BMC Endocrine Disorders

RESEARCH

Open Access

Prevalence of diabetes and its associated factors in Cape Verde: an analysis of the 2020 WHO STEPS survey on non-communicable diseases risk factors

Joshua Okyere[1,2*], Castro Ayebeng[1,3] and Kwamena Sekyi Dickson[1]

Abstract

Background Type 2 diabetes mellitus (T2DM) represents a significant global health challenge, with its prevalence steadily rising across diverse populations. Understanding the factors associated with T2DM is crucial for effective prevention and management strategies. In Cape Verde, an archipelago nation off the coast of West Africa, the burden of T2DM is of particular concern, yet comprehensive studies investigating its determinants in this context remain sparse. This study aims to narrow the knowledge gap by assessing the prevalence of prediabetes, T2DM and its associated factors among the adult Cape Verdean population.

Methods Data from the WHO STEPs survey were used. We analyzed data from 1,936 adults aged 18–69 years. The outcome variable was diabetes status computed using the fasting blood glucose (mg/dl). The data was weighted before the analysis to account for sampling biases. Multinomial logistic regression models were computed in STATA version 18.

Results The overall prevalence of prediabetes and T2DM was 7.8% (95% CI: 6.1–9.9) and 3.9% (95% CI: 3.1–4.9), respectively. Increasing age was associated with a higher odd of prediabetes and T2DM with the highest odds observed among older adults [(prediabetes: AORs = 3.20, 95%CI: 1.88–5.54) and T2DM: AOR = 3.51, 95%CI: 1.71–7.18)]. Additionally, high total cholesterol levels were linked to increased odds of T2DM (AOR = 2.48, 95%CI: 1.64–3.76). Individuals who consumed less than four servings of vegetables daily had higher odds of T2DM (AOR = 1.74, 95%CI: 1.12–2.71) while being overweight/obese was associated with higher odds of prediabetes (AOR = 1.57, 95%CI: 1.10–2.23). Urban residents had higher odds of T2DM than rural residents (AOR = 1.92, 95%CI: 1.23-3.00). Also, higher educational attainment was associated with lower odds of T2DM only (AOR = 0.33, 95%CI: 0.12–0.88) but not statistically significant for prediabetes.

Conclusion Based on the findings, we conclude that ageing, overweight/obesity, vegetable consumption and total cholesterol level are important predictors of pre-diabetes and T2DM in Cape Verde. As such, weight management and cholesterol management should be integral parts of T2DM prevention strategies. Additionally, clinicians and diabetes

*Correspondence:
Joshua Okyere
joshuaokyere54@gmail.com; joshua.okyere@hud.ac.uk

Full list of author information is available at the end of the article

societies in Cape Verde must make the promotion of vegetable consumption a key component of their health advice and advocacy.

Clinical trial number Not applicable

Keywords Diabetes, Chronic diseases, Epidemiology, Public health, Risk factors

Background

Around the world, the human population is living longer than before. This has often been attributed to the improvements in science, technology and medicine. However, amidst this increased life expectancy comes some concomitant health challenges [1]. Notably, there is a surge in the incidence, prevalence and deaths attributable to non-communicable diseases (NCDs). The Global Burden of Disease estimates that NCDs account for 71% of all mortalities, and are going to "overtake communicable, maternal, neonatal, and nutritional (CMNN) diseases combined" by 2030 in sub-Saharan Africa (SSA) [2]. Among these NCDs is type 2 diabetes mellitus (T2DM) which affects approximately 537 million people worldwide, and is expected to increase by 46% by the end of 2045 [3]. Within the African context, there were approximately 24 million people living with diabetes in 2021, and 416,000 deaths [3]. Thus, making T2DM a serious public health concern in African countries.

Extant literature has shown that T2DM significantly hampers healthy quality of life, and is a precursor to many other adverse health effects [4, 5]. For instance, T2DM has been found to exacerbate the risk of chronic kidney diseases and end-stage kidney disease [5, 6], blindness [7], cardiovascular diseases [8], and stroke [9]. As such, gaining an understanding of the risk factors of diabetes provides an opportunity to inform policies, preventive programs and clinical targeting necessary to ensure reduce the burden of T2DM.

In Cape Verde, an archipelago nation off the coast of West Africa, the burden of T2DM is of particular concern [10], yet comprehensive studies investigating its determinants in this context remain sparse. Coelho et al. [10] in their study estimated the prevalence of T2DM to be 4.5% among the adult population, highlighting increasing age as the only significant predictor of the disease risk. Meanwhile, previous studies conducted in South Africa [11], Kenya [12], and Brazil [13] have found a mixture of socio-demographic, lifestyle and health-seeking behavior to be significantly associated with the risk of T2DM. This prompts an examination of the situation in Cape Verde. The absence of established vital statistics systems and reliable population-level data have, for years, made it difficult to assess the prevalence of T2DM and its associated factors in this island nation. As such, we aim to narrow the knowledge gap by assessing the prevalence of prediabetes, T2DM and its associated factors among the adult Cape Verdean population using the 2020 WHO STEPS survey.

Methods

Data source and design

We relied on data from the 2020 WHO STEPS survey on NCD risk factors undertaken in Cape Verde. Conducted over February and March of 2020, this survey comprised three distinct phases. The initial step involved collecting socio-demographic and behavioral data [14]. Subsequently, Step 2 focused on anthropometric measurements using a digital scale (Seca) and a conventional stadiometer (Seca) while blood pressure was measured through the sphygmomanometer (OMRON) [14]. Finally, Step 3 entailed the collection of blood and urine samples to conduct biochemical analyses, including assessing blood glucose and cholesterol levels, as well as salt intake [14, 15]. The survey targeted adults aged 18–69 and employed a multiple-stage probability sampling design to ensure the data's representativeness for this age group across Cape Verde [15]. A total of 4,563 adults participated in Steps 1 and 2, with a subset of 2,436 adults contributing to Step 3. However, we excluded respondents who declined to disclose their educational level, instances with missing values for fasting blood glucose, individuals who did not respond to questions regarding fruit consumption and vegetable consumption. As a result, the dataset was reduced to 1,936 observations, upon which our statistical analyses were based.

Measures

Outcome variable

We computed for diabetes status using the fasting blood glucose (mg/dl). Having a fasting blood glucose of <100 mg/dl was categorized as non-diabetic and ≥ 126 mg/dl was categorized as T2DM while ≥ 100 mg/dl and <126 mg/dl was categorized as prediabetes.

Explanatory variables

Informed by previous studies conducted on diabetes mellitus and its risk factors [10–13], we selected a total of 13 explanatory variables. These included the sex of the participant (male and female), age categories (18–32, 33-52, and 53 or more), place of residence (rural and urban), marital status (never married, married, previously married, cohabiting), educational level (no formal education, primary, secondary, and higher), alcohol consumption

(yes and no), hypertension status, visit a health facility in the last 12 months (yes and no), employment status (unemployed or employed), fruit and vegetable consumption (four or more servings and less than four servings per day), body mass index (BMI), and total cholesterol level. BMI was computed by dividing the height (cm) by 100 to generate height in meters. We then divided their weight (kg) by the square of their height (m). A BMI of 18.49 or less was coded 'underweight'; between 18.5 and 24.99 was coded 'Normal' while 25 and above were coded as 'overweight/obese'. Hypertension status was derived from an average of the three systolic/diastolic blood pressure (bp) measurement. Individuals with an average systolic bp of ≥140 and diastolic bp of ≥90 were classified as being hypertensive. Total cholesterol level was categorized as normal (<194 mg/dl) and high (≥194 mg/dl) [16].

Statistical analysis

To address potential biases, we applied sample weights. To account for the complex survey design, the analyses adjusted for the primary sampling unit and the stratification cluster using the survey command (*svyset*) in STATA. Descriptive analysis was performed to determine the prevalence of prediabetes and T2DM within the sample, presented as frequencies and percentages. Multinomial logistic regression models were computed using a backward stepwise approach. The base outcome for this study was individuals who did not have T2DM. This group were compared to those who were diabetic and pre-diabetic. For easy interpretation of the multinomial logistic regression results, the coefficients were transformed into odds ratios (AORs) along with their corresponding 95% confidence intervals (CIs). We based our level of statistical significance at p-value ($p<0.05$). A multicollinearity test was conducted to rule out any potential multicollinearity between explanatory variables using variance inflation factor (VIF). All analyses were conducted using STATA version 18 (StataCorp, College Station, TX, USA).

Ethical approval

We did not seek ethical approval as this has already been done for all the STEPS survey of NCD risk factors. Rather, we formally requested the data from the WHO NCD Microdata Repository: https://extranet.who.int/ncdsmicrodata/index.php/home. However, ethical approval for the 2020 WHO STEPS survey was granted by the National Ethics Committee for Health Research and the Data Protection Commission (CNEPS).

Results

General characteristics of the study population

Most participants were men (51.2%), with women comprising 48.8% of the sample. The majority of participants were aged 33–52 years (40.2%), and 53.4% had never married. In terms of education, 44.8% had attained secondary education, and 67.9% resided in urban areas. A substantial proportion (58.7%) had visited a health facility in the past 12 months, and 56.9% were employed. Regarding alcohol consumption, 73.8% reported drinking alcohol, while 27.9% of participants had hypertension. Almost half of the participants (47.2%) were overweight or obese. In terms of dietary habits, 87.3% consumed fewer than four servings of fruit daily, and 66.5% consumed fewer than four servings of vegetables. Additionally, 16.6% of participants had high total cholesterol levels (Table 1).

Prevalence of diabetes across all explanatory variables

The overall prevalence of prediabetes and T2DM was 7.8% (95% CI: 6.1–9.9) and 3.9% (95% CI: 3.1–4.9), respectively. Men had a higher prevalence of prediabetes (8.5%), whereas T2DM was more common among women (4.9%). Older adults (53 years and older) exhibited the highest prevalence of both prediabetes (14.8%) and T2DM (11.8%). Prediabetes and T2DM were also more prevalent among individuals with hypertension, those consuming fewer than four servings of vegetables daily, individuals with high total cholesterol levels, and those classified as overweight or obese. Prediabetes was more common in rural residents, alcohol consumers, and the employed, while T2DM was more prevalent among urban residents, unemployed adults, and those with no formal education (Table 1).

Factors associated with prediabetes and T2DM risk among Cape Verdean adult population

In the unadjusted model, age, educational level, marital status, place of residence, hypertension status, vegetable consumption, total cholesterol level, healthcare facility visitation and body mass index were significantly associated with T2DM and prediabetes. However, this changed in the adjusted model. Increasing age remained associated with a higher odd of prediabetes and T2DM with the highest odds observed among older adults [(prediabetes: AORs=3.20, 95%CI: 1.88–5.54) and T2DM: AOR=3.51, 95%CI: 1.71–7.18)]. Additionally, high total cholesterol levels were linked to increased odds of T2DM (AOR=2.48, 95%CI: 1.64–3.76). Individuals who consumed less than four servings of vegetables daily had higher odds of T2DM (AOR=1.74, 95%CI: 1.12–2.71) while being overweight/obese was associated with higher odds of prediabetes (AOR=1.57, 95%CI: 1.10–2.23). Urban residents had higher odds of T2DM than rural residents (AOR=1.92, 95%CI: 1.23-3.00). Also, higher

Table 1 Prevalence of prediabetes and T2DM across all explanatory variables

Variables	Weighted sample *n* (%)	Pre-diabetes *n* (% [95%CI])	T2DM *n* (% [95%CI])	*p*-values
Total sample	**1936 (100.0)**	**151 (7.8 [6.1–9.9])**	**75 (3.9 [3.1–4.9])**	
Gender				0.121
Men	991 (51.2)	85 (8.5 [6.2–11.6])	29 (2.9 [2.0-4.3])	
Women	945 (48.8)	66 (7.0 [5.1–9.6])	46 (4.9 [3.7–6.5])	
Ages				**< 0.001**
18–32 years	816 (42.1)	39 (4.8 [2.7–8.6])	6 (0.8 [0.4–1.5])	
33–52 years	778 (40.2)	63 (7.9 [5.7–10.7])	31 (3.8 [2.6–5.5])	
53 years and older	342 (17.7)	48 (14.8 [10.9–19.7])	38 (11.8 [8.4–16.4])	
Educational level				**< 0.001**
No formal education	66 (3.4)	5 (9.9 [5.6–17.1])	9 (17.9 [9.7–30.6])	
Primary/basic	688 (35.5)	74 (11.2 [8.2–14.9])	39 (5.9 [4.2–8.1])	
Secondary	867 (44.8)	61 (7.1 [4.8–10.2])	21 (2.4 [1.5–3.8])	
Tertiary	315 (16.3)	10 (2.9 [1.3–6.4])	6 (1.8 [0.8–3.9])	
Marital status				**0.021**
Never married	1033 (53.4)	81 (7.5 [5.1–10.9])	34 (3.1 [2.2–4.4])	
Married	276 (14.2)	22 (8.3 [4.9–13.7])	15 (5.5 [3.4–8.9])	
Previously married	154 (8.0)	25 (13.1 [7.9–20.9])	14.2 (7.5 [4.1–13.3])	
Cohabiting	473 (24.4)	22 (5.6 [3.7–8.2])	13 (3.2 [2.0-5.1])	
Residence				0.263
Rural	622 (32.1)	55 (9.5 [5.8–15.0])	17 (2.9 [2.0-4.4])	
Urban	1314 (67.9)	95 (7.1 [5.4–9.1])	58 (4.3 [3.3–5.6])	
Hypertension status				**< 0.001**
Normotensive	1395 (72.1)	84 (6.0 [4.2–8.6])	40 (2.9 [2.1-4.0])	
Hypertensive	541 (27.9)	66 (12.3 [9.2–16.3])	35 (6.5 [4.7–8.9])	
Alcohol consumption				0.709
Yes	1429 (73.8)	115 (7.8 [6.0-10.1])	54 (3.7 [2.8–4.8])	
No	507 (26.2)	35 (7.7 [5.1–11.3])	21 (4.5 [3.1–6.5])	
Visited healthcare facility				**0.021**
No	799 (41.3)	73 (9.1 [6.3–12.9])	18 (2.3 [1.5–3.5])	
Yes	1137 (58.7)	78 (6.9 [5.2–8.9])	57 (5.0 [3.8–6.6])	
Employment status				**0.041**
Unemployed	835 (43.1)	50 (6.1 [4.1–8.9])	40 (4.9 [3.5–6.8])	
Employed	1101 (56.9)	101 (9.0 [6.8–11.7])	35 (3.2 [2.3–4.3])	
Fruit consumptions				0.501
Four or more servings	247 (12.7)	22 (9.4 [5.6–15.4])	7 (2.9 [1.5–5.5])	
Less than four servings	1689 (87.3)	129 (7.5 [5.8–9.8])	69 (4.0 [3.2–5.1])	
Vegetable consumptions				0.622
Four or more servings	648 (33.5)	54 (8.1 [5.4–11.8])	21 (3.2 [2.0-4.9])	
Less than four servings	1288 (66.5)	97 (7.6 [5.6–10.3])	54 (4.3 [3.3–5.6])	
BMI categories				**0.028**
Underweight	64 (3.3)	9 (14.2 [5.5–31.8])	2 (2.3 [0.3–14.8])	
Normal	958 (49.5)	58 (6.0 [4.1–8.9])	27 (2.8 [1.9–4.1])	
Overweight/obese	914 (47.2)	84 (9.2 [7.0-11.9])	47 (5.1 [3.8–6.8])	
Total cholesterol level				**< 0.001**
Normal TCL	1615 (83.4)	103 (6.4 [4.8–8.4])	42 (2.6 [1.9–3.6])	
High TCL	321 (16.6)	47 (14.7 [10.3–20.7])	33 (10.2 [7.3–14.1])	

educational attainment was associated with lower odds of T2DM only (AOR=0.33, 95%CI: 0.12–0.88) but not statistically significant for prediabetes (see Table 2)

Discussion

In this study, we sought to examine the lifetime prevalence of T2DM and its associated factors among the adult Cape Verdean population. Our study revealed that four out of a hundred adults in Cape Verde were living with T2DM while 7.8% lived with pre-diabetes. This T2DM prevalence rate is similar to an earlier study in Cape Verde that found a T2DM prevalence of 4.5% [10]. Our prevalence of T2DM is also similar to the situation in Ghana where it is estimated that 6.5% of the adult population lives with T2DM [17]. However, when compared to other African nations like Kenya, which reported a lower prevalence of 2.4% [12], our findings suggest a relatively higher burden of T2DM among Cape Verdean adults. Thus, underscoring the importance of ongoing surveillance and monitoring of T2DM prevalence within the adult Cape Verdean population

We found that increasing age was positively associated with T2DM risk. That is, older adults had 3.20 and 3.51 times higher odds of being pre-diabetic and diabetic, respectively. The result is consistent with Coelho et al.'s study [10], which found significantly higher risk of T2DM among adult Cape Verdeans aged 58–67 years than in younger adults. Similar pattern of association has been reported in other African countries including Ethiopia [18], Nigeria [19], and Uganda [20]. From a biological perspective, advancing age is often accompanied by physiological changes such as decreased insulin sensitivity and impaired glucose regulation, predisposing older individuals to a higher risk of developing diabetes [21, 22]. It is also possible that age-related factors such as cumulative exposure to unhealthy lifestyle behaviors, including poor dietary habits and sedentary lifestyles, may contribute to the development of diabetes over time. Thus, explaining the high risk of T2DM in older adults than in younger adults

Urban residency was another factor that was associated with significantly higher odds of T2DM risk. This aligns with some studies that have found urban resident to be at a higher risk of T2DM than rural dwellers [23, 24]. In the perspective of Khan et al. [24], urban areas often lack a green built spaces; as such, there is high air pollution that dissuade people from engaging in physical activities and exacerbates diabetes risk. Another plausible explanation for this association could be the easy availability of fast-food and calorie rich diets like burgers and fries in urban areas of Cape Verde compared to rural areas

Our findings indicate that individuals who consumed less servings of vegetables were at higher odds of being diabetic. The observed association between vegetable consumption and T2DM is inconsistent with evidence from previous studies that found no significant association [25]. Nonetheless, it is corroborated by Mamluk et al. [25] who report that higher intake of vegetables significantly reduces the risk of diabetes. A plausible explanation for the inverse association is that vegetable tend to contain polyphenols, such as flavonoids, and antioxidant compounds like carotenoids, vitamin C, and vitamin E which significantly reduces the risk of T2DM by alleviating oxidative stress [26]. This implies that less consumption of vegetables may lead to poorer glycemic control and increased risk of insulin resistance which are known risk factors of T2DM

Consistent with previous literature [27, 28], we found the odds of T2DM to be significantly high among persons with a high total cholesterol level. One plausible explanation is the role of cholesterol in the development of insulin resistance [29]. Elevated cholesterol levels can lead to the accumulation of lipids in tissues, particularly in muscle and liver cells, which can disrupt insulin signaling pathways [30, 31]. This disruption impairs the ability of cells to respond effectively to insulin, resulting in elevated blood glucose levels and, ultimately, the onset of T2DM. Another perspective to this finding could be the role of cholesterol in the formation of atherosclerotic plaques which trigger inflammatory processes in the body [32]. Such chronic inflammation can exacerbate metabolic dysfunction, increasing the likelihood of T2DM

The findings from the study suggests that higher education has a protective effect against T2DM. Our findings corroborate Steele et al.'s study [33] which showed that individuals with lower educational attainment have a higher risk of developing T2DM. This association is expected as individuals with higher educational attainment have been documented to be more likely to engage in physical activity, and less likely to engage in smoking - a known risk factor of diabetes [34]. Also, individuals who have attained higher education can easily access, appreciate and comprehend health promotion message, and thus act accordingly to protect their health including reducing their risk of T2DM

It must be noted that prediabetes and T2DM are part of a continuum, characterized by a gradual impairment in glucose metabolism [35]. Risk factors such as advancing age and overweight/obesity are known to drive metabolic changes that predispose individuals to insulin resistance and impaired glucose regulation, both of which are central to the development of prediabetes and T2DM [35]. It is thus not surprising that increasing age was a significant predictor for both conditions in our study. However, to being overweight/obese was significantly associated with prediabetes but not T2DM. This is inconsistent with existing literature that have found a significant positive association between overweight/obesity and T2DM

Table 2 Factors associated with pre-diabetes and T2DM among Cape Verdean adult population

Variables	Pre-diabetes		T2DM	
	Unadjusted model (OR; 95%CI)	Adjusted model (AOR; 95%CI)	Unadjusted model (OR; 95%CI)	Adjusted model (AOR; 95%CI)
Gender				
Men	Ref.	-	Ref.	-
Women	0.98 [0.71–1.35]	-	1.43 [0.94–2.16]	-
Age				
18–32 years	Ref.	Ref.	Ref.	Ref.
33–52 years	**2.16 [1.35–3.46]****	**1.76 [1.08–2.88]***	**2.57 [1.34–4.93]****	1.86 [0.94–3.66]
53 years and older	**4.48 [2.80–7.17]*****	**3.20 [1.88–5.44]*****	**7.03 [3.72–13.27]*****	**3.51 [1.71–7.18]****
Educational level				
No formal education	Ref.	-	Ref.	Ref.
Primary/basic	0.97 [0.52–1.81]	-	**0.42 [0.24–0.74]****	0.63 [0.34–1.18]
Secondary	**0.51 [0.26–0.97]***	-	**0.19 [0.10–0.36]*****	**0.39 [0.19–0.82]***
Tertiary	**0.34 [0.14–0.81]***	-	**0.17 [0007-0.43]*****	**0.33 [0.12–0.88]***
Marital status				
Never married	Ref.		Ref.	
Married	1.40 [0.91–2.16]	-	**1.70 [1.03–2.83]***	-
Previously married	1.58 [0.87–2.83]	-	1.56 [0.87 [2.83]	-
Cohabiting	1.15 [0.69–1.91]	-	1.15 [0.69–1.91]	-
Residence				
Rural	Ref.	-	Ref.	Ref.
Urban	1.11 [0.81–1.54]	-	**1.61 [1.06–2.45]***	**1.92 [1.23-3.00]****
Hypertension status				
Normotensive	Ref.	-	Ref.	-
Hypertensive	**1.95 [1.41–2.68]*****	-	**2.37 [1.61–3.50]*****	-
Alcohol consumption				
Yes	Ref.	-	Ref.	-
No	1.02 [0.72–1.43]	-	1.41 [0.95–2.10]	-
Visited healthcare facility				
No	Ref.	-	Ref.	-
Yes	0.99 [0.72–1.37]	-	**1.57 [1.03–2.40]***	-
Employment status				
Unemployed	Ref.	-	Ref.	-
Employed	1.16 [0.84–1.59]	-	0.90 [0.61–1.33]	-
Fruit consumptions				
Four or more servings	Ref.	-	Ref.	-
Less than four servings	0.88 [0.57–1.36]	-	1.33 [0.72–2.47]	-
Vegetable consumptions				
Four or more servings	Ref.	-	Ref.	Ref.
Less than four servings	0.99 [0.72–1.37]	-	**1.64 [1.07–2.53]***	**1.74 [1.12–2.71]***
BMI categories				
Underweight	1.85 [0.80–4.25]	1.94 [0.82–4.57]	0.35 [0.05–2.59]	-
Normal	Ref.	Ref.	Ref.	-
Overweight/obese	**2.00 [1.42–2.81]*****	**1.57 [1.10–2.23]***	**1.63 [1.09–2.43]***	-
Total cholesterol level				
Normal TCL	Ref.	-	Ref.	Ref.
High TCL	**1.94 [1.38–2.73]*****	-	**3.51 [2.37–5.20]*****	**2.48 [1.64–3.76]*****

*$p<0.05$, **$p<0.01$, ***$p<0.001$; Ref = Reference category; Mean VIF = 7.8

(-) iteratively excluded after implementing backward stepwise approach

Base outcome: Non-diabetic

[36]. Further research is needed to better understand why overweight/obesity is associated with prediabetes but not T2DM in Cape Verde

Strengths and limitations

This study utilized a population-based sample, allowing for the generalization of findings to the broader adult population of men and women in Cape Verde. Furthermore, rigorous statistical analyses were conducted, enhancing the credibility and reliability of the results. However, it is important to acknowledge the limitations inherent in the study design. As a cross-sectional study, causal relationships cannot be inferred from the observed associations. Also, the lack of information about family history of diabetes is a limitation worth noting. These considerations highlight the need for caution in interpreting the findings and underscore the importance of future research utilizing longitudinal designs to further elucidate the factors associated with life prevalence and associated factors of diabetes. Due to high multicollinearity, factors like engagement in physical activity were not included in our statistical modelling

Conclusion

Based on the findings, we conclude that ageing, overweight/obesity, vegetable consumption and total cholesterol level are important predictors of pre-diabetes and T2DM in Cape Verde. As such, weight management and cholesterol management should be integral parts of T2DM prevention strategies. Additionally, clinicians and diabetes societies in Cape Verde must make the promotion of vegetable consumption a key component of their health advice and advocacy

Abbreviations

AOR	Adjusted odds ratio
CI	Confidence interval
CMNN	Communicable, maternal, neonatal, and nutritional
NCDs	Non-communicable diseases
SSA	Sub-Saharan Africa

Acknowledgements

We acknowledge the WHO for granting us free access to the dataset used in this study.

Author contributions

JO and CA conceptualized and designed the study. JO curated the data and performed the formal analyses. JO and CA drafted the initial manuscript. KSD reviewed the initial manuscript for its accuracy. All authors reviewed the final manuscript and approved its submission. JO had the final responsibility of submitting the manuscript.

Funding

None.

Data availability

The datasets generated and/or analysed during the current study are available in the WHO NCD Microdata Repository: https://extranet.who.int/ncdsmicrodata/index.php/catalog/935. Accession number/ID: CPV_2020_STEPS_v01.

Declarations

Ethical approval and consent to participate

We did not seek ethical approval as this has already been done for all the STEPS surveys of NCD risk factors. However, ethical approval for the 2020 WHO STEPS survey was granted by the National Ethics Committee for Health Research and the Data Protection Commission (CNEPS). We formally requested the data from the WHO NCD Microdata Repository: https://extranet.who.int/ncdsmicrodata/index.php/home.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Department of Population and Health, University of Cape Coast, Cape Coast, Ghana
[2]School of Human and Health Sciences, University of Huddersfield, Queensgate, Huddersfield, England, United Kingdom
[3]School of Demography, Australian National University, Canberra, ACT, Australia

Received: 24 April 2024 / Accepted: 5 December 2024
Published online: 18 December 2024

References

1. Gyasi RM, Phillips DR. Aging and the rising burden of noncommunicable diseases in sub-saharan Africa and other low-and middle-income countries: a call for holistic action. Gerontologist. 2020;60(5):806–11.
2. Bigna JJ, Noubiap JJ. The rising burden of non-communicable diseases in sub-saharan Africa. Lancet Global Health. 2019;7(10):e1295–6.
3. International Diabetes Federation. Regional factsheet: Africa. World Diabetes Foundation Diabetes around the world. 2021. https://diabetesatlas.org/regional-factsheets/?dlmodal=active&dlsrc=https%3A//diabetesatlas.org/idfawp/resource-files/2021/11/IDFDA10-global-fact-sheet.pdf
4. Rwegerera GM, Moshomo T, Gaenamong M, Oyewo TA, Gollakota S, Rivera YP, Masaka A, Godman B, Shimwela M, Habte D. Health-related quality of life and associated factors among patients with diabetes mellitus in Botswana. Alexandria J Med. 2018;54(2):111–8.
5. Koye DN, Magliano DJ, Nelson RG, Pavkov ME. The global epidemiology of diabetes and kidney disease. Adv Chronic Kidney Dis. 2018;25(2):121–32.
6. Ooi YG, Sarvanandan T, Hee NK, Lim QH, Paramasivam SS, Ratnasingam J, Vethakkan SR, Lim SK, Lim LL. Risk Prediction and Management of Chronic Kidney Disease in People Living with Type 2 Diabetes Mellitus. Diabetes & metabolism journal. 2024 Jan 26.
7. Wykoff CC, Khurana RN, Nguyen QD, Kelly SP, Lum F, Hall R, Abbass IM, Abolian AM, Stoilov I, To TM, Garmo V. Risk of blindness among patients with diabetes and newly diagnosed diabetic retinopathy. Diabetes Care. 2021;44(3):748–56.
8. Almourani R, Chinnakotla B, Patel R, Kurukulasuriya LR, Sowers J. Diabetes and cardiovascular disease: an update. Curr Diab Rep. 2019;19:1–3.
9. Mosenzon O, Cheng AY, Rabinstein AA, Sacco S. Diabetes and stroke: what are the connections? J Stroke. 2023;25(1):26.
10. Coelho P, Mascarenhas K, Rodrigues J, Rodrigues FJ. Prevalence of Cardiovascular Risks Factors in Cape Verde (Prevcardio. cv)–Santiago Island. 2023. https://doi.org/10.20944/preprints202312.0527.v1
11. Chiwandire N, Zungu N, Mabaso M, Chasela C. Trends, prevalence and factors associated with hypertension and diabetes among South African adults living with HIV, 2005–2017. BMC Public Health. 2021;21:1–4.
12. Mohamed SF, Mwangi M, Mutua MK, Kibachio J, Hussein A, Ndegwa Z, Owondo S, Asiki G, Kyobutungi C. Prevalence and factors associated with pre-diabetes and diabetes mellitus in Kenya: results from a national survey. BMC Public Health. 2018;18:1–1.
13. Oppermann K, Spritzer PM. Prevalence and risk factors associated with diabetes mellitus among middle-aged women in southern Brazil: a population-based study. Menopause. 2024;31(3):225–30.
14. Pengpid S, Peltzer K. Behavioural and biological risk factors of non-communicable diseases among adults in Cabo Verde: a repeated cross-sectional

study of the 2007 and 2020 national community-based surveys. BMJ open. 2023;13(8):e073327.
15. Okyere J, Ayebeng C, Dickson KS. Factors associated with age at first screening for cervical cancer among adult Cape Verdean women: a cross-sectional study. BMC Public Health. 2024;24(1):2444.
16. World Health Organization. Mean total cholesterol. 2024. https://www.who.int/data/gho/indicator-metadata-registry/imr-details/2384
17. Asamoah-Boaheng M, Sarfo-Kantanka O, Tuffour AB, Eghan B, Mbanya JC. Prevalence and risk factors for diabetes mellitus among adults in Ghana: a systematic review and meta-analysis. Int Health. 2019;11(2):83–92.
18. Zekewos A, Loha E, Egeno T, Wubshet K, Merga Z. Prevalence of diabetes mellitus and associated factors in Southern Ethiopia: a community based study. Ethiop J Health Sci. 2018;28(4).
19. Uloko AE, Musa BM, Ramalan MA, Gezawa ID, Puepet FH, Uloko AT, Borodo MM, Sada KB. Prevalence and risk factors for diabetes mellitus in Nigeria: a systematic review and meta-analysis. Diabetes Therapy. 2018;9:1307–16.
20. Asiimwe D, Mauti GO, Kiconco R. Prevalence and risk factors associated with type 2 diabetes in elderly patients aged 45–80 years at Kanungu District. J Diabetes Res. 2020;2020:1–5.
21. Karakelides H, Irving BA, Short KR, O'Brien P, Nair KS. Age, obesity, and sex effects on insulin sensitivity and skeletal muscle mitochondrial function. Diabetes. 2010;59(1):89–97.
22. Chia CW, Egan JM, Ferrucci L. Age-related changes in glucose metabolism, hyperglycemia, and cardiovascular risk. Circul Res. 2018;123(7):886–904.
23. Molina RT, García AR, Vergara TA, Florez-Garcia VA, Gutierrez VR, Lozano KF, Barengo NC. Predictors of diabetes risk in urban and rural areas in Colombia. Heliyon. 2022;8(1).
24. Khan JR, Sultana A, Islam MM, Biswas RK. A negative association between prevalence of diabetes and urban residential area greenness detected in nationwide assessment of urban Bangladesh. Sci Rep. 2021;11(1):19513.
25. Mamluk L, O'Doherty MG, Orfanos P, Saitakis G, Woodside JV, Liao LM, Sinha R, Boffetta P, Trichopoulou A, Kee F. Fruit and vegetable intake and risk of incident of type 2 diabetes: results from the consortium on health and ageing network of cohorts in Europe and the United States (CHANCES). Eur J Clin Nutr. 2017;71(1):83–91.
26. Basu A, Alman AC, Snell-Bergeon JK. Associations of dietary antioxidants with glycated hemoglobin and insulin sensitivity in adults with and without type 1 diabetes. J Diabetes Res. 2022;2022(1):4747573.
27. Cui J, Sun J, Wang W, Xin H, Qiao Q, Baloch Z, Ma A. The association of triglycerides and total cholesterol concentrations with newly diagnosed diabetes in adults in China. Oncotarget. 2017;8(61):103477.
28. Chen Z, Hu H, Chen M, Luo X, Yao W, Liang Q, Yang F, Wang X. Association of Triglyceride to high-density lipoprotein cholesterol ratio and incident of diabetes mellitus: a secondary retrospective analysis based on a Chinese cohort study. Lipids Health Dis. 2020;19:1–1.
29. Zhou X, Xu J. Association between serum uric acid-to-high-density lipoprotein cholesterol ratio and insulin resistance in patients with type 2 diabetes mellitus. J Diabetes Invest. 2024;15(1):113–20.
30. Perego C, Da Dalt L, Pirillo A, Galli A, Catapano AL, Norata GD. Cholesterol metabolism, pancreatic β-cell function and diabetes. Biochimica et Biophysica Acta (BBA)-Molecular basis of Disease. 2019;1865(9):2149–56.
31. Oliveira TV, Maniero F, Santos MH, Bydlowski SP, Maranhão RC. Impact of high cholesterol intake on tissue cholesterol content and lipid transfers to high-density lipoprotein. Nutrition. 2011;27(6):713–8.
32. Janoudi A, Shamoun FE, Kalavakunta JK, Abela GS. Cholesterol crystal induced arterial inflammation and destabilization of atherosclerotic plaque. Eur Heart J. 2016;37(25):1959–67.
33. Steele CJ, Schöttker B, Marshall AH, Kouvonen A, O'Doherty MG, Mons U, Saum KU, Boffetta P, Trichopoulou A, Brenner H, Kee F. Education achievement and type 2 diabetes—what mediates the relationship in older adults? Data from the ESTHER study: a population-based cohort study. BMJ open. 2017;7(4):e013569.
34. Hu M, Yang T, Yang Y. Causal associations of education level with cardiovascular diseases, cardiovascular biomarkers, and socioeconomic factors. Am J Cardiol. 2024;213:76–85.
35. Afzal R, Sultana A, Shoaib M, Ashraf H. Ziabetus (Prediabetes): a harbinger of critical stage in the Continuum of glucose metabolism disorder: a review. J Drug Delivery Ther. 2024;14(5):229–33.
36. Klein S, Gastaldelli A, Yki-Järvinen H, Scherer PE. Why does obesity cause diabetes? Cell Metabol. 2022;34(1):11–20.

Publisher's note