a random blood sugar (RBS) level of >11.0 mmol/l (>196 mg/dl), and a mean score of

12.36.1± mmol/l (222110± mg/dl). This report's findings corresponds with those from another study that showed that (64.7%) had a poor glycemic control (Abebe et al., 2015). Similarly, another study showed that the mean blood sugar level was 174.25±57.14 mg/dl (Fasil et al., 2019). This is further re-enforced by a similar study from Jimma, Ethiopia that found that the average blood sugar levels were 163±45 mg/dl (Angamo, 2013). Generally, diabetic patients seem to have a challenge in controlling their blood glucose levels.

The significant association observed between household income and dietary diversity (P≤0.018) is also reported by other findings that reported a significant association between participants' income and dietary diversity (p<0.01) (Begum et al., 2004). This was further reinforced by a study that showed that having a income was associated with better access to healthy more diverse diet (Breland et al., 2013). Carbohydrates (P≤0.034) and fiber (P≤0.016) consumption and patients age (P≤0.043) has a bearing has a bearing on T2DM patients Random blood sugar. This were in agreement with another study that showed a significant association (P≤0.004) between participant's age in years and glycemic control (Fasil, et al., 2019). On the other hand, foods with high fiber content were significantly associated (P<0.001) with glycemic control (Karimbeiki et al., 2018). On the contrary though another study showed no significant association (P≤0.96) between patients glycemic control and carbohydrate intake (P≤0.53) (Tay et al., 2020).

V. CONCLUSION

i. The determinants of T2DM are male gender, having an age of >40 years, poor education level, low income and having a history of diabetes.

ii. Most T2DM patients consume a highly diverse diet, they however consume carbohydrates and fats more frequently, and exceeded their adequacy levels in carbohydrates and proteins, but however, do not meet the adequacy levels for fats and fiber.

VI. RECOMMENDATIONS

i. Further research is required in order to better understand the role gender, age , level of education and income plays in the management of T2DM

ii. More emphasis should be placed on the quantity and quality of the macronutrients consumed by encouraging the patients to consume a moderate amount of carbohydrates and proteins, but increase their consumption of a fiber-rich diet.

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CONFLICT OF INTEREST

There is no conflict of interest

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