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Frequency of internet use and hypertension risk among men and women in Kenya: an analysis of the 2022 demographic and health survey

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Abstract

Background The proliferation of internet use in the 21st century has brought about a pluralistic effect on health. Users of the internet are more exposed to health information, thus, making them more health literate and more likely to adopt healthy behaviors. However, frequent use of the internet has been found to adversely affect mental health (e.g., depression), social wellbeing, and obesity. Yet, the link between internet use and physical health outcomes such as hypertension remains less explored. We examined the association between frequency of internet use and hypertension risk among women and men in Kenya using data from the 2022 Kenyan demographic and health survey.

Results Overall, the prevalence of hypertension was higher among women (1,398 [8.69%]) compared to men (504 [3.49%]). Those who reported using the internet often reported higher prevalence of hypertension (women: $n=638$ [10.49%]; men: $n=279$ [3.98%]). The mean age was 29.3 years (SD = 9.6) for women and 29.9 years for men (SD = 10.9). After adjusting for potential confounders, women who reported often using the internet also demonstrated a significant association [AOR = 1.21; 95%CI: 1.03–1.43]. However, we found no significant association between frequency of internet use and hypertension among men after adjusting for confounders.

Conclusion Our study concludes that frequent use of internet is positively associated with hypertension risk among women but not men. Policymakers may consider implementing guidelines or regulations to promote healthy internet usage habits and encourage breaks or limits on screen time, especially for individuals at risk of hypertension (i.e., older women of reproductive age, women with higher education, married and previously married women, those in affluent households, parous women, those who consume alcohol and those overweight/obese). Healthcare providers should educate patients about the potential health consequences of prolonged internet usage and incorporate discussions about screen time management into routine clinical encounters.

Keywords Internet use, Hypertension, Cardiovascular diseases, Public health, Digital health

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Background

Hypertension, characterized by elevated blood pressure (140/90 mmHg or higher), is a leading risk factor for cardiovascular diseases, stroke, and other chronic conditions [1, 2]. This ill-health condition has gained the accolade of being a silent killer due to the high proportion of adults (46%) living with undiagnosed high-blood pressure [3]. Available evidence [2] indicates that nearly a fifth of all cardiovascular diseases is attributable to hypertension. Globally, it is further estimated that hypertension is responsible for 218 million disability-adjusted life-years [4]. In the case of sub-Saharan Africa, one study estimated that 8 out of every 100 women of reproductive age are hypertensive, with Kenya reporting a prevalence of 9.37 percent [5]. This situation makes hypertension a serious public health concern. Consequently, the World Health Organization (WHO) has set a global target of reducing hypertension by 33% between 2010 and 2030 [3].

To ensure that all countries, including Kenya, achieve the global target of reducing hypertension prevalence by 33 percent [3], there is a need to understand the factors that exacerbate women's risk to hypertension. Extant studies have identified factors such as the use of unclean cooking fuel [5], HIV status [6], ageing [7], sedentary lifestyles [8], overweight and obesity [9], poor socioeconomic status [10], smoking [11], and high sodium intake [12] constitutes high risk factors for hypertension. While traditional risk factors such as unhealthy diet, physical inactivity, and smoking are well-established, the role of emerging factors such as internet use patterns in hypertension development remains underexplored.

The proliferation of internet use in the 21st century has brought about a pluralistic effect on health. On one hand, users of the internet are more exposed to health information, thus, making them more health literate and more likely to adopt healthy behaviors. On the other hand, frequent use of the internet has been found to adversely affect mental health (e.g., depression) [13], social wellbeing, and obesity [14]. Despite some studies establishing an association between frequent internet use and adverse mental and social health outcomes, the link between internet use and physical health outcomes such as hypertension remains less explored. Given the ubiquitous nature of internet use across diverse demographic groups and its potential to influence lifestyle behaviors, investigating its association with hypertension risk is of paramount importance. Particularly, in Kenya, there is no published empirical study that has investigated this association. As such, the study poses the following questions: (a) What is the association between frequency of internet use and hypertension risk? (b) Does the association between frequency of internet use and hypertension risk differ by sex? We aimed to narrow the knowledge gap by examining the association between frequency of internet use and hypertension risk among both men and women in Kenya.

Methods

Data source

Data was sourced from the individual recode file of the 2022 Kenyan demographic and health survey (KDHS). The 2022 KDHS is the 7th in a series of nationally representative survey conducted in the country since 1989. The survey aimed to offer current data on socio-economic, demographic, nutritional, and health indicators to facilitate the planning, monitoring, and evaluation of diverse health programs and policies [15]. The 2022 KDHS, conducted as part of the DHS-8 series, extended certain inquiries and introduced additional modules focusing on areas such as early childhood development and chronic diseases [15]. This survey was implemented under the auspices of the Kenya National Bureau of Statistics (KNBS), with partnership from the Ministry of Health (MoH) and a host of other stakeholders [15]. The 2022 KDHS sample was selected from the Kenya Household Master Sample Frame (K-HMSF), which is currently utilized by KNBS for conducting household-based sample surveys across Kenya.

The 2022 KDHS employed a two-stage stratified sample design. Initially, 1,692 clusters were chosen from the K-HMSF using the Equal Probability Selection Method (EPSEM) in the first stage, with clusters being independently selected within each sampling stratum [15]. Subsequently, household listing occurred in all selected clusters, generating a list of households for the second stage of selection, where 25 households were to be chosen from each cluster. However, it was discovered that certain clusters contained fewer than 25 households [15]. Consequently, all households within these clusters were included in the sample. This adjustment resulted in a total of 42,022 households being sampled for the 2022 KDHS [15]. The KDHS collected data on 32,156 women and 14,453 men. However, for the purpose of this study, we had to drop all missing values (see Fig. 1). The analysis was based on a sample of 16,089 women and 14,453 men.

Study variables

Outcome variable

Self-reported hypertension status was the outcome variable. Respondents were asked whether a healthcare provider has told them they had high blood pressure. The responses were 'Yes' or 'No'. Those who responded yes to this question were classified as being hypertensive.

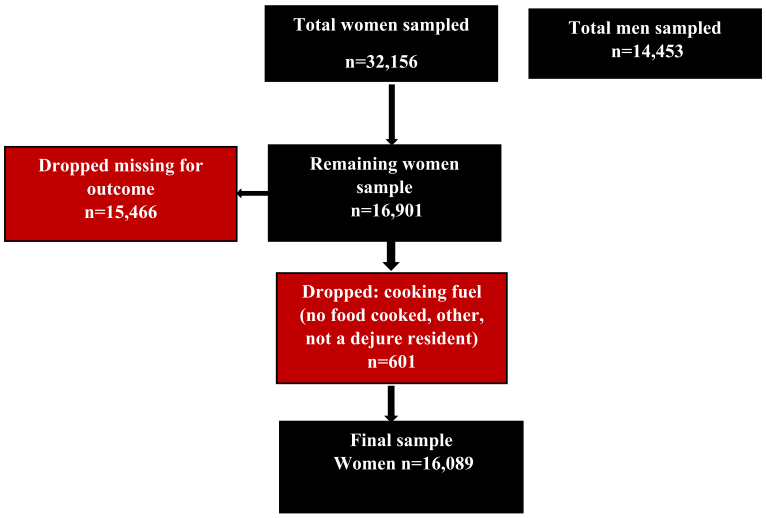

Fig. 1 Flowchart of sampling

Exposure variable

Our exposure variable was the frequency of internet use which was derived from the question, *"What is the frequency of using internet in the last month?"* The inquiry encompassed four possible responses: "not at all", "less than once a week", "at least once a week", and "almost every day". To streamline the analysis, we recoded these responses into three distinct groups: "never", "infrequent" (encompassing those who reported internet use less than once a week and at least once a week), and "often" (comprising respondents who indicated internet use almost every day).

Confounders

After conducting an extensive review of relevant literature [5–12], we identified several confounders deemed essential for our analysis. These confounders encompassed age (15–49 years for females and 15–59 years for males), residential location (categorized as rural or urban), level of education (ranging from no formal education to primary, secondary, and higher levels), marital status (including individuals who were never married, currently in a union, or previously in a union), exposure to media (classified as yes or no), wealth index (divided into categories such as poorest, poorer, middle, richer, and richest), and type of cooking fuel (i.e., clean and unclean cooking fuel).

To generate type of cooking fuel, we categorized electricity, LPG, natural gas and biogas as "clean cooking fuel" while grouping kerosine, coal lignite, charcoal, wood, straw/shrubs/grass, agricultural crop, and animal dung as "unclean cooking fuel". A similar categorization has been used in other studies [5]. Originally, the DHS has frequency of reading newspaper or magazine (not at all = 0, less than once a week = 1, at least once a week = 2, almost every day = 3); frequency of listening to the radio (not at all = 0, less than once a week = 1, at least once a week = 2, almost every day = 3); frequency of watching television (not at all = 0, less than once a week = 1, at least once a week = 2, almost every day = 3). We used the 'egen' command in STATA to generate a composite variable where those who did not listen to radio, watch TV or read newspaper/magazine at all were categorized as no media exposure, while the remaining responses were categorized as having media exposure. Women with no births were categorized as 'nulliparous' while those with one or more births were categorized as 'parous'. Employment status was categorized as 'unemployed' and 'employed'. We computed the BMI for women by dividing their weight (kg) with their height (cm). A BMI of 18.49 or less was coded 'underweight'; between 18.5 and 24.99 was coded 'Normal' while 25 and above was coded as 'overweight/obese' (see Fig. 2).

In the confounder diagram, frequency of internet use (exposure variable) is shown on the left side, influencing hypertension status (outcome of interest) on the right side, indicated by a deep black arrow, showing the primary relationship of interest. Confounding variables such as age, type of residence, level of education, marital status, media exposure, wealth status, employment status, BMI, alcohol consumption, parity, and type of cooking fuel may affect the exposure, as well as the outcome of interest, independent of the effect that the exposure has on the outcome, indicated by two faint black arrows.

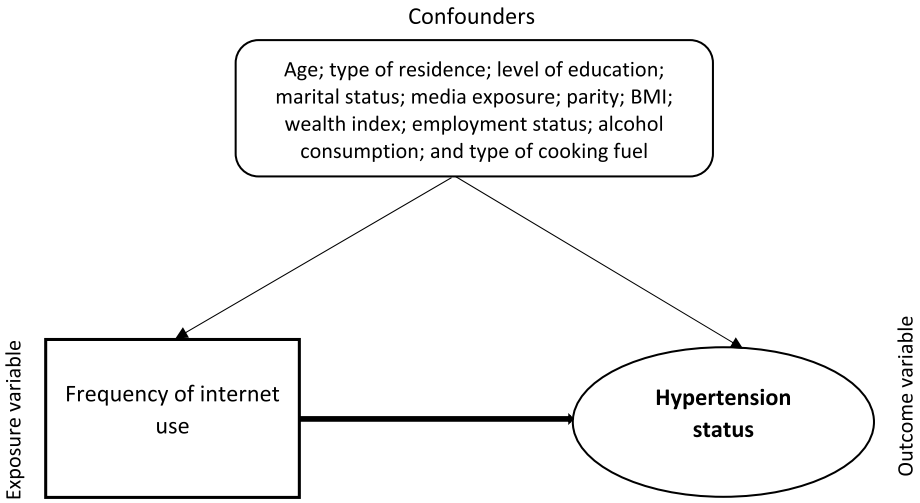

Fig. 2 Confounder diagram

Statistical analyses

The analyses were conducted in STATA version 18. A descriptive analysis of the participants' characteristics was done. Two models were computed. Model I examined the association between frequency of internet use and hypertension risk, and we computed the bivariable logistic regression. This model did not adjust for the effects of confounders. Following this, Model II, a multivariable logistic regression model was fitted to examine the association between frequency of internet use and hypertension risk, while accounting for the variations in the confounders. Findings from the multivariable logistic regression were presented in adjusted odds ratios at a 95% confidence interval. To address issues of multicollinearity, we computed the variance inflation factor which showed a Mean VIF of 5.5 and 4.9 for women and men data, respectively, indicating the absence of multicollinearity [16]. All estimates were sample-weighted to address any sampling bias due to under or over-sampling of participants from the total population. This was attained by using the individual sampling weight variable (v005 for women and mv005 for men). Due to the complex sampling design of the survey, the regression analyses were adjusted for clustering at the primary sampling unit level, stratification, and sample weight effects using the survey command (svyset) in STATA. We relied on the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline in presenting the results [17] (see Supplementary file 1).

Ethical considerations

We did not seek ethical clearance because the KDHS dataset used is publicly available. We obtained the datasets from the KDHS Program after completing the necessary registration and getting approval for their use. We followed all the ethical guidelines that pertain to using secondary datasets in research publications.

Results

Socio-demographic characteristics of the study participants

Of the 16,089 female participants, the majority had never used the internet (59.28%). Most of the participants resided in rural areas (59.18%), were currently in union (56.47%), were exposed to the media (78.24%), had secondary education level (38.86%), were employed (52.83%), did not consume alcohol (94.82%), used clean cooking fuel (67.24%), and had a normal BMI (52.28%). (see Table 1). The mean age was 29.3 years (SD = 9.6) for women and 29.9 years for men (SD = 10.9). Among the male participants, 7,023 (48.59%) often used the internet. Most of the male participants resided in rural areas (61.09%), had secondary education (40.48%), were currently in union (48.14%), were exposed to the media (85.14%), were employed (78.16%), did not consume alcohol (73.40%) and were in the richest wealth index (24.24%) (see Table 1).

Prevalence of hypertension and its distribution across frequency of internet use, by sex

Figure 3 shows the prevalence of hypertension and its distribution across frequency of internet use, by sex. Overall, the prevalence of hypertension was higher among women (1,398 [8.69%]) compared to men (504 [3.49%]). Those who reported using the internet often reported higher prevalence of hypertension (women: $n = 638$ [10.49%]; men: $n = 279$ [3.98%]).

Table 1 Participants' socio-demographic characteristics

Variables	Weighted sample Women		Weighted sample Men	
	n	%	n	%
Frequency of internet use				
Never	9537	59.28	6885	47.64
Infrequent	475	2.95	545	3.77
Often	6077	37.77	7023	48.59
Place of residence				
Urban	6567	40.82	5624	38.91
Rural	9522	59.18	8829	61.09
Age group				
15–19 years	2985	18.55	3175	21.97
20–24 years	2860	17.77	2404	16.63
25–29 years	2828	17.58	2268	15.69
30–34 years	2272	14.12	1787	12.37
35–39 years	2242	13.93	1577	10.91
40–44 years	1575	9.79	1332	9.21
45–49 years	1328	8.25	1109	7.67
50–54 years	-	-	801	5.54
Highest level of education				
No formal education	893	5.55	396	2.74
Primary	5949	36.98	5264	36.42
Secondary	6252	38.86	5850	40.48
Higher	2995	18.62	2943	20.36
Marital status				
Never married	5034	31.29	6596	45.64
Currently in union	9085	56.47	6957	48.14
Previously in union	1970	12.24	900	6.22
Exposure to media				
No	3501	21.76	2147	14.86
Yes	12,588	78.24	12,306	85.14
Wealth index				
Poorest	2532	15.74	2175	15.05
Poorer	2893	17.98	2762	19.11
Middle	2982	18.53	2932	20.29
Richer	3554	22.09	3504	24.24
Richest	4127	25.65	3079	21.31
Employment status				
Unemployed	7590	47.17	3157	21.84
Employed	8499	52.83	11,296	78.16
Alcohol consumption				
No	15,256	94.82	10,608	73.40
Yes	833	5.18	3845	26.60
Parity				
Nulliparous	4358	27.08	-	-
Parous	11,731	72.92	-	-
Type of cooking fuel				
Clean cooking fuel	5271	32.76	-	-
Unclean cooking fuel	10,818	67.24	-	-
BMI categories				
Underweight	1482	9.21	-	-
Normal	8411	52.28	-	-
Overweight/obese	6196	38.51	-	-
Total	**16,089**	**100.00**	**14,453**	**100.00**

The data for men does not ask about the type of cooking fuel used, weight and height for BMI, parity

Association between frequency of internet use and hypertension

The results from the logistic regression analysis are presented in Table 2. The findings indicate that women who infrequently used internet [COR = 1.51; 95%CI: 1.08,2.12] and those who used internet often [AOR = 1.56; 95%CI:1.39–1.76] were more likely to be hypertensive than those who did not use the internet at all. After adjusting for the confounders, women who reported often using the internet also demonstrated a significant association [AOR = 1.21; 95%CI: 1.03–1.43]. Likewise, men who often used the internet showed higher odds of being hypertensive in the unadjusted model [COR = 1.39; 95%CI: 1.16–1.68]. However, this association was no longer statistically significant after adjusting for the confounders. Increasing age, being currently in union or previously in union, and higher wealth index were significant confounders irrespective of the sex of the participants. Higher educational level, parity, engaging in alcohol consumption and being overweight/obese were only significant confounders among women.

Discussion

The internet holds a lot of positivity to health and well-being but has been evidenced to also have some adverse effects on health [13, 14]. Consequently, there is a need to understand how frequent internet use can influence physical health outcomes such as hypertension. Against this background, we examined the association between frequency of internet use and hypertension risk in Kenya. Our study suggests that less than one-tenth of women of reproductive age (8.69%) were hypertensive. This is corroborated by an earlier study that found a hypertension prevalence of 9.37% in Kenya [5]. This perspective is grounded in the WHO's [3] report that about 42% of people are unaware of their hypertension status. The result is a call for Kenya's Ministry of Health to invest in advancing blood pressure screening across all regions of the country.

It is worth noting that the prevalence of hypertension was higher among women than in men. This finding is inconsistent with studies from Kenya [18] and Mali [19] that have reported hypertension to be higher among men compared to women. There is no clear biological explanation for this high prevalence of hypertension among women than men as existing literature has shown that biologically, hormonal mechanisms including the role of estrogen is a protective factor against hypertension in younger women (15–49 years) and rather a risk factor among postmenopausal women (50 years and over) [20]. As such, there is a need for some longitudinal and clinical studies to fully comprehend and explain

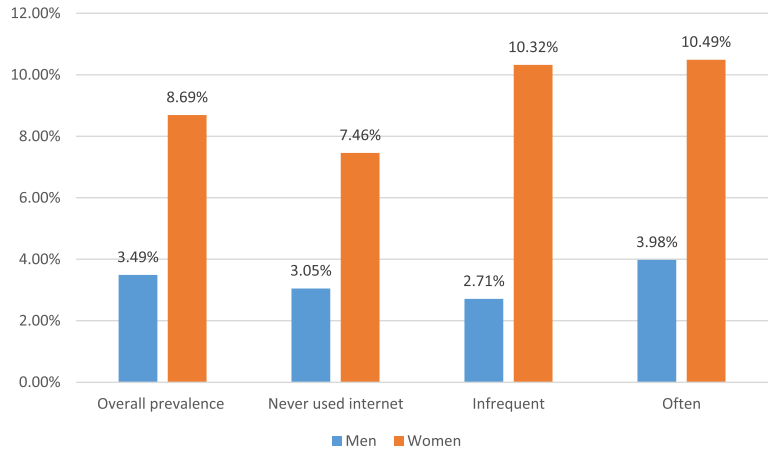

Fig. 3 Prevalence of hypertension and its distribution across frequency of internet use

the biological differences in the prevalence of hypertension between men and women. The results also suggest that internet use is more prevalent among men (52.36%) than in women (40.72%). Our findings are consistent with Dufour et al.'s study [21] that reported high use of the internet among males compared to females. A qualitative study conducted in Kenya [22] has linked the low utilization of the internet among women to slow changing traditional norms, as well as the low level of technology literacy among women compared to men.

Regarding the main hypothesis, we found a significant association between the frequency of internet use and hypertension risk among women. Our analysis revealed a substantial association, showcasing that women who frequently engage with the internet exhibit a 28% higher likelihood of developing hypertension compared to those who abstain from internet use entirely. This observation aligns with the findings of Li et al. [23], who similarly identified a significant relationship between internet usage and the risk of chronic diseases. However, while Li et al. [23] reported an inverse relationship, indicating that frequent internet usage was linked to a reduced risk of hypertension, our study presents a contrasting result, highlighting a positive association. This discrepancy prompts consideration of various factors that may contribute to divergent outcomes.

Delving deeper into the potential mechanisms underlying our observed association, we draw on the insights put forth by Matusitz and McCormick [24], who propose that habitual internet use may foster sedentary behaviors, potentially increasing the risk of obesity. This premise finds support in a substantial body of literature [8, 9, 25] emphasizing obesity as a significant risk factor for hypertension. The observed association is further validated by our findings that overweight/obese women are twice as likely to have hypertension. Sedentary lifestyles, often facilitated by prolonged internet use, have been consistently linked to reduced physical activity levels and an increased prevalence of obesity [20, 24]. Thus, while we acknowledge the statistically significant association between internet use frequency and hypertension risk, it's crucial to recognize that this relationship is likely mediated by various factors, such as sedentary behaviors and obesity, rather than being directly causal. Surprisingly, we found no significant association between frequency of internet use and hypertension risk among men. It suggests that other factors beyond internet use frequency (i.e., increasing age and higher wealth status) had a more pronounced influence on hypertension risk among men.

Strengths and limitations

The present study is arguably the first of its kind in Kenya that brings to the fore the important role of internet use as a risk factor for hypertension. This, in itself, is a strength of the study. Also, the large sample size and the sampling methodology of the KDHS ensure that the findings can be extrapolated to all women aged 15–49 years. While this study holds significant strengths, it has some limitations. It must be noted that the estimated prevalence of hypertension as seen in this study may be underestimated given that is self-reported. The study does not account for sedentarism which is a significant confounder of the association between frequency of internet use and hypertension risk. Additionally, we are unable to establish causal relationships due to the cross-sectional nature of the data. Hypertension was self-reported as such, caution should be taken when interpreting the findings. Also, the KDHS does not provide us with data to assess the type of information accessed on the internet,

Table 2 Association between frequency of internet use and hypertension

Variables	Women		Men	
	Model I Crude Odds Ratio (COR)	Model II Adjusted Odds Ratio (AOR)	Model I Crude Odds Ratio (COR)	Model II Adjusted Odds Ratio (AOR)
Frequency of internet use				
Never	Ref.	Ref.	Ref.	Ref.
Infrequent	**1.51 [1.08,2.12]***	1.32 [0.92–1.88]	0.88 [0.51,1.51]	1.03 [0.57,1.83]
Often	**1.56 [1.39,1.76]*****	**1.21 [1.03, 1.43]***	**1.39 [1.16,1.68]*****	1.15 [0.88,1.49]
Place of residence				
Urban		Ref.		Ref.
Rural		1.11 [0.94–1.31]		1.26 [0.98,1.62]
Age				
15–19 years		Ref.		Ref.
20–24 years		**1.99 [1.31,3.04]****		1.11 [0.58, 2.10]
25–29 years		**2.18 [1.39,3.43]****		1.66 [0.85, 3.24]
30–34 years		**2.55 [1.61,4.03]*****		**2.07 [1.01, 4.23]***
35–39 years		**3.13 [1.97,4.95]*****		**4.37 [2.17, 8.77]*****
40–44 years		**4.68 [2.95,7.41]*****		**4.97 [2.46, 10.03]*****
45–49 years		**5.44 [3.44,8.62]*****		**8.97 [4.48, 17.97]*****
50–54 years		-		**11.21 [5.53, 22.74]*****
Level of education				
No formal education		Ref.		Ref.
Primary		**1.84 [1.39, 2.42]*****		0.96 [0.59, 1.55]
Secondary		**1.71 [1.27, 2.30]*****		1.10 [0.66, 1.84]
Higher		**1.57 [1.13, 2.19]*****		1.65 [0.95, 2.86]
Marital status				
Never married		Ref.		Ref.
Currently in union		**1.31 [1.01, 1.70]***		**1.72 [1.13, 2.61]***
Previously in union		**1.51 [1.13, 2.01]****		**2.08 [1.25, 3.47]****
Exposure to media				
No		Ref.		Ref.
Yes		1.09 [0.92, 1.28]		0.94 [0.70, 1.27]
Wealth				
Poorest		Ref.		Ref.
Poorer		1.22 [0.96, 1.55]		1.32 [0.89, 1.94]
Middle		**1.50 [1.19, 1.91]****		**1.48 [1.01, 2.16]***
Richer		**1.47 [1.13, 1.91]****		**1.66 [1.09, 2.52]***
Richest		**1.62 [1.16, 2.25]****		**2.44 [1.53, 3.91]*****
Employment status				
Unemployed		Ref.		Ref.
Employed		1.04 [0.90, 1.19]		0.84 [0.57, 1.22]
Alcohol				
No		Ref.		Ref.
Yes		**1.40 [1.09, 1.81]****		1.19 [0.97, 1.47]
Parity				
Nulliparous		Ref.		-
Parous		**2.17 [1.52, 3.09]*****		-
Type of cooking fuel				
Clean cooking fuel		Ref.		-
Unclean cooking fuel		0.88 [0.73, 1.06]		-

Table 2 (continued)

Variables	Women		Men	
	Model I Crude Odds Ratio (COR)	Model II Adjusted Odds Ratio (AOR)	Model I Crude Odds Ratio (COR)	Model II Adjusted Odds Ratio (AOR)
BMI categories				
Underweight		Ref.		-
Normal		**1.38 [1.03, 1.84]***		-
Overweight/obese		**2.28 [1.69, 3.06]*****		-
Model fitness				
Prob > chi2	< 0.001	< 0.001	< 0.001	< 0.001
Constant	**0.07 [0.06–0.08]*****	**0.003 [0.002–0.005]*****	**0.029 [0.026–0.034]*****	**0.004 [0.002–0.007]*****
Number of observations	16,089	16,089	14,453	14,453

(-): data were not available or not applicable

Ref Reference category

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$

dietary habits, and level of physical activity. Hence, we were not able to account for these variables in our multivariable logistic regression model.

Conclusion

Our study concludes that frequent use of internet is positively associated with hypertension risk among women but not men. Policymakers may consider implementing guidelines or regulations to promote healthy internet usage habits and encourage breaks or limits on screen time, especially for individuals at risk of hypertension (i.e., older women of reproductive age, women with higher education, married and previously married women, those in affluent households, parous women, those who consume alcohol and those overweight/obese). Healthcare providers should educate patients about the potential health consequences of prolonged internet usage and incorporate discussions about screen time management into routine clinical encounters.

Abbreviations

AOR	Adjusted Odds Ratio
CI	Confidence Interval
KDHS	Kenya Demographic and Health Survey
KNBS	Kenya National Bureau of Statistics
K-HMSF	Kenya Household Master Sample Frame
WHO	World Health Organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s44247-024-00104-w.

Supplementary Material 1.

Acknowledgements

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Authors' contributions

JO conceived and designed the study. JO and CA contributed to the design of the analysis. JO performed the formal analysis and provided methodological insights. JO, CA, CO and KSD drafted the initial manuscript. KSD supervised the research. All authors read, revised and approved the final manuscript for submission. JO had the responsibility of submitting the manuscript.

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Availability of data and materials

The datasets generated and/or analysed during the current study are available in the Measure DHS repository: https://dhsprogram.com/methodology/survey/survey-display-566.cfm.

Declarations

Ethics approval and consent to participate

We did not need to seek ethical clearance because the KDHS dataset used is publicly available. We obtained the datasets from the KDHS Program after completing the necessary registration and getting approval for their use. We followed all the ethical guidelines that pertain to using secondary datasets in research publications. Details of KDHS data and ethical standards followed can be found here: http://goo.gl/ny8T6X.

Consent for publication

None declared.

Competing interests

The authors declare no competing interests.

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