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Determinants of Diabetes Mellitus in Adults in Rural Areas in 2024: A Case Study of the Commune of Kpomassè (Benin)

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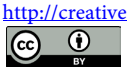

Abstract

Introduction: Diabetes mellitus is a chronic disease that leads to premature death and disability. This disease increases healthcare costs and hinders the development of countries, compromising their ability to achieve the Sustainable Development Goals (SDGs) for health. The aim of the study was to investigate the determinants of diabetes mellitus in adults in the commune of Kpomassè in 2024. **Methods:** This was a cross-sectional, descriptive, analytical study carried out in March 2024. Residents aged 18 to 69 were selected using the World Health Organization (WHO) probability cluster sampling method. Data collection was carried out using an electronic questionnaire administered to respondents by interviewers, in compliance with ethical principles. Data were analyzed using STATA 15 software. Determinants of diabetes were identified using a multiple logistic regression model, with a threshold set at 5%. **Results:** A total of 308 subjects, including 156 men, were surveyed. The prevalence of diabetes was 14.94%. Five determinants were associated with diabetes: gender ($p = 0.038$), age ($p = 0.006$), sleep duration ($p = 0.026$), consumption of fried foods ($p = 0.024$) and stress ($p = 0.013$). **Conclusion:** Diabetes among adults in Kpomassè poses a serious public health problem. It is imperative to strengthen diabetes prevention efforts through concerted action by the competent authorities.

Keywords

Determinants, Diabetes, Adult, Kpomassè, Benin

1. Introduction

Diabetes mellitus poses a significant clinical issue and constitutes a complex public health challenge globally. The rapid epidemic growth and increasing socio-economic impact place it as a major concern [1]. Since the year 2000, the global prevalence of diabetes mellitus among adults aged 20 to 79 years has more than tripled [2]. In 2000, approximately 151 million people, or 4.6% of the global population, were affected, a figure that surged to 537 million by 2021, representing 10.5% of the population. If current trends persist, this number could escalate to 783 million people, or 12.2% of the global population, by 2045 [2]. In Africa, in 2021, the prevalence of diabetes mellitus among adults aged 20 to 79 years was reported to be 24 million, with 6.7 million resulting deaths. Projections suggest this figure may rise to 33 million by 2030 and reach 55 million by 2045. These statistics indicate a troubling increase in the number of individuals affected by diabetes mellitus over time, with more than half (54%) of the cases in the region going undiagnosed [3]. In Benin, diabetes mellitus ranks as the second most prevalent Non-Communicable Disease (NCD) following cardiovascular diseases [4]. Based on the STEPS surveys, the prevalence of diabetes was estimated at 1.1% in 2001, rising to 2.6% in 2008, and climbing significantly to 12.4% in 2015. This consistent upward trend mirrors global patterns [4]. According to the 2022 Annual Health Statistics (AHS), there were 11,197 newly diagnosed diabetes cases within the year [5].

Diabetes mellitus has significant ramifications across multiple dimensions. Socially, stigma and necessary lifestyle adjustments may affect interpersonal interactions [6]. Economically, diabetes mellitus represents a costly disease with a frequently underestimated economic impact. This condition imposes not only financial burdens on affected individuals but also on society, healthcare systems, and national economies, due to direct medical expenses and indirect costs such as productivity losses stemming from morbidity, disability, premature mortality, and increased demands for social support [7] [8]. From a health perspective, it leads to severe complications [9]. These complications significantly elevate the mortality and morbidity rates associated with the disease. Psychologically, individuals with diabetes frequently experience emotional stress, depression, and anxiety [10].

Multiple factors can influence the onset of diabetes mellitus in adults. These factors include, but are not limited to: age, gender, hypertension, abdominal obesity, family history of diabetes, general obesity, sleep duration, alcohol and tobacco use, stress, marital status, sedentary behavior, diet, low birth weight, educational level, occupation, knowledge level, and exposure to pesticides [11]-[22].

In Benin, despite the deployment of various initiatives, including the consolidation of WHO-PEN usage by the National Program for the Fight against Non-Communicable Diseases (PNLMNT), diabetes mellitus remains a significant challenge. A situational analysis conducted over a one-month period from January to February 2024 at the Kpomassè health center revealed that 42% of adults who came for consultation were diagnosed with diabetes. It is noteworthy that diabetes screening tests were performed only when patients exhibited suggestive symptoms. Consequently,

we questioned which factors contribute to the prevalence of this disease among adults residing in this municipality.

2. Materials and Methods

The commune of Kpomassè, situated in the Atlantique department in the south-west of the Republic of Benin, spans an area of 305 km². It is bounded by the commune of Allada to the north, the commune of Ouidah to the south, the communes of Comè and Bopa to the west, which are bordered by Lake Ahémé and a tributary of the Couffo River, and the communes of Tori Bossito and Ouidah to the east.

2.1. Study Design

The investigation was a cross-sectional, descriptive study with an analytical perspective, featuring both quantitative and qualitative elements. Data collection occurred in March 2024.

2.2. Study Population

The target population was comprised of residents of the commune of Kpomassè aged between 18 and 69 years.

2.2.1. Inclusion Criteria

The study included any individual who had been residing in the commune of Kpomassè for no less than 6 months and who had consented to participate in the survey.

2.2.2. Non-Inclusion Criteria

Individuals excluded from the study included:

- those unable to communicate;
- pregnant women, to prevent the influence of pregnancy on anthropometric measurements and blood glucose levels.

2.2.3. Exclusion Criterion

Participants who withdrew their consent during the study were excluded.

2.3. Sampling

2.3.1. Technical Method and Sample Size

We used a three-stage probabilistic cluster sampling method, adapted from WHO guidelines. The sample size was calculated based on Schwartz's formula, considering the diabetes mellitus prevalence in the general population of Benin in 2015 (12.4%) [4], a margin of error of 5%, and a cluster effect of 1.5. To account for potential refusals and missing data, the calculated sample size was increased by 10% and proportionally allocated according to the number of inmates.

2.3.2. Sampling Procedure

First degree: selection of villages (utilizing 30 clusters);

Second degree: selection of households/concessions;

Third degree: selection of individuals (using the Kish method).

The sampling progressed systematically from step to step. This procedure was replicated until the predetermined sample size for each village was achieved.

2.4. Technical Equipment

The equipment utilized comprised OMRON® brand electronic arm blood pressure monitors, ACCU-CHEK Active® brand electronic glucose meters, mechanical bathroom scales, stadiometers (SATURE METER 2M) for height measurement, cotton, and professional measuring tapes for waist circumference measurement.

2.5. Preparation and Pretest

The research protocol for this study as well as the collection tools were validated by a jury which met on March 8, 2024 at the Regional Institute of Public Health (IRSP). The data collection sheet (Appendix 1) was drawn up taking into account the STEPS surveys carried out and the literature review we had carried out. The conceptual framework (Appendix 2) summarizes the data sought. After obtaining authorization from the municipal authorities of Kpomassè, we undertook a preliminary phase in one of the villages in this commune. The aim was to assess the local population's understanding of the survey form used, to identify and correct any shortcomings, and to adjust our instruments accordingly. The pretest was carried out in the village of Missebo, which was not included in the study.

2.6. Collection Team

An invitation to apply was issued to form the data collection team. After a careful analysis of the applications received, the selected candidates were given the opportunity to undergo comprehensive training on notions relating to diabetes, the aim of the study and collection tools, culminating in a practical assessment. Only the first five candidates to pass this assessment were finally selected to join the data collection team.

2.7. Data Collection

With the required authorizations from the Ministry of Health and the local municipal authorities, data collection commenced in the designated villages. This data collection phase spanned from March 16 to March 30, 2024. To ensure accuracy and minimize information bias, each completed electronic form was systematically reviewed on a daily basis. Data were collected between 5:00 a.m. and 11:00 a.m., prior to any food intake by the subjects. We also inquired about the time of their last meal to confirm that at least eight hours had passed. Biometric and anthropometric data were gathered at the conclusion of the questionnaire. Weight was recorded using an electronic scale with an accuracy of 100 grams. Blood glucose levels were assessed with ACCU-CHEK Active® test strips for capillary blood glucose. A drop of capillary blood was collected from the fingertip and applied to

the test strip inserted into the glucometer. The glucometer displayed blood glucose results, measured in mg/dL, within 12 seconds. Blood pressure was measured after a 15-minute rest period using an OMRON electronic sphygmomanometer, a device recommended for community surveys. Two readings were taken five minutes apart, and their average was computed. Height was measured using a standing stadiometer with a precision of 0.1 cm. Stress levels were assessed using the Hospital Anxiety and Depression (HAD) scale.

2.8. Variables

2.8.1. Dependent Variable

The dependent variable in this study was the presence of diabetes mellitus in adults, categorized as either diabetic or non-diabetic. A participant was classified as diabetic if they exhibited a fasting capillary blood glucose level of 1.26 g/L or higher, or if they had received diabetes treatment within the previous 12 months. Non-diabetic participants were further classified into normoglycemia or prediabetes. Prediabetes was defined by a blood glucose level ranging from 1.1 g/L to 1.25 g/L, whereas a blood glucose level of 1.1 g/L or below was considered as normoglycemia.

2.8.2. Independent Variables

The study identified and examined the independent variables that could elucidate the incidence of diabetes mellitus among adults in the commune of Kpomassè. These variables were categorized into four groups of factors:

- Sociodemographic and Sociocultural: Profession/Occupation, Educational level, Average monthly income, Marital status, Ethnicity, Social perception.
- Behavioral and Environmental: Physical activity, Alcohol consumption, Tobacco use, Dietary habits (consumption of fruits and vegetables, salt, sugar, fried foods), Knowledge level, Sleep duration, Exposure to chemical pollutants.
- Health System-Related: Non-communicable disease (NCD) awareness, Community-based nutritional education, Diabetes risk screening.
- Biological: Age, Gender, Blood pressure, Family history of diabetes, Body Mass Index (BMI), Waist circumference, Stress, Low birth weight.

2.9. Data Processing and Analysis

To ensure data integrity, the completeness and consistency of the collected data were reviewed daily. The data processing and analysis utilized Stata 15 software, encompassing both descriptive and analytical phases.

2.9.1. Descriptive Stage

Quantitative variables following a normal distribution were summarized by their mean and standard deviation. For variables with non-normal (asymmetric) distributions, the median and interquartile range (IQR) were reported. For qualitative variables, the analysis included calculating proportions or percentages.

2.9.2. Analytical Procedure

Initially, univariate analyses were conducted through simple logistic regression and Pearson's chi-squared tests, with a significance threshold set at 5%. For the multivariate analysis, a multiple logistic regression model was implemented to identify the determinants of diabetes mellitus in adults. Variables demonstrating a p-value below 20% in the bivariate analysis were included in the preliminary multiple logistic regression model. Subsequently, a stepwise backward elimination was applied. Variables with a p-value under 5% were maintained in the final model. The final model's fit was evaluated using the Hosmer-Lemeshow test, and the reference categories were those associated with the lowest risk.

2.10. Ethical Considerations

The study adhered to fundamental ethical principles concerning research involving human subjects. Necessary approvals were obtained, and a preliminary informational notice was distributed to inform residents. Authorization to conduct the study was granted by the Ministry of Health. On a local scale, consent from municipal authorities and health structures was secured prior to the initiation of data collection. Study participants were fully informed about the study's nature and objectives, and informed consent was obtained from each respondent. Confidentiality was assured, and data collection was executed anonymously.

3. Results

Out of a planned sample of 300, the survey was carried out among three hundred and eight (308) people.

3.1. Description of Study Population

3.1.1. Behavioural, Environmental and Biological Characteristics of Adults Surveyed in the Commune of Kpomassè in 2024

1) Biological characteristics of adults surveyed in the commune of Kpomassè in 2024

Out of 308 subjects surveyed, 156 were men, accounting for 50.65%, with a male to female ratio of 1.03. The median age of the study population was 43 years (Quartile 1: 36; Quartile 3: 55). The youngest participant was 19 years old, while the eldest was 69. Regarding diabetes history, 269 participants indicated no family history of diabetes. Among the 39 respondents who reported a family history of diabetes, 20 (51.28%) specified it as a first-degree relative. In terms of stress, approximately 123 (39.94%) subjects reported being stressed, and 127 (41.23%) were at least overweight. Table 1 summarizes the distribution of adults surveyed according to biological characteristics in the commune of Kpomassè in 2024 (n=308).

2) Behavioural and environmental characteristics of adults surveyed in the commune of Kpomassè in 2024

The majority of subjects (75.65%) were not physically active. The number of hours spent daily in sedentary activities was 2.93 hours (1.4). The proportion of individuals consuming alcohol in a harmful or excessive manner was zero. On the

other hand, 181 subjects (58.76%) had at least low alcohol consumption, and only 6.17 of the subjects used tobacco. With regard to food consumption, only 12.34% of subjects consumed at least 05 fruits and vegetables a day, and 37.99% of subjects consumed sweet or fried foods at most once a week. Average sleep duration was 7.26 ± 1.72 and 48.7% of subjects had abnormal sleep duration (short or long). Regarding knowledge of diabetes, 71.10% of subjects had poor knowledge, and of these, 50.68% (111 subjects) had no knowledge of diabetes. Table 2 summarizes the distribution of adults surveyed according to behavioral characteristics in the commune of Kpomassè in 2024.

Table 1. Distribution of adults surveyed according to biological characteristics in the commune of Kpomassè in 2024 (n = 308).

Variables	Number	%
Age (in years)		
≤ 40	130	42.21
> 40	178	57.79
Gender		
Male	156	50.65
Female	152	49.35
Blood pressure		
Normal	185	60.06
High	123	**39.94**
Family history of diabetes		
No	269	87.34
Yes	39	**12.66**
Body Mass Index		
Undernutrition	20	6.49
Normal	161	52.27
Overweight	78	**25.32**
Obese	49	**15.91**
Waist circumference		
Normal	237	76.95
Abdominal obesity	71	**23.05**
Stress		
No	185	60.06
Yes	123	**39.94**

Table 2. Distribution of adults surveyed according to behavioral characteristics in the commune of Kpomassè in 2024 (n = 308).

Variables	Number	%
Physical activity		
No	233	**75.65**
Yes	75	24.35
Level of knowledge		
Poor	219	**71.10**
Average	79	25.65
Good	10	3.25
Sleep duration		
Short	116	**37.66**
Normal	158	51.30
Long	34	11.04
Tobacco consumption		
No	289	93.83
Yes	19	**6.17**
Alcohol consumption		
Heavy	11	3.57
Low	170	55.19
No consumption	127	41.23
Fruit and vegetable consumption		
Not every day	270	**87.66**
Every day	38	12.34
Consumption of sweet products		
Every day	34	**11.04**
At least two to three times a week and not every day	157	**50.97**
At most once a week	117	37.99
Consumption of fried foods		
Every day	22	7.14
At least two to three times a week and not every day	169	**54.87**
At most once a week	117	**37.99**

Regarding insecticide use, 70%, or 238 adults surveyed, did not use insecticides

in their homes. Among farmers using pesticides, 34.78% mentioned using herbicides. Table 3 summarizes the distribution of adults surveyed according to environmental characteristics in the commune of Kpomassè in 2024.

Table 3. Distribution of adults surveyed according to environmental characteristics in the commune of Kpomassè in 2024 (n = 308).

Variables	Number	%
Use of insecticides against female anopheles and insects in the home (n = 308)		
No	238	77.27
Yes	70	**22.73**
Pesticide use in fields (n = 63)		
No	40	63.49
Yes	23	**36.51**

3.1.2. Socio-Demographic and Socio-Cultural Characteristics of Adults Surveyed in the Commune of Kpomassè in 2024

The most predominant profession or occupation among the individuals surveyed was that of trader or dealer, encompassing a significant percentage of 37.26%. In second place were farmers, with a share of 20.45%. In terms of level of education, a majority of 223 subjects, that is 72.41% of the group studied, had attained primary level or less. In terms of income, 86.69% of those surveyed earned no more than the guaranteed minimum wage. In terms of marital status, a remarkable 82.14% of adults surveyed were either cohabiting or married. The Pedah ethnic group and its relatives were the most represented, accounting for 31.82%. Table 4 summarizes the distribution of adults surveyed by socio-demographic and socio-cultural characteristics in the commune of Kpomassè in 2024.

Table 4. Distribution of adults surveyed by socio-demographic and socio-cultural characteristics in the commune of Kpomassè in 2024 (n = 308).

Variables	Number	%
Occupation		
Executive/senior	16	5.16
Craftsman	47	15.26
Retailer	116	37.26
Farmer	63	20.45
Fisherman/Farmer	43	14.29
Other profession*	22	7.14

Continued

Level of education		
No schooling	132	**42.86**
Primary school	91	29.55
Secondary school	72	23.38
Higher education	13	4.22
Average monthly income (CFA francs)		
<52,000	267	**86.69**
[52,000-100,000[	25	8.12
≥100,000	16	5.19
Marital status		
Single	9	2.92
Divorced	11	3.57
Married	114	37.01
Cohabiting	139	45.13
Widowed	35	11.36
Ethnicity		
Fon	87	28.25
Sahouè	71	23.05
Pédah and related	98	31.82
Aizo	34	11.04
Other ethnic groups**	18	5.84

*: Tradipratician (01), Driver (07), Mechanic (02), Cook (03), Pupil/student (03), Housekeeper (03), Photographer (01), Plumber (02); **: Adja (07), Goun (03), Kotafon (01), Kotokoli (01), Mina (01), Nagot (01), Yoruba (01).

3.1.3. Health System Characteristics

All subjects surveyed said they had never received nutritional education, awareness-raising about non-communicable diseases, or systematic screening for diabetes risk.

3.1.4. Prevalence of Diabetes Mellitus among Adults in the Commune of Kpomassè in 2024

Of the 308 subjects surveyed, 62 individuals, representing 20.13% of the sample, exhibited fasting hyperglycemia. Within this group, 46 were diagnosed with diabetes, and 16 were identified as prediabetic. Therefore, the prevalence rates of

diabetes and prediabetes among adults in the Kpomassè commune were 14.94% and 5.19%, respectively. Table 5 details the distribution of the surveyed adults based on their glycemic levels.

Table 5. Distribution of surveyed adults aged 18 to 69 by glycemic levels in the Kpomassè commune in 2024 (n = 308).

Blood glucose	Number	%	IC 95%
Diabetes	46	**14.94**	11.15 - 19.41
Pre-diabetes	16	**5.19**	3.53 - 9.73
Normal	246	79.87	75.80 - 85.09

3.2. Univariate Analysis

Thirteen variables in univariate analysis had modalities with p-values below 20%. These were age, gender, blood pressure, waist circumference, family history of diabetes, body mass index (BMI), stress, level of knowledge, sleep duration, salt consumption, fried food consumption, ethnic origin and marital status. Table 6 presents the associations between a few variables and diabetes mellitus in adults in the commune of Kpomassè in 2024.

Table 6. The associations between a few variables and diabetes mellitus in adults in the commune of Kpomassè in 2024.

Explanatory variables	Diabetes mellitus in adults		OR	p-value
	Yes n (%)	No n (%)		
Age (in years)				
≤40	9 (19.57)	121 (46.18)	1	
>40	37 (80.43)	141 (53.82)	3.53	**0.001**
Gender				
Male	31 (67.39)	125 (47.71)	2.27	**0.016**
Female	15 (32.61)	137 (52.29)	1	
Blood pressure				
Normal	22 (47.83)	163 (62.21)	1	
High	24 (52.17)	99 (37.79)	1.80	**0.069**
Stress				
No	16 (34.78)	169 (64.50)	1	
Yes	30 (65.22)	93 (35.50)	3.41	**0.000**

Continued

Sleep duration				
Short	28 (60.87)	88 (33.59)	3.03	**0.001**
Normal	15 (32.61)	143 (54.58)	1	
Long	3 (6.52)	31 (11.83)	0.92	0.903
Consumption of high-salt meals				
No	38 (82.61)	184 (70.23)	1	
Yes	8 (17.39)	78 (29.77)	0.50	**0.089**
Consumption of fried foods				
Every day	6 (13.04)	16 (6.11)	5.11	**0.007**
At least two to three times a week and not every day	32 (69.57)	137 (52.29)	3.18	**0.005**
At most once a week	8 (17.39)	109 (41.60)	1	
Use of insecticides against female anopheles and insects in the home				
No	38 (82.61)	200 (95.51)	1	
Yes	8 (17.39)	62 (6.49)	0.66	0.351
Pesticide use in fields (n = 63)				
No	6 (50.00)	34 (66.67)	1	
Yes	6 (50.00)	17 (33.33)	2	0.286

3.3. Bivariate Analysis

The aim of the bivariate analysis was to find associations between the different independent variables. We present the dependent variables that were statistically significantly related to each other.

3.3.1. Bivariate Analysis between Sedentary Lifestyle and Age

Sedentary lifestyle and age are statistically associated. Adults over 40 are more sedentary than those under 40 (Table 7).

Table 7. Association between sedentary lifestyle and age of adults surveyed in the commune of Kpomassè in 2024 (n = 308).

		sedentary lifestyle		
Age (in years)	**Observation**	**Average hours in sedentary position**	**IC 95%**	**p value**
≤40	130	2.31	1.98 - 2.63	
>40	178	3.39	3.03 - 3.75	**0.000**
Combined	308	2.93	2.68 - 3.19	

3.3.2. Bivariate Analysis between Waist Circumference and Age

There was a statistically significant relationship between age and waist circumference (p = 0.011). Among subjects with abdominal obesity, 66.40% were over 40 years of age (Table 8).

Table 8. Association between waist circumference and age of adults surveyed in the commune of Kpomassè in 2024 (n = 308).

Age (in years)	Waist circumference		Total n (%)	p value
	Normal n (%)	Abdominal obesity n (%)		
≤40	88 (48.09)	42 (33.60)	130 (42.21)	**0.011**
>40	95 (51.91)	83 (66.40)	178 (57.79)	
Total	183 (100)	125 (100)	308 (100)	

3.3.3. Bivariate Analysis between BMI and Age

There was a statistically significant relationship between age and BMI (p = 0.001). Among overweight subjects, 70.51% were over 40 years of age. Similarly, among obese subjects, 69.39% were aged over 40 (Table 9).

Table 9. Association between BMI and the age of surveyed adults in the commune of Kpomassè in 2024 (n = 308).

Age (in years)	BMI					p value
	Undernutrition n (%)	Normal n (%)	Overweight n (%)	Obese n (%)	Total n (%)	
≤40	7 (35.00)	85 (52.80)	23 (29.49)	15 (30.61)	130 (42.21)	**0.001**
>40	13 (65.00)	76 (47.20)	55 (70.51)	34 (69.39)	178 (57.79)	
Total	20 (100)	161 (100)	78 (100)	49 (100)	308 (100)	

3.3.4. Bivariate Analysis between Physical Activity and Gender

There is a statistically significant association between gender and physical activity (p = 0.017). Among the individuals engaging in physical activity, 62.67% are male (Table 10).

Table 10. Association between physical activity and gender among surveyed adults in the commune of Kpomassè in 2024 (n = 308).

Gender	Physical activity			p value
	No n (%)	Yes n (%)	Total n (%)	
Male	109 (46.78)	47 (62.67)	156 (50.65)	**0.017**
Female	124 (53.23)	28 (37.33)	152 (49.35)	
Total	233 (100)	75 (100)	308 (100)	

3.3.5. Bivariate Analysis between Gender and Alcohol Consumption

There is a statistically significant association between gender and alcohol consumption (p = 0.000). Among those who consume at least small amounts of alcohol, 64.64% are male (Table 11).

Table 11. Association between alcohol consumption and gender among surveyed adults in the commune of Kpomassè in 2024 (n = 308).

Gender	Alcohol consumption				p value
	No consumption n (%)	Low n (%)	Heavy n (%)	Total n (%)	
Male	39 (30.71)	108 (63.53)	9 (81.82)	156 (50.65)	0.000
Female	88 (69.29)	62 (36.47)	2 (18.18)	152 (49.35)	
Total	127 (100)	170 (100)	11 (100)	308 (100)	

3.3.6. Bivariate Analysis between Average Monthly Income and Stress

There is a statistically significant association between income and stress (p = 0.005). Among individuals suffering from stress, 94.31% have an income below 52,000 FCFA (Table 12).

Table 12. Association between income and stress among surveyed adults in the commune of Kpomassè in 2024 (n = 308).

Average monthly income (CFA francs)	Stress		Total n (%)	p value
	No n (%)	Yes n (%)		
<52,000	151 (81.62)	116 (94.31)	267 (86.69)	0.005
[52,000 - 100,000[	20 (10.81)	5 (4.07)	25 (8.12)	
>100,000	14 (7.57)	2 (1.63)	34 (5.19)	
Total	185 (100)	123 (100)	308 (100)	

3.4. Multivariate Analysis

Thirteen variables were integrated into the initial multivariate model, including age, sex, blood pressure, waist circumference, family history of diabetes, body mass index (BMI), stress, knowledge level, sleep duration, salt intake, fried food consumption, ethnicity, and marital status. Following a stepwise backward elimination of non-significant variables, five were identified as being associated with diabetes mellitus among adults residing in Kpomassè in 2024. Analysis of the final model enabled us to conclude that diabetes mellitus in adults in the municipality of Kpomassè is influenced by the interaction between sex, age, sleep duration, fried food consumption, and stress. Table 13 shows the final multivariate model of determinants associated with diabetes mellitus among adults in the municipality of Kpomassè in 2024.

Table 13. Final multivariate model of determinants associated with diabetes mellitus among adults in the municipality of Kpomassè in 2024 (n = 308).

Explanatory variables	Diabetes mellitus in adults		Weight adjusted OR	IC 95%	p-value
	Yes n (%)	No n (%)			
Age (in years)					
≤ 40	9 (19.57)	121 (46.18)	1		
> 40	37 (80.43)	141 (53.82)	**3.15**	1.40 - 7.07	**0.006**
Gender					
Male	31 (37.39)	125 (47.71)	**2.12**	1.04 - 4.31	**0.038**
Female	15 (32.61)	137 (52.29)	1		
Sleep duration					
Short	28 (60.87)	88 (33.59)	**2.30**	1.11 - 4.75	**0.026**
Normal	15 (32.61)	143 (54.58)	1		
Long	3 (6.52)	31 (11.83)	0.86	0.22 - 3.33	0.827
Stress					
No	16 (34.78)	169 (64.50)	1		
Yes	30 (65.22)	93 (35.50)	**2.50**	1.21 - 5.03	**0.013**
Consumption of fried foods					
Every day	6 (13.04)	16 (6.11)	**4.14**	1.18 - 14.48	**0.026**
At least two to three times a week and not every day	32 (69.57)	137 (52.29)	**2.73**	1.14 - 6.53	**0.024**
At most once a week	8 (17.39)	109 (41.60)	1		

4. Discussion

4.1. Achievement of Objectives

The present study aimed to investigate the determinants of diabetes mellitus in adults within the municipality of Kpomassè in 2024. The process of collecting and analyzing data enabled us to achieve our research objectives.

4.2. Validity of Results

The study followed a mixed cross-sectional approach, encompassing both qualitative and quantitative methods, with a focus on analytical outcomes. The chosen methodology was fully aligned with the purpose of the study. Sampling was conducted using a probabilistic approach, adhering to the cluster sampling technique recommended by the World Health Organization (WHO), which is known for its reliability. An exhaustive list of villages in the commune was drawn up in order to effectively implement the cluster technique, selecting 30 clusters (Villages). Data

were collected from adults of all sexes, aged 18 to 69, using a questionnaire administered by specially trained interviewers. Biological and anthropometric measurements were taken using appropriate instruments. For univariate and multivariate analysis, simple and multiple logistic regression were used. However, as with any study, ours may be subject to information bias, notably due to memory defects. In order to control this bias, the interviewers, local health workers, were accompanied by community relays to establish a relationship of trust with the respondents and guarantee the anonymity of the survey. Sensitive questions were formulated progressively to facilitate the respondent's response, and certain questions were repeated to elicit the respondent's memory. To limit interviewer bias, data collection was carried out by qualified, experienced interviewers under supervision. They were trained in the use of measurement tools and equipment, which helped them to better understand these instruments. Biological and anthropometric measurements were taken after the questionnaire had been completed, to avoid any influence on the interviewers' questions. Blood pressure was measured with an OMRON electronic sphygmomanometer, recommended for community surveys, and height was accurately measured with a caliper fathometer. Capillary blood glucose was assessed using ACCU-CHEK Active® test strips. All these devices were of the same brand for each team, to minimize equipment bias. Stress was assessed using the HAD scale, and interviews with secondary targets were conducted in a confidential setting after obtaining free and informed consent. Overall, data collection and analysis techniques enabled triangulation of the data collected, guaranteeing results deemed valid. Despite the biases inherent in studies based on declarative data, we are confident in the validity and reliability of our results, which could be generalized to the entire population of the commune of Kpomassè.

4.3. Study Difficulties and Limitations

The difficulties and limitations encountered in the course of this study are many and varied. They relate in particular to several points:

- Exploration of the variable of birth weight proved impossible, as only one person had this information.

- The absence of a statistical link between diabetes mellitus in adults and the use of insecticides in the home or pesticides in the field means that a link between pesticide exposure and the onset of diabetes cannot be definitively ruled out. A further study should be undertaken to establish a link between plasma organochlorine concentrations and the onset of diabetes. Similarly, we can't say that we've explored every avenue in terms of chemical exposure. We had explored the most likely according to the literature review.

- On the nutritional front, the unavailability of resources to recruit nutritionists hampered the possibility of quantifying energy intake, for example, by recalling 24-hour diets. However, the results point to nutritional problems that need to be resolved.

4.4. Discussion of Results

4.4.1. Prevalence of Diabetes Mellitus

The prevalence of diabetes mellitus among adults in the Kpomassè commune in 2024 stands at 14.94%. This figure is notably higher compared to the 9.5% found in the rural regions of Benin during the 2015 STEP survey. This 5.44% increase over nine years may be attributed to the larger study sample in the STEP survey as well as the global rise in diabetes prevalence, particularly noted in Africa and Benin. This trend, significantly influenced by globalization in Africa, can generally be ascribed to a combination of lifestyle changes (notably decreased physical activity) and dietary shifts, driven by industrialization and urbanization. In the commune of Kpomassè, risk factors for diabetes are also found. Indeed, 39.94% of the subjects surveyed had elevated blood pressure, 41.23% were at least overweight, 23.05% had abdominal obesity, and 39.94% were stressed. The majority of subjects, that is 75.65%, did not practice physical activity. 58.76% of adult subjects had at least low alcohol consumption. Finally, 37.99% of subjects consumed sweet products or fried foods at most once a week. These factors are all elements that can explain the high prevalence of diabetes.

At the national level, our findings differ from those reported by Dovonou *et al*. in Parakou in 2021 [18] and Amoussou-guenou *et al*. in Porto Novo in 2014 [12], which reported prevalences of 2.84% and 6.7%, respectively. These discrepancies may be due to differences in the examined populations, the periods of the respective studies, as well as the distinct biological characteristics of the populations involved.

4.4.2. Stress and Diabetes

Our study demonstrates a significant association between stress and diabetes incidence. Specifically, adults experiencing stress had a 2.50-fold higher risk (95% CI [1.21 - 5.03]) of developing diabetes compared to those without stress. Chronic stress, in particular, has complex biological effects that contribute to the onset and progression of diabetes. It activates the sympathetic nervous system, prompting the release of stress hormones such as adrenaline and noradrenaline, which sustain insulin resistance and elevate blood glucose levels. Moreover, chronic stress stimulates the hypothalamic-pituitary-adrenal axis, resulting in increased cortisol production, which enhances glucose release by the liver and decreases its utilization by peripheral tissues. Additionally, chronic stress can cause systemic inflammation, which is linked to insulin resistance and beta cell damage in the pancreas [16] [23] [24]. Among the factors likely to explain chronic stress in the commune of Kpomassè, income could be a source of permanent stress. Indeed, our study shows that there is a statistically significant link between income and stress ($p = 0.005$). Among the subjects suffering from stress, 94.31% had an income of less than 52,000 CFA francs. Insufficient monthly income to meet the most basic needs could explain the high prevalence of chronic stress in this population.

Our findings align with those of Novak *et al*., who conducted a study on men, published in 2013, demonstrating that men under constant stress had a higher risk

of diabetes [hazard ratio 1.52 (95% CI 1.26 - 1.82)] compared to men without stress [25]. Furthermore, a longitudinal study by Harris *et al*. in 2017 on women in Australia found that moderate to high stress levels were associated with a 2.3-fold increase in the risk of type 2 diabetes after three years [26].

4.4.3. Gender and Diabetes

Gender was statistically linked to the incidence of diabetes in our study. Adult males had a 2.12 times greater risk of developing diabetes (95% CI [1.04 - 4.31]) compared to females. This predominance in males could be explained through two perspectives. Biologically, certain studies indicate that estrogens have a protective role in preventing diabetes. Estrogens influence the overall metabolism by regulating blood glucose levels, particularly by acting on pancreatic GLP-1-producing cells and intestinal L cells, which are also responsible for GLP-1 production [27]. This hormone is especially protective in women before menopause [27]. Behaviorally, women are reported to have a healthier lifestyle than men [28]. This observation is confirmed in our study. Indeed, there was a significant statistical link between sex and alcohol consumption ($p = 0.000$). Among the subjects consuming alcohol at least lightly, 64.64% are male. Likewise, although there was no association between sex and tobacco consumption, 68.42% of subjects who consumed tobacco were also male.

Our findings are consistent with those reported by Kpozehouen *et al*. in 2015 [17], who also found that gender was associated with diabetes incidence ($p = 0.0031$). Male subjects had a 2.94 times higher risk of developing diabetes than female subjects (95% CI [1.44 - 5.88]).

4.4.4. Age and Diabetes

Our study reveals a significant association between age and the incidence of diabetes among adults in the Kpomassè community. Individuals over the age of 40 are 3.15 times more likely to develop diabetes (95% CI [1.40 - 7.07]) compared to those who are 40 years or younger. This finding can be attributed to both biological and lifestyle factors associated with aging. From a biological perspective, physiological aging, particularly after the age of 40 - 45, leads to the development of insulin resistance. This resistance is often aggravated in individuals with excess adipose tissue, overweight, or obesity. The cells gradually become resistant to insulin, impairing its effective role, and subsequently, blood glucose levels rise. In response, the pancreas increases insulin production. Nevertheless, after 10 to 20 years, the pancreas struggles to keep up with the demand due to sustained insulin resistance and eventually becomes exhausted, failing to produce adequate insulin to manage blood glucose levels [29]. Still on a biological level, in our study, there is a significant statistical link between age and BMI ($p = 0.001$). Among overweight subjects, 70.51% are over 40 years old. Likewise among obese subjects, 69.39% are over 40 years old. There is also a significant statistical link between age and waist circumference ($p = 0.011$). Among subjects with abdominal obesity, 66.40% are over 40 years old. On the behavioral front, aging is often accompanied

by the adoption of riskier behaviors such as increased sedentariness, decreased physical activity, and the consumption of certain substances. In our study, sedentary lifestyle and age are statistically associated. Adults over 40 are more sedentary than those aged 40 and under. In addition, there is an association between tobacco consumption and age in our study (p = 0.004). Among those who use tobacco, 89.47% are over 40 years old.

Similar findings were observed by Elegbede *et al*. in Nigeria in 2019 [30], and Kingori *et al*. in Kenya in 2019 [31], where age above 40 was statistically linked to the onset of diabetes.

4.4.5. Sleep Duration and Diabetes

Our research revealed a significant correlation between sleep duration and the onset of diabetes. Specifically, adults who experienced short sleep durations (<7 hours) exhibited a 2.30 times higher risk (95% CI [1.11 - 4.75]) of developing diabetes compared to those with normal sleep durations (7 to 9 hours). Sleep deprivation or short sleep duration, defined as less than seven hours, increases appetite by affecting appetite-regulating hormones such as leptin, ghrelin, and orexin. This increase in food intake, along with fatigue and daytime sleepiness, leads to reduced energy expenditure during waking hours, thereby heightening the risk of weight gain. Furthermore, a decrease in sleep duration disrupts the circadian rhythm, which controls the synthesis of key hormones like cortisol and growth hormone, both critical to glucose metabolism. This disruption fosters glucose intolerance and gradually contributes to the development of type 2 diabetes, independent of weight gain [32]-[34]. The short sleep duration within the population of Kpomassè can be explained by lifestyle as well as concerns related to lack of money which are a source of permanent stress. Indeed, in the study population, 39.94% were stressed and 89.69% had an average monthly income of less than 52,000 CFA francs.

Our findings align with those of Dovonou *et al*. in Benin (2021), who demonstrated that abnormal daily sleep duration was statistically associated with the onset of diabetes (p = 0.03; OR: 5.09) [18].

4.4.6. Consumption of Fried Foods and Diabetes

Our study indicates a significant association between the consumption of fried foods and the incidence of diabetes in adults residing in the commune of Kpomassè. Specifically, individuals who consumed fried foods daily, as well as those who consumed them at least two to three times a week but not daily, exhibited a heightened risk of developing diabetes. The relative risk for daily consumers was 4.14 times (95% CI [1.18 - 14.48]), and for those consuming fried foods two to three times weekly, the risk was 2.73 times (95% CI [1.14 - 6.53]), compared to those who ate these foods no more than once a week. Fried foods are typically high in saturated fats and empty calories, contributors to obesity and insulin resistance, both of which are well-established risk factors for type 2 diabetes [35]. In the commune of Kpomassè, the consumption of fried foods can be explained, among other

things, by cultural traditions, taste and texture, and availability of foods. These elements could interact to influence eating behaviors.

These findings are consistent with the results of Cahill *et al*. (2014), which demonstrated a significant association between frequent consumption of fried foods and an increased risk of developing type 2 diabetes. Their study found that the association was stronger for fried food consumption outside the home [OR: 1.81 (95% CI: 1.58 - 2.08)] compared to at-home consumption [OR: 1.26 (95% CI: 1.09 - 1.47)] [36].

4.4.7. Health System Factors and Diabetes

Health system factors were not fully analyzed due to the fact that all participants surveyed indicated that they had never benefited from nutrition education, non-communicable disease (NCD) awareness or systematic screening for diabetes risk. This situation is attributable to the lack of effective implementation of the new 2018-2022 community health policy and the failure to implement the WHO-PEN program in the commune, due to financial constraints. For a more in-depth assessment, further studies could be envisaged to analyze the impact of these elements on the Kpomassè population, in comparison with currently available data.

5. Conclusion

Diabetes mellitus among adults in the commune of Kpomassè represents a significant public health challenge. Our study's findings identify five key determinants associated with diabetes: gender ($p = 0.038$), age ($p = 0.006$), sleep duration ($p = 0.026$), consumption of fried foods ($p = 0.024$), and stress ($p = 0.013$). Strengthening prevention efforts is crucial, as most of these risk factors can be mitigated through coordinated actions by relevant authorities at various levels. Initiatives such as enhancing measures to combat diabetes across all tiers of the healthcare system, implementing the WHO-PEN FINDRISC score during adult consultations and within community settings, and conducting awareness sessions on non-communicable diseases (NCDs), particularly diabetes, for the general population, could be vital.

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Conflicts of Interest

The authors declare that there are no conflicts of interest.

References

[1] Bureau régional de la Méditérranée de l'Organisation Mondiale de la Santé (2021) S'attaquer au diabète en tant que défi de santé publique dans la Région de la Méditerranée orientale.

[2] International Diabetes Federation (2021) IDF Diabetes Atlas.

[3] Organisation mondiale de la Santé (2023) Région Afrique. Fiche de synthèse analytique du Diabète.

[4] Programme National de Lutte contre les Maladies, Non Transmissibles/Ministère de la Santé Bénin (2018) Plan stratégique intégré de lutte contre les maladies non transmissibles 2019-2023.

[5] Ministère de la Santé (2023) Annuaire des Statistiques Sanitaire 2022 Bénin.

[6] Schabert, J., Browne, J.L., Mosely, K. and Speight, J. (2013) Social Stigma in Diabetes. *The Patient-Centered Outcomes Research*, **6**, 1-10. https://doi.org/10.1007/s40271-012-0001-0

[7] American Diabetes Association (2018) Economic Costs of Diabetes in the U.S. in 2017. *Diabetes Care*, **41**, 917-928. https://doi.org/10.2337/dci18-0007

[8] Dall, T.M., Yang, W., Gillespie, K., Mocarski, M., Byrne, E., Cintina, I., *et al.* (2019) The Economic Burden of Elevated Blood Glucose Levels in 2017: Diagnosed and Undiagnosed Diabetes, Gestational Diabetes Mellitus, and Prediabetes. *Diabetes Care*, **42**, 1661-1668. https://doi.org/10.2337/dc18-1226

[9] Papatheodorou, K., Papanas, N., Banach, M., Papazoglou, D. and Edmonds, M. (2016) Complications of Diabetes 2016. *Journal of Diabetes Research*, **2016**, 1-3. https://doi.org/10.1155/2016/6989453

[10] Liu, X., Haagsma, J., Sijbrands, E., Buijks, H., Boogaard, L., Mackenbach, J.P., *et al.* (2020) Anxiety and Depression in Diabetes Care: Longitudinal Associations with Health-Related Quality of Life. *Scientific Reports*, **10**, Article No. 8307. https://doi.org/10.1038/s41598-020-57647-x

[11] Séré, L., Tiéno, H., Yanogo, D., Traoré, S., Nagabila, Y., Ouédraogo, D.D., *et al.* (2021) Prévalence du Diabète et Facteurs de Risque Cardiovasculaire Associés dans une Population Rurale au Burkina Faso. *Médecine Tropicale et Santé Internationale*, **1**, B1J8-7K63.

[12] Amoussou-Guenou, D., Wanvoegbe, A., Hermans, M., Agbodande, A., Boko, M., Fandi, A.A., *et al.* (2015) Prevalence and Risk Factors of Diabetes Mellitus in the Adult Population of Porto-Novo (Benin). *Journal of Diabetes Mellitus*, **5**, 135-140. https://doi.org/10.4236/jdm.2015.53016

[13] Rosengren, A. and Dikaiou, P. (2023) Cardiovascular Outcomes in Type 1 and Type 2 Diabetes. *Diabetologia*, **66**, 425-437. https://doi.org/10.1007/s00125-022-05857-5

[14] Rojo-Martínez, G., Valdés, S., Soriguer, F., Vendrell, J., Urrutia, I., Pérez, V., *et al.* (2020) Incidence of Diabetes Mellitus in Spain as Results of the Nation-Wide Cohort Diabetes Study. *Scientific Reports*, **10**, Article No. 2765. https://doi.org/10.1038/s41598-020-59643-7

[15] Masson, E. (2024) Étude de la prévalence du diabète sucré et de ses facteurs de risque dans la commune rurale de Bankass. https://www.em-consulte.com/article/1078830/etude-de-la-prevalence-du-diabete-sucre-et-de-ses-

[16] Diabète Québec (2024) Le stress et le diabète. https://www.diabete.qc.ca/le-diabete/la-gestion-du-diabete/bien-etre-et-sante-mentale/le-stress-et-le-diabete/

[17] Kpozehouen, A., Djrolo, F., Sossa, C.J., Gbary, A.R., Chouehanou, Y., Fambo, D., *et al.* (2015) Prevalence and Associated Factors of Diabetes Mellitus in Benin. *Open Journal of Epidemiology*, **5**, 163-171. https://doi.org/10.4236/ojepi.2015.53021

[18] Dovonou, C.A., Alassani, A., Mama, C.I., Saké, A.K. and Gomina, M. (2022) Prévalence et facteurs associés au diabète chez les conducteurs de taxi-motos de la ville de

Parakou (Bénin) en 2021. *Revue Africaine de Médecine Interne*, **9**, 47-51.

[19] Ben Ali, R.A., Hannoun, Z., Harraqui, K., Zeghari, L., Aboussaleh, Y., Mohamed, S., *et al*. (2019) Profile of Diabetes and Cardiovascular Risk Factors in Adults Anjouan Island (Comoros). *Pan African Medical Journal*, **33**, Article 140. https://doi.org/10.11604/pamj.2019.33.140.19016

[20] Azandjeme, C.S. (2015) Exposition aux pesticides et risque de diabète de type 2: Une étude au nord du Bénin (Afrique de l'Ouest). https://papyrus.bib.umontreal.ca/xmlui/handle/1866/1183630

[21] FHP-MCO (2021) Santé de l'adulte et poids de naissance: Quel rapport? https://www.fhpmco.fr/2021/09/30/sante-de-ladulte-et-poids-de-naissance-quel-rapport/

[22] Al-Othman, A.A., Abd-Alrahman, S.H. and Al-Daghri, N.M. (2014) DDT and Its Metabolites Are Linked to Increased Risk of Type 2 Diabetes among Saudi Adults: A Cross-Sectional Study. *Environmental Science and Pollution Research*, **22**, 379-386. https://doi.org/10.1007/s11356-014-3371-0

[23] Laboratoire Lescuyer (2024) Le stress chronique: Causes, conséquences et solutions. https://www.laboratoire-lescuyer.com/blog/nos-conseils-sante/stress-chronique-causes-consequences-solutions

[24] Fédération pour la Recherche sur le Cerveau (2024) Le stress. https://www.frcneurodon.org/comprendre-le-cerveau/a-la-decouverte-du-cerveau/le-stress/

[25] Novak, M., Björck, L., Giang, K.W., Heden-Ståhl, C., Wilhelmsen, L. and Rosengren, A. (2012) Perceived Stress and Incidence of Type 2 Diabetes: A 35-Year Follow-Up Study of Middle-Aged Swedish Men. *Diabetic Medicine*, **30**, e8-e16. https://doi.org/10.1111/dme.12037

[26] Harris, M.L., Oldmeadow, C., Hure, A., Luu, J., Loxton, D. and Attia, J. (2017) Stress Increases the Risk of Type 2 Diabetes Onset in Women: A 12-Year Longitudinal Study Using Causal Modelling. *PLOS ONE*, **12**, e0172126. https://doi.org/10.1371/journal.pone.0172126

[27] University of Geneva and Geneva University Hospitals (2018) Diabète: Le rôle protecteur des œstrogènes enfin compris. https://www.unige.ch/medias/2018/diabete-le-role-protecteur-des-strogenes-enfin-compris

[28] Le Point (2018) La raison pour laquelle les femmes vivent plus longtemps que les hommes.

[29] KORIAN (2024) Diabète chez les personnes âgées: Causes, symptômes et traitements. https://www.korian.fr/maladies-troubles-grand-age/diabete

[30] Elegbede, O.E., Sanni, T.A. and Alabi, A.K. (2022) Prevalence and Risk Factors Associated with Diabetes Mellitus in Public Secondary Schools Teachers in Ekiti State. *Ibom Medical Journal*, **15**, 95-101. https://doi.org/10.61386/imj.v15i2.246

[31] Sarah, K., Abdillahi, H.S., Reuben, M. and Lydia, A. (2021) Prevalence and Risk Factors Associated with Diabetes in Meru County, Kenya: A Cross-Sectional Study. *International Journal of Diabetes in Developing Countries*, **41**, 412-418. https://doi.org/10.1007/s13410-020-00902-8

[32] Viot-Blanc, V. (2010) Le manque de sommeil favorise-t-il l'obésité, le diabète et les maladies cardiovasculaires? *Médecine du Sommeil*, **7**, 15-22. https://doi.org/10.1016/j.msom.2010.01.006

[33] Fondation pour la Recherche Médicale (2024) Santé publique: La durée du sommeil

influence-t-elle la santé ?
https://www.frm.org/fr/actualites/duree-sommeil-influence-sante

[34] Inserm (2024) Sommeil. https://www.inserm.fr/dossier/sommeil/

[35] Xaillé, A. (2022) Minceur: 9 aliments à indice glycémique élevé (et par quoi les remplacer).
https://www.topsante.com/minceur/aliments-indixe-gycemique-eleve-ig-650352

[36] Cahill, L.E., Pan, A., Chiuve, S.E., Sun, Q., Willett, W.C., Hu, F.B., *et al*. (2014) Fried-food Consumption and Risk of Type 2 Diabetes and Coronary Artery Disease: A Prospective Study in 2 Cohorts of US Women and Men. *The American Journal of Clinical Nutrition*, **100**, 667-675. https://doi.org/10.3945/ajcn.114.084129

Appendices

Appendix 1: Questionnaire Administered to Adults in the Commune of Kpomassè

1) File number	
2) Date of the survey	
3) Name and first name of the investigator	
Location identification	
4) Name of the district	
5) Name of the village	
Please circle the number (s) corresponding to the answer elements of the question concerned or answer the question precisely and concisely as appropriate.	
Sociodemographic and sociocultural characteristics	
6) What is your profession/occupation?	1) Executive/senior 2) Craftsman 3) Retailer 4) Farmer 5) Fisherman/Farmer 6) Other profession
7) If the farmer answers yes, ask yourself if you use pesticides in your fields?	1) Yes 2) No
8) If yes, which pesticide?	
9) What is your level of education?	1) No schooling 2) Primary school 3) Secondary school 4) Higher education
10) What is your average monthly income? (CFA Franc)	1) <52,000 2) [52,000 – 100,000[3) ≥100,000
11) What is your family situation?	1) Single 2) Divorced 3) Married 4) Cohabiting 5) Widowed
12) What is your ethnicity?	1) Fon 2) Sahouè 3) Pédah and related 4) Aizo 5) Other ethnic groups
13) Do you use insecticides in your house for spraying?	1) Yes 2) No

Continued

Biological characteristics	
14) What is your date of birth?	……../……./…….
15) What is your age? (In completed year)	
16) What is your physiological sex?	1) Male 2) Female
17) Do you have familial ATCD of diabetes?	1) Yes (1st or 2nd degree) 1) No
18) Do you suffer from stress? (HAD scale) Administer the HAD scale and at the end if the score is greater than 11 then presence of Stress	1) Yes 2) No
19) What was your birth weight?	1) Low birth weight (less than 2500 grams) 2) Normal 3) Macrosomia (over 4000 grams)
Behavioral and environmental characteristics	
20) Do you practice physical activities?	1) Yes 2) No
21) Sedentary lifestyle (number of hours sitting or lying apart from sleeping)	…… hours
22) Do you consume alcohol?	1) Excessive 2) Harmful 3) Heavy 4) Low 5) No
23) Do you consume tobacco?	1) Yes 2) No
24) Do you often eat fruits and vegetables?	1) Tous les jours 2) Pas tous les jours
25) Do you often eat fried foods?	1) Every day 2) At least two to three times a week and not every day 3) At most once a week
26) Do you eat meals with a lot of salt?	1) Yes 2) No
27) Do you often consume sugary products?	1) Every day 2) At least two to three times a week and not every day 3) At most once a week

Continued

28) What is the level of knowledge about diabetes? (Here consult the knowledge level evaluation sheet)	1) Poor (0 - 1) 2) Average (2 - 4) 3) Good (5 - 6)
29) What is the average sleep duration?	1) Short (less than 7 hours of sleep) 2) Normal (between 7 and 8 hours of sleep) 3) Long (more than 8 hours of sleep)
30) Do you use insecticides in your house for spraying?	1) Yes 2) No

Health system characteristics

31) Have you ever benefited from awareness about NCDs or diabetes?	1) Yes 2) No
32) Have you ever benefited from a nutritional education session?	1) Yes 2) No
33) Have you ever benefited from diabetes screening in your community?	1) Yes 2) No
34) Have you received treatment for diabetes in the last 12 months?	1) Yes 2) No
35) Have you ever taken medication for high blood pressure?	1) Yes 2) No
36) Have you ever been identified as having a high blood sugar level during a consultation, during an illness or during pregnancy (if female)?	1) Yes 2) No

Biological and anthropometric measurements

37) Fasting blood sugar	……. g/L
38) Systolic blood pressure (in mmHg)	……. mmHg
39) Diastolic blood pressure (in mmHg)	……. mmHg
40) Size (in m)	……. m
41) Weight in Kg	……..... Kg
42) Waist measurement in cm	……. cm
43) Adapted FINDRISC score	

NB: Measurements and blood sugar levels will be taken at the end of the exchange.

Appendix 2: Conceptual Framework for the Study of the Determinants of Diabetes Mellitus in Adults in the Commune of Kpomassè in 2024