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## Prevalence of and factors associated with tobacco smoking in The Gambia: A national cross-sectional study

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## Prevalence of and factors associated with tobacco smoking in The Gambia: A national cross-sectional study

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4

## 5 **Abstract**

6  
7 **Objectives** To examine the prevalence and risk factors associated with tobacco smoking in  
8 The Gambia.  
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11 **Design** A nationwide cross-sectional study  
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13  
14 **Setting** The Gambia  
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16 **Participants** The participants of this study was both women and men aged between 15 and  
17 49 years old. We included 16,066 men and women in our final analysis.  
18

19  
20 **Data Analysis** We analysed from The Gambia Demographic and Health Survey (DHS), 2019-  
21 20. DHS collected data nationally stratified by local government areas and rural-urban areas.  
22  
23 The outcome variable was the prevalence of tobacco smoking. Descriptive analysis,  
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25 prevalence and logistic regression methods were used to analyse these data to identify the  
26  
27 potential determinants of tobacco smoking.  
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33 **Results** The prevalence of current tobacco smoking was 9.92% in The Gambia in 2019-20,  
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35 whereas, 81% of consumers smoked tobacco daily. Men (19.3%) smoked tobacco much higher  
36  
37 than women (0.65%). People aged 40-49 years old, lower educated, and manual workers were  
38  
39 the most prevalent group of smoking in The Gambia.  
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43 Men were 33 times more likely to smoke tobacco than women. The chance of consuming  
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45 smoked tobacco increased with the increase of age. The strength of association was the  
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47 highest among primary educated individuals (adjusted odds ratio 5.35, 95% CI 3.35-8.54).  
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51 Manual workers and people from the poorest households were the risk groups of smoking in  
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53 The Gambia. However, place of residency and region was insignificantly associated with  
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55 smoking in The Gambia.  
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3 **Conclusions** Men, older people, manual workers, individuals with lower education, and lower  
4  
5 wealth status were the vulnerable groups to tobacco smoking in The Gambia. Government  
6  
7 should intensify awareness programs on the harmful effects of smoking, right cessation  
8  
9 support services among tobacco smoking users prioritizing these risk groups.  
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11

### 12 13 **Strengths and limitations of this study**

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15  
16 1. This study analysed data drew from nationally representative surveys to investigate  
17  
18 the prevalence of and risk factors associated with tobacco smoking in The Gambia.
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20  
21 2. We included all relevant socio-demographic predictor variables and ran a series of  
22  
23 models applying a complex survey design, controlling for potential confounding  
24  
25 factors and multicollinearity to reach a final parsimonious model.
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28 3. The cross-sectional nature of the data in this study does not reveal a causal  
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30  
31 association.  
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### 36 37 **Introduction**

38  
39 Tobacco use is the second-ranked leading risk factor of mortality, accounting for 8.71 million  
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41 fatalities worldwide (15.4 percent of total deaths) in 2019.<sup>1</sup> It is attributed to about 100  
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43 million deaths in the twentieth century, the vast majority of which occurred in developed  
44  
45 countries.<sup>2,3</sup> If the current trends of smoking persist, tobacco will kill around one billion people  
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47 this century, with the bulk of deaths occurring in low- and middle-income countries.<sup>2-5</sup> Along  
48  
49 with the health consequences, tobacco smoking caused significant economic costs: yearly it  
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51 exceeds \$1 trillion.<sup>6</sup>  
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57 The burden of tobacco use is increasing in low-income and middle-income countries. In 2019,  
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59 around 77.5% (around 6 of 7.69 million) of total tobacco smoking-related death occurred in  
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3 low-income and middle-income countries. The number of smokers has also increased by 75%  
4  
5 in Sub-Saharan Africa since 1990.<sup>7</sup> The prevalence of all forms of tobacco was 16% in The  
6  
7 Gambia, compared with only 8% in neighbouring Senegal in 2016.<sup>8</sup> Every day, 105000 adults  
8  
9 use tobacco in The Gambia. Around 98.9% of consumers used tobacco smoking in The  
10  
11 Gambia. Tobacco use caused 6.4% of deaths among men and 2.5% of death among women  
12  
13 in The Gambia.<sup>9</sup> Tobacco smoking cost around five million USD in The Gambia economy every  
14  
15 year.<sup>6</sup> Tobacco smoking increases the chance of non-communicable diseases such as  
16  
17 cardiovascular diseases, cancer, chronic respiratory diseases.<sup>10,11</sup> These three non-  
18  
19 communicable diseases cause 20% of all deaths in The Gambia.<sup>8</sup> World Health Organization  
20  
21 set a target of a 25% decrease in deaths from cardiovascular diseases, diabetes, cancer, and  
22  
23 chronic respiratory illnesses among people aged 30-70 from 2010 to 2025.<sup>12</sup> To reach the  
24  
25 global target of non-communicable diseases in The Gambia, reducing tobacco smoking can be  
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27 the best single preventive and cost-effective strategy.  
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36 A study conducted among The Gambian men reported 31.4% of men aged 25-64 years old  
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38 smoked tobacco in 2010.<sup>13</sup> Another study carried out among students aged 12-20 years old  
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40 reported 16.7% of students consumed tobacco in 2016 in The Gambia.<sup>14</sup> Nevertheless, the  
41  
42 prevalence of and factors associated with tobacco smoking based on up-to-date data among  
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44 both men and women and nationally representative data was not available in The Gambia.  
45  
46 Up-to-date knowledge of the smoking prevalence and risk factors can inform policymakers in  
47  
48 The Gambia to design policies and interventions to accelerate smoking cessation. Therefore,  
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50 to address this knowledge gap, we aimed to examine the prevalence of tobacco smoking  
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52 among different socio-demographic groups' levels and factors associated with tobacco  
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54 smoking in The Gambia using the Demographic and Health Survey 2019-20 data.  
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## Methods

### Study Design and Data Source

We analysed data from The Gambia Demographic and Health Survey (DHS), 2019-20. DHS is a nationally representative data stratified by local government areas (LGAs) and rural-urban areas. The sample was two stages cluster in design. The sampling unit was the enumeration area (EA) that was selected based on the 2013 Gambia Population and Housing Census conducted by the Gambia Bureau of Statistics. In the first stage of sampling, 281 EAs were obtained from the sample frame. The sample had 14 strata, 12 strata from six LGAs (urban and rural), and two in municipalities (Banjul and Kanifing, no rural area in municipalities). In the second step of survey sampling, systematic sampling was used to choose a fixed number of 25 households from each EA. Trained data collectors interviewed only in pre-selected households. Sampling selection is illustrated in figure 1. The detailed sampling procedure is given in the DHS final report of The Gambia 2019-20.<sup>15</sup> In this study, the STROBE statement (Strengthening the Reporting of Observational Studies in Epidemiology) was followed.<sup>16</sup>

**Figure 1 Flow chart of selection of sample**

### Study Population

Women aged 15-49 years and men aged 15-59 years were interviewed using separate questionnaires during data collection in The Gambian DHS. However, we analysed data of both participants aged 15-49 years to get a pooled estimate.



### Outcome variables

The outcome was the prevalence of current tobacco smoking in this study. Respondents were asked, "Do you currently use smokeless tobacco every day, some days, or not at all?" The response was taken as "every day", "some days" or "not at all". We made the response dichotomous by coding "every day" and "some days" responses as "Yes", and "not at all" as "No". Smoked tobacco included manufacture, hand-rolled cigarettes, e-cigarettes, pipe full of tobacco, cigars and cheroots tobacco forms.

### Independent variables

We identified tobacco smoking variables based on prior research on tobacco usage in the Sub-Saharan African region.<sup>17-19</sup> The independent variables were age, sex, union with men/women, ethnicity, religion, parity, place of residence, region (LGA), education level, occupation, wealth status, and access to information (television, radio, and newspapers). Age was grouped as 15-19, 20-29, 30-39, and 40-49. Both men and women were included in this study. Union status of respondents who categorized as never union and currently/formally union. Never union defined as respondents who were unmarried and never lived together with men/women in her/his life. Ethnic groups were grouped into five categories (non-Gambian, Mandinka/Jahanka, Wollof, Fula/Tukulur/Lorobo, and others).

The religion of participants was categorized as Islam and others. The parity of respondents was grouped into 3 categories (respondents with no child, one child, and one+ children). Rural and urban areas were the place of residence. Regions were six local government areas and two municipalities. Education level was grouped into four categories, no education (0 schooling year), primary (1-5 schooling years), secondary (6-12 schooling years) and higher (12+ schooling years). Occupation of respondents was divided as not working,

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3 professional/technical/managerial/clerical/sales/services/armed forces/other, agriculture,  
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5 and skilled/unskilled manual categories. The wealth status of households was grouped into  
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7 five quintiles (poorest, poorer, middle, richer and richest). Implementing partners of the DHS  
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9 program classified wealth status depending on the household asset and dwelling  
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11 characteristics. Information access, newspapers/magazines, television, and radio were all  
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13 divided into three categories (not use at all, less than once a week, at least once a week).  
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### 17 18 **Statistical Analysis**

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20 We performed descriptive statistics to assess the distribution of participants and presented  
21  
22 them as frequencies (n) and proportions (%). The prevalence of tobacco smoking was  
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24 estimated among the independent variables. The prevalence was reported as a percentage  
25  
26 with the 95% confidence interval (CI). To examine the relationship between variables and  
27  
28 tobacco smoking, we used the Chi-square test. We also conducted bivariate and multivariate  
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30 logistic regression to investigate factors of tobacco smoking in The Gambia, presented as  
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32 unadjusted odds ratio (UOR), and adjusted odds ratio (AOR) with 95% CIs, and *p*-value. All of  
33  
34 the analyses were two-tailed. Statistical significance was defined as a *p*-value of less than 0.05.  
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37 Multi-collinearity of independent and exposure variables was checked. The prevalence,  
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39 bivariate, multivariate regression model took into account the complicated sample design and  
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41 sampling weight (weight was adjusted for women and men). Missing values were excluded  
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43 before conducting the final analysis (Figure 1). The statistical program R 4.0 was used to  
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45 analyse the data.  
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### 51 52 **Ethical Consideration**

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54 We analysed the publicly available DHS dataset with the approval of the DHS program. The  
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56 DHS survey followed standardized data collection procedures. They received permission from  
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58 the relevant authority's ethical review committees during conducting the primary study.  
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3 According to the DHS, informed consent was taken from respondents/ households who  
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5 enrolled in the survey.  
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9 **Patient and Public Involvement** No patient involved  
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## 11 12 13 14 15 **Results**

### 16 17 **Socio-demographic Characteristics**

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20 Of the 16,066 participants, 73.9% were women. A total of 35.2% of participants' age was 20-  
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22 29 years and 65.1% were currently or formally in a union with men or women. The majority  
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24 of participants were from the Islam (97.5%) religion, while Mandinka/Jahanka (30.7%) group  
25  
26 were the majority in ethnic background. Almost half of the participants had more than one  
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28 child. About 56.1% of respondents were living in rural areas and 1 in 5 participants was from  
29  
30 the Brikama region (local government area). In socio-economic position, only 6% (970) of the  
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32 participants had a higher level of education, and 40.2% of them were involved in  
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34 professional/technical/managerial/clerical/sales/services/armed forces works, while 27.4%  
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36 of respondents were from poorest households (Table 1).  
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**Table 1 Characteristics of participants and prevalence of tobacco smoking among The Gambians<sup>a</sup>**

Factor	Total	Smoking tobacco		
		N (%) <sup>b</sup>	Yes n (%) <sup>b</sup>	No n (%) <sup>b</sup>
<b>Participants</b>	16066 (100)	869 (100)	15197 (100)	9.9 (8.9-11.0)
<b>Age</b>				<0.001
15-19	3766 (23.4)	75 ( 8.6)	3691 (24.3)	3.3 (2.3-4.5)
20-29	5648 (35.2)	269 (31.0)	5379 (35.4)	8.9 (7.6-10.3)
30-39	4136 (25.7)	297 (34.2)	3839 (25.3)	13.6 (11.6-15.6)
40-49	2516 (15.7)	228 (26.2)	2288 (15.1)	16.7 (14.2-19.4)
<b>Sex</b>				<0.001
Women	11865 (73.9)	58 ( 6.7)	11807 (77.7)	0.6 (0.4-0.8)
Men	4201 (27.1)	811 (93.3)	3390 (22.3)	19.3 (17.4-21.3)
<b>Union</b>				0.421
Never Union	5603 (34.9)	357 (42.1)	5246 (34.5)	9.6 (8.3-11)
Currently or formally union	10463 (65.1)	512 (58.9)	9951 (65.5)	10.2 (9-11.5)
<b>Religion</b>				0.437
Islam	15671 (97.5)	849 (97.7)	14822 (97.5)	10 (9-11)
Others	395 (2.5)	20 ( 2.3)	375 ( 2.5)	8 (4.3-13.4)
<b>Ethnic group</b>				0.014
Non-Gambian	1639 (10.2)	70 ( 8.1)	1569 (10.3)	7 (5.1-9.2)
Mandinka/Jahanka	4932 (30.7)	293 (33.7)	4639 (30.5)	11.4 (9.7-13.3)
Wolof	2294 (14.3)	104 (12.0)	2190 (14.4)	8.5 (6.6-10.8)
Fula/Tukulur/Lorobo	3528 (22.0)	194 (22.3)	3334 (21.9)	8.7 (7-10.7)
Others	3673 (22.9)	208 (23.9)	3465 (22.8)	10.6 (8.7-12.7)
<b>Parity</b>				0.137
No child	6584 (41.0)	391 (45.0)	6193 (40.8)	9.5 (8.2-10.8)
One child	1880 (11.7)	106 (12.2)	1774 (11.7)	12.1 (9.7-14.8)
One+ children	7602 (47.3)	372 (42.8)	7230 (47.6)	9.9 (8.6-11.3)
<b>Place of residence</b>				0.0582
Rural	7060 (43.9)	335 (38.6)	6725 (44.3)	8.6 (7.3-9.9)
Urban	9006 (56.1)	534 (61.4)	8472 (55.7)	10.3 (9.1-11.7)
<b>Region</b>				0.066
Mansakonko	1361 (8.5)	59 ( 6.8)	1302 ( 8.6)	8.4 (6.2-11)
Banjul	1414 (8.8)	102 (11.7)	1312 ( 8.6)	12.1 (10.4-13.9)
Kanifing	2246 (14.0)	156 (18.0)	2090 (13.8)	12.1 (10.2-14.2)
Brikama	3239 (20.2)	177 (20.4)	3062 (20.1)	9.6 (7.8-11.5)
Kerewan	1857 (11.6)	87 (10.0)	1770 (11.6)	8.3 (6.1-10.9)
Kuntaur	1693 (10.5)	81 ( 9.3)	1612 (10.6)	8.9 (6.4-11.9)
Janjanbureh	1715 (10.7)	91 (10.5)	1624 (10.7)	8.8 (7.3-10.5)
Basse	2541 (15.8)	116 (13.3)	2425 (16.0)	9 (7-11.4)
<b>Education</b>				<0.001
No education	6214 (38.7)	241 (27.7)	5973 (39.3)	7.5 (6.2-8.9)
Primary	2720 (16.9)	190 (21.9)	2530 (16.6)	14.2 (11.8-16.8)
Secondary	6162 (38.4)	389 (44.8)	5773 (38.0)	10.7 (9.2-12.3)
Higher	970 (6.0)	49 ( 5.6)	921 ( 6.1)	5.7 (4-7.9)
<b>Wealth status</b>				0.9198
Poorest	4402 (27.4)	231 (26.6)	4171 (27.4)	10.3 (8.7-12.1)
Poorer	3116 (19.4)	172 (19.8)	2944 (19.4)	10.6 (8.5-12.9)
Middle	3104 (19.3)	165 (19.0)	2939 (19.3)	9.6 (7.6-11.9)
Richer	2719 (16.9)	133 (15.3)	2586 (17.0)	9.8 (7.8-12.2)
Richest	2725 (17.0)	168 (19.3)	2557 (16.8)	9.5 (7.6-11.6)

Factor	Total	Smoking tobacco		
	N (%) <sup>b</sup>	Yes n (%) <sup>b</sup>	No n (%) <sup>b</sup>	P-value and prevalence, % (95% CI) <sup>c</sup>
<b>Occupation</b>				<0.001
Not working	4869 (30.3)	52 ( 6.0)	4817 (31.7)	1.9 (1.3-2.8)
Professional/technical/managerial/clerical/sales/services/armed forces/other	6454 (40.2)	526 (60.5)	5928 (39.0)	12.9 (11.5-14.4)
Agricultural-self employed	3651 (22.7)	114 (13.1)	3537 (23.3)	7.1 (5.2-9.4)
Skilled/unskilled manual	1092 (6.8)	177 (20.4)	915 ( 6.0)	21 (17.3-25)
<b>Access to information</b>				
<b>Reading newspaper/magazine</b>				<0.001
Not at all	13853 (86.2)	677 (77.9)	13176 (86.7)	9 (8-10)
Less than once a week	1586 (9.9)	118 (13.6)	1468 ( 9.7)	13.5 (10.7-16.5)
At least once a week	627 (3.9)	74 ( 8.5)	553 ( 3.6)	13.9 (9.6-18.9)
<b>Watching television</b>				0.0843
Not at all	3439 (21.4)	142 (16.3)	3297 (21.7)	8.1 (6.3-10.2)
Less than once a week	4106 (25.6)	211 (24.3)	3895 (25.6)	9.2 (7.6-11.1)
At least once a week	8521 (53.0)	516 (59.4)	8005 (52.7)	10.6 (9.4-11.9)
<b>Listening radio</b>				<0.001
Not at all	3507 (21.8)	82 ( 9.4)	3425 (22.5)	4.9 (3.6-6.4)
Less than once a week	5186 (32.3)	169 (19.4)	5017 (33.0)	5.9 (4.6-7.3)
At least once a week	7373 (45.9)	618 (71.1)	6755 (44.4)	14 (12.5-15.7)
<sup>a</sup> Data are from Standard Demographic and Health Survey (DHS) conducted in The Gambia 2019-20. The age of respondents was 15-49 years old. <sup>b</sup> Column percentages. Data are not weighted in this column. <sup>c</sup> Data are weighted in this column. N- number of respondents CI- confidence interval Union- respondent live/lived together with men/women				

## Prevalence of tobacco smoking

The prevalence of any tobacco use among all adults aged 15-49 years was 9.94%, while 9.92% and 0.08% of adults used smoked and smokeless tobacco (SLT) respectively in The Gambia in 2019-20. However, 81% of users smoked tobacco daily in The Gambia (data not shown). The prevalence of any tobacco consumption among men was 30 times higher than that among women (19.3% vs 0.65%). Smoking prevalence among men was 19.26% (95% CI 17.35 - 21.27) and among women was 0.60% (95% CI 0.41 - 0.85). Regarding smoking forms of tobacco, cigarettes were the popular form of tobacco use among both men and women in The Gambia (Figure 2).

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3 **Figure 2 Prevalence of tobacco use in The Gambia in 2019-20** Prevalence showed in percentage  
4 with a 95% confidence interval (CI) value. The black-coloured error bar shows 95% CI. The left bar graph shows  
5 the tobacco prevalence of all adults aged 15-49 years, the middle bar graph shows the tobacco prevalence of  
6 men, and the right bar graph shows the tobacco prevalence of women. SLT- smokeless tobacco.  
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16 The prevalence of tobacco smoking increased with the increase of age among the Gambians  
17 (3.3% in 15-19 years to 16.7% in 40-49 years' group). Non-Gambian (7%, 95% CI 5.1-9.2%) had  
18 lower smoking prevalence than other ethnic groups, while individuals with one child (12.1%)  
19 were the most prevalent class of parity. The prevalence of smoking was the lowest among the  
20 higher education category (5.7%) among all education groups. Smoking prevalence decreased  
21 among higher wealthy status. In occupation, not working groups had a smoking prevalence  
22 <2%, while the population involved in manual work had a smoking prevalence >20%. In access  
23 to information, smoking prevalence increased with the increased access to  
24 newspaper/magazines, television and radio (Table 1).  
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### 38 **Factors associated with Smoking**

39 Men (UOR 39.33, AOR 32.9;  $p < 0.001$ ) were more likely to smoke tobacco compared with  
40 women in The Gambia (Table 2). Age was associated with smoking in The Gambia. The  
41 strength of association increased with the increase of age (AOR 3.41 in 20-29, AOR 6.50 in 30-  
42 39, and AOR 9.08 in 40-49; reference group 15-19;  $p < 0.001$ ). Those who attained primary  
43 education level had a higher odds ratio (AOR 5.35, 95% CI 3.35-8.54) than participants with  
44 secondary education (AOR 3.26, 95% CI 2.17-4.9) and no education (AOR 2.73, 95% CI 1.68-  
45 4.44) had lower odds of self-reporting tobacco smoking compared with the individuals with  
46 higher education ( $\geq 12$  schooling year).  
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The occupation was referenced to not working group, and all other occupations had a significant positive association with tobacco smoking in both bivariate and multivariate regression. In wealth status, poorest (AOR 1.86, 95% CI 1.16-2.98,  $P=0.01$ ) and poorer group (AOR 1.48, 95% CI 1.02-2.14;  $p=0.042$ ) had increased odds ratio of reporting smoking compared with richest households. Mandinka/Jahanka ethnic group smoked 142% more likely tobacco ( $p < 0.001$ ) compared with the non-Gambian category. Individuals who had one child had an increased odds ratio (AOR 1.88, 95% CI 1.27-2.77) where the reference group was the population with more than one child. In Gambia, individuals' union status with men or women, religion, place of residence, region, and access to the information (newspaper/magazine, television, radio) had an insignificant association with tobacco smoking.

**Table 2 Logistic regression to identify factors associated with tobacco smoking in The Gambia<sup>a</sup>**

Factors	Bivariate regression		Multivariate regression	
	Unadjusted OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
<b>Age</b>				
15-19	1 (ref)		1 (ref)	
20-29	2.86 (1.99-4.11)	<0.001	3.41 (2.24-5.19)	< 0.001
30-39	4.61 (3.11-6.84)	<0.001	6.5 (3.66-11.54)	< 0.001
40-49	5.89 (3.98-8.71)	<0.001	9.08 (5.08-16.22)	< 0.001
<b>Sex</b>				
Women	1 (ref)		1 (ref)	
Men	39.33 (27.08-57.13)	<0.001	32.9 (21.94-49.32)	< 0.001
<b>Union</b>				
Currently or formally union	1 (ref)		1 (ref)	
Never union	0.93 (0.77-1.11)	0.420	1.14 (0.78-1.68)	0.497
<b>Religion</b>				
Islam	1.27 (0.7-2.32)	0.44	1.19 (0.58-2.44)	0.645
Others	1 (ref)		1 (ref)	
<b>Ethnic group</b>				
Non-Gambian	1 (ref)		1 (ref)	
Mandinka/Jahanka	1.73 (1.21-2.46)	0.003	2.42 (1.58-3.72)	< 0.001
Wolof	1.25 (0.84-1.85)	0.269	1.46 (0.9-2.37)	0.124
Fula/Tukulur/Lorobo	1.28 (0.86-1.88)	0.223	1.47 (0.93-2.32)	0.101
Others	1.59 (1.07-2.36)	0.023	1.96 (1.22-3.13)	0.006
<b>Parity</b>				
No child	0.95 (0.79-1.16)	0.64	1.29 (0.86-1.93)	0.214
One child	1.25 (0.97-1.61)	0.08	1.88 (1.27-2.77)	0.001
One+ children	1 (ref)		1 (ref)	

Factors	Bivariate regression		Multivariate regression	
	Unadjusted OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
<b>Place of residence</b>				
Rural	1 (ref)		1 (ref)	
Urban	1.23 (0.99-1.52)	0.059	1.45 (0.98-2.13)	0.067
<b>Region</b>				
Mansakonko	1 (ref)		1 (ref)	
Banjul	1.5 (1.07-2.11)	0.020	1.39 (0.87-2.23)	0.167
Kanifing	1.5 (1.06-2.13)	0.025	1.48 (0.93-2.36)	0.102
Brikama	1.15 (0.8-1.67)	0.442	1.08 (0.69-1.71)	0.729
Kerewan	0.99 (0.64-1.51)	0.947	1.07 (0.66-1.73)	0.788
Kuntaur	1.07 (0.69-1.65)	0.766	1.22 (0.76-1.96)	0.422
Janjanbureh	1.06 (0.74-1.51)	0.758	1.19 (0.78-1.82)	0.429
Basse	1.09 (0.73-1.62)	0.679	1.09 (0.7-1.7)	0.687
<b>Education</b>				
No education	1.33 (0.89-1.99)	0.17	2.73 (1.68-4.44)	< 0.001
Primary	2.73 (1.85-4.03)	<0.001	5.35 (3.35-8.54)	< 0.001
Secondary	1.98 (1.38-2.82)	<0.001	3.26 (2.17-4.9)	< 0.001
Higher	1 (ref)		1 (ref)	
<b>Wealth status</b>				
Poorest	1.1 (0.82-1.47)	0.53	1.86 (1.16-2.98)	0.010
Poorer	1.13 (0.82-1.56)	0.46	1.48 (1.02-2.14)	0.042
Middle	1.01 (0.72-1.42)	0.95	0.98 (0.66-1.47)	0.940
Richer	1.04 (0.75-1.44)	0.81	1 (0.7-1.42)	0.976
Richest	1 (ref)		1 (ref)	
<b>Occupation</b>				
Not working	1 (ref)		1 (ref)	
Professional/technical/managerial/clerical/sales/services/armed forces/other	7.53 (4.99-11.38)	<0.001	2.11 (1.32-3.36)	0.002
Agricultural/self employed	3.9 (2.38-6.39)	<0.001	2.01 (1.2-3.37)	0.008
Skilled/unskilled manual	13.47 (8.62-21.06)	<0.001	2.73 (1.67-4.48)	< 0.001
<b>Access to information</b>				
<b>Reading newspaper/magazine</b>				
Not at all	1 (ref)		1 (ref)	
Less than once a week	1.57 (1.19-2.08)	0.002	1.34 (0.98-1.84)	0.071
At least once a week	1.63 (1.1-2.42)	0.016	1.01 (0.67-1.52)	0.958
<b>Watching television</b>				
Not at all	1 (ref)		1 (ref)	
Less than once a week	1.15 (0.86-1.53)	0.337	0.85 (0.59-1.23)	0.383
At least once a week	1.34 (1.02-1.76)	0.036	0.86 (0.62-1.19)	0.372
<b>Listening radio</b>				
Not at all	1 (ref)		1 (ref)	
Less than once a week	1.21 (0.83-1.77)	0.32	0.97 (0.66-1.42)	0.862
At least once a week	3.17 (2.34-4.29)	<0.001	1.28 (0.95-1.73)	0.106

<sup>a</sup>Data are from Standard Demographic and Health Survey (DHS) conducted in The Gambia 2019-20. The age of respondents was 15-49 years old. Data are weighted in this column.  
OR- odds ratio  
CI- confidence interval  
Ref- reference group  
Union- respondent live/lived together with men/women



## Discussion

Despite two decades of efforts to control tobacco smoking in The Gambia,<sup>20</sup> this country has a high prevalence of tobacco use among adults. Moreover, one in ten adults smoked tobacco in 2019-20, while 81% of users smoked tobacco daily. Chisha et al. (2020) also found most smokers in The Gambia were daily users.<sup>21</sup> Tobacco smoking among men was significantly higher than women in The Gambia in 2019. Only a 3% reduction in smoking prevalence among men was observed since 2013.<sup>22</sup> Smoking prevalence was significantly higher among older people. We found people involved in manual work were the most prevalent group of smoking (21%). Overall smoking prevalence in The Gambia was higher than the average prevalence of tobacco smoking in the Western Sub-Saharan Africa region and lower than Guinea, Mauritania, and Sierra Leone.<sup>7</sup>

Sex, age, education level, occupation, and wealth of households were significantly associated with tobacco smoking in The Gambia. We found that the prevalence of tobacco smoking is comparatively higher among men than women. This might be the result of the unacceptability of smoking practices towards women in The Gambia. Older people smoked tobacco more likely than younger people. This finding is in line with previous tobacco studies conducted in Sub-Saharan Africa.<sup>19,23-25</sup> We can explain this by the age effects of tobacco smoking. Individuals progressively initiate tobacco smoking as they grow older, and the rate of smoking cessation is lower than the smoking initiation rate.

People with a lower level of education smoked tobacco more than people with higher education in The Gambia. This finding is in line with previous studies performed in Sub-Saharan Africa and Asia.<sup>18,23</sup> The protective effect of households' wealth was coherent with the finding in other Sub-Saharan African countries.<sup>17,19</sup> People who have lower education were less aware of their health risks.<sup>26</sup> The tobacco epidemic initiates among higher

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3 socioeconomic groups in developed countries and then extended to poorer and less educated  
4 individuals,<sup>27</sup> while in developing countries the less educated may have taken up smoking  
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6 owing to a lack of information and awareness about the harmful consequences of smoking.<sup>26</sup>  
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10 In addition to this, poor people have less control to deal with the management of stress from  
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12 their economic situations.<sup>28</sup>  
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15 People involved in any work had a positive association with tobacco smoking compared to  
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17 those not working. Manual workers had the strongest association with smoking in The  
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19 Gambia. A similar finding was observed in Sub-Saharan African studies<sup>23,25</sup> and the United  
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21 States of America.<sup>29</sup> Working individuals may experience work stress. At the same time,  
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23 manual work represents the social status, education, and income of people, all of which have  
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25 an impact on healthy habits and seeking medical help.<sup>30</sup>  
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### 32 **Public Health Implications**

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34 The Gambia implemented diverse tobacco control initiatives and ratified the WHO  
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36 Framework Convention on Tobacco Control,<sup>20,31</sup> however, only 3% of smoking prevalence was  
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38 reduced among men since 2013.<sup>15,22</sup> The reduction rate of smoking prevalence can be  
39  
40 accelerated by increasing smoking cessation and reducing the initiation rate of smoking  
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42 through the right support in The Gambia. First, the government should improve monitoring  
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44 of current tobacco use and prevention policies and revise based on evidence. Advertising and  
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46 promotion of tobacco are banned in The Gambia. However, we found that access to media  
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48 did not act as a protective factor against smoking. We also found poor, manual workers and  
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50 lower educated people smoked more likely in The Gambia. Awareness about the dangers of  
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52 tobacco smoking can help to reduce early initiation of smoking and increase smoking  
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54 cessation. Anti-tobacco campaigns should include television, radio and newspapers to spread  
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3 anti-smoking messages in The Gambia. Price incentive initiatives can be effective in The  
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6 Gambia. Currently, the excise tax rate of tobacco is 33% in The Gambia, however, WHO has  
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8 recommended 70% of taxation of retail tobacco price.<sup>32</sup> It is documented increasing taxes  
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10 reduced tobacco smoking in The Gambia.<sup>33</sup> Increment revenue from tax can be allocated to  
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12 implement smoking cessation support from primary care to tertiary hospitals, and the  
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14 community, and initiate free nicotine replacement therapy and quitline which are still absent  
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17 in The Gambia.<sup>31</sup>

### 23 **Strengths and limitations**

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26 The major strength of this study is that it analysed data from the nationally representative  
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28 survey which included both men and women with a high response rate. It provided enough  
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30 power to investigate the prevalence of and factors linked to tobacco smoking. Therefore, the  
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32 findings are generalizable. In all analyses in this study, sample weight, cluster effect, and  
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34 complex sampling design were employed and generated with 95% CI with point estimates. It  
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36 improves the precision of the results in this study. However, this study had a few limitations.  
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39 A major limitation is that we drew the data from a cross-sectional study. The smoking habit  
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41 of respondents could not be followed over a period due to the study design. Causal inferences  
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43 could not be drawn. Another drawback is that the sample included men and women aged 15  
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45 to 49 years, which does not reflect the whole population of The Gambia. The findings might  
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47 be underestimated as we found tobacco smoking increases with age, we can hypothesize that  
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49 people aged >49 years smoked more in The Gambia who were not included in this study.  
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52 Furthermore, because this self-reporting data was gathered based on events, there is a risk  
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54 of recall bias and bias owing to social stigma and norms.  
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## Conclusions

The key findings from this paper are the prevalence of tobacco smoking and its determinants in The Gambia. Men, elderly people, manual workers, those with lesser education, and people with lower wealth status were the most vulnerable to tobacco smoking. In addition to monitoring current tobacco use, policies, and interventions, the government should launch a public awareness campaign on the adverse effect of smoking and appropriate cessation support services focusing on those risk groups irrespective of their health status.

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**Authors' contributions** M Shariful Islam conceptualized the study. MG Rabbani and H Harun contributed to the study design. M Ferdous and NS Mahfuza, E Silenga conducted the literature search. M Shariful Islam analysed the data. M Shariful Islam, MG Rabbani, D Konka and H Harun prepared the original draft. AN Zafar Ullah supervised the team. All authors have been revised the draft of the manuscript and approved the final version.

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**Competing interests** We do not have any conflict of interest to disclose.

**Patient consent of publication** Not required

**Ethics approval** We do not need ethical approval to conduct this secondary data analysis study. To carry out data collection from the sample, implementing partners of the DHS program has taken ethical approval from responsible authority at The Gambia. More information about DHS data and ethical standards can be found at: <http://goo.gl/ny8T6X>.

**Data sharing statement** DHS data is available publicly. To use data, prior request explaining reason is required at <https://dhsprogram.com/data/available-datasets.cfm>

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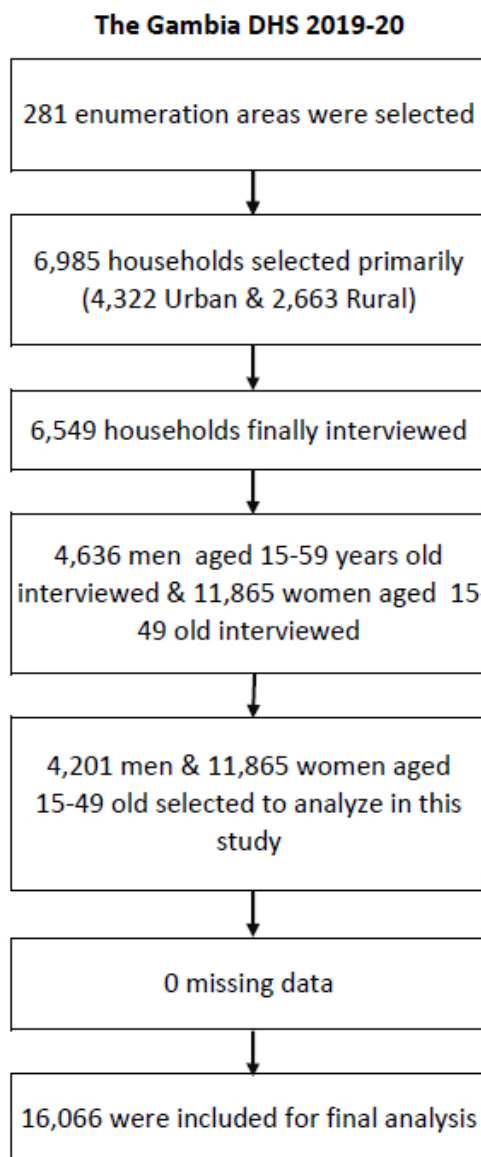


Figure 1 Flow chart of selection of sample

174x379mm (47 x 47 DPI)



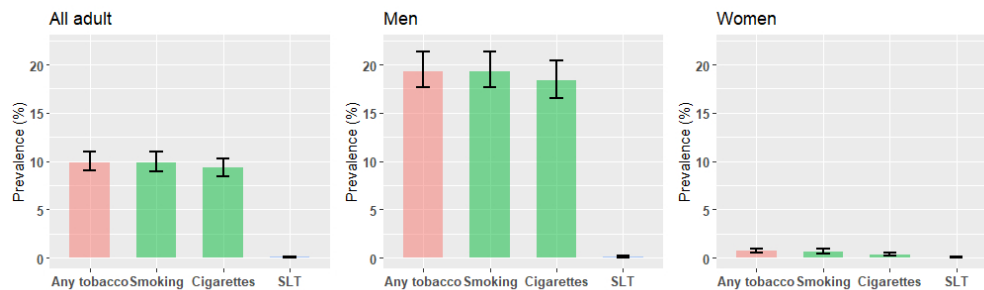


Figure 2 Prevalence of tobacco use in The Gambia in 2019-20 Prevalence showed in percentage with a 95% confidence interval (CI) value. The black-coloured error bar shows 95% CI. The left bar graph shows the tobacco prevalence of all adults aged 15-49 years, the middle bar graph shows the tobacco prevalence of men, and the right bar graph shows the tobacco prevalence of women. SLT- smokeless tobacco.

676x209mm (38 x 38 DPI)

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3,4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6,7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6,7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	7
		(c) Explain how missing data were addressed	7
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8,9
		(b) Indicate number of participants with missing data for each variable of interest	7
Outcome data	15*	Report numbers of outcome events or summary measures	8,9
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10,11

		(b) Report category boundaries when continuous variables were categorized	6
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14,15
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

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## Prevalence of and factors associated with tobacco smoking in The Gambia: A national cross-sectional study

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## Prevalence of and factors associated with tobacco smoking in The Gambia: A national cross-sectional study

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## Abstract

**Objectives** To examine the prevalence and risk factors associated with tobacco smoking

**Design** A nationwide cross-sectional study

**Setting** The Gambia

**Participants** The study participants were both women and men aged between 15 and 49 years old. We included 16,066 men and women in our final analysis.

**Data Analysis** We analysed data from The Gambia Demographic and Health Survey (DHS), 2019-20. DHS collected nationally stratified data from local government areas and rural-urban areas. The outcome variable was the prevalence of tobacco smoking. Descriptive analysis, prevalence, and logistic regression methods were used to analyse data to identify the potential determinants of tobacco smoking.

**Results** The response rate was 93%. The prevalence of current tobacco smoking was 9.92% in The Gambia in 2019-20, of which, 81% of the consumers smoked tobacco daily. Men (19.3%) smoked tobacco much higher than women (0.65%) ( $p<0.001$ ). People aged 40-49 years, with lower education, and manual workers were the most prevalent group of smoking in The Gambia ( $p<0.001$ ).

Men were 33 times more likely to smoke tobacco than women. The chance of consuming smoked tobacco increased with the increase of age (adjusted odds ratio 9.08, 95% CI 5.08-16.22 among adults aged 40-49 years,  $p<0.001$ ). The strength of association was the highest among primary educated individuals (AOR 5.35, 95% CI 3.35-8.54).

Manual workers (AOR 2.73) and people from the poorest households (AOR 1.86) were the risk groups for smoking. However, place of residency and region were insignificantly associated with smoking in The Gambia.

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2  
3 **Conclusions** Men, older people, manual workers, individuals with lower education, and lower  
4  
5 wealth status were the vulnerable groups to tobacco smoking in The Gambia. Government  
6  
7 should intensify awareness programs on the harmful effects of smoking, and introduce proper  
8  
9 cessation support services among tobacco smoking users prioritizing these risk groups.  
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11

### 12 13 **Strengths and limitations of this study**

- 14  
15  
16 1. This study analysed data drawn from nationally representative surveys to investigate  
17  
18 the prevalence of and risk factors associated with tobacco smoking in The Gambia.
- 19  
20  
21 2. We included all relevant socio-demographic predictor variables and ran a series of  
22  
23 models applying a complex survey design, controlling for potential confounding  
24  
25 factors and multicollinearity to reach a final parsimonious model.
- 26  
27  
28 3. The cross-sectional nature of the data in this study does not reveal a causal  
29  
30 association.  
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### 36 37 **Introduction**

38  
39 Tobacco use is the second-ranked leading risk factor of mortality, accounting for 8.71 million  
40  
41 fatalities worldwide (15.4 percent of total deaths) in 2019.<sup>1</sup> It is attributed to about 100  
42  
43 million deaths in the twentieth century, the vast majority of which occurred in developed  
44  
45 countries.<sup>2,3</sup> If the current trends of smoking persist, tobacco will kill around one billion people  
46  
47 this century, with the bulk of deaths occurring in low- and middle-income countries.<sup>2-5</sup> Along  
48  
49 with the health consequences, tobacco smoking caused significant economic costs: yearly, it  
50  
51 exceeds \$1 trillion.<sup>6</sup>  
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53  
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55

56  
57 The burden of tobacco use is increasing in low-income and middle-income countries. In 2019,  
58  
59 around 77.5% (around 6 of 7.69 million) of total tobacco smoking-related death occurred in  
60



1  
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3 low-income and middle-income countries. The number of smokers has also increased by 75%  
4  
5 in Sub-Saharan Africa (68.7% in The Gambia) since 1990. Age-standardized prevalence of  
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7 tobacco smoking in The Gambia had 1.6 times compared in neighbouring country, Senegal, in  
8  
9 2019 (12.5%).<sup>7</sup> Every day, 105,000 adults use tobacco in this country. Around 98.9% of users  
10  
11 consumed tobacco smoking. Tobacco smoking caused 4.5% (7.9 % in men and 0.5% in  
12  
13 women) of death among the Gambians in 2019, while the smoking-attributable death  
14  
15 increased 38% since 1990.<sup>7</sup> Tobacco smoking costs around five million USD in its economy  
16  
17 every year.<sup>6</sup> Tobacco smoking increases the chance of non-communicable diseases such as  
18  
19 cardiovascular diseases, cancer, and chronic respiratory diseases.<sup>8,9</sup> These three non-  
20  
21 communicable diseases cause 20% of all deaths in The Gambia.<sup>10</sup> World Health Organization  
22  
23 (WHO) set a target of a 25% decrease in deaths from cardiovascular diseases, diabetes,  
24  
25 cancer, and chronic respiratory illnesses among people aged 30-70 from 2010 to 2025.<sup>11</sup> To  
26  
27 reach the global target of non-communicable diseases in The Gambia, reducing tobacco  
28  
29 smoking can be the single best preventive and cost-effective strategy.

30  
31  
32 A study conducted among The Gambian men reported that 31.4% of men aged 25-64 years  
33  
34 old smoked tobacco in 2010.<sup>12</sup> Another study carried out in this country among students aged  
35  
36 12-20 years old found that 16.7% of students consumed tobacco in 2016.<sup>13</sup> Nevertheless, the  
37  
38 prevalence of and factors associated with tobacco smoking based on up-to-date data among  
39  
40 both men and women and nationally representative data were not available in The Gambia.  
41  
42 Up-to-date knowledge of the smoking prevalence and risk factors can inform policymakers to  
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44 design policies and interventions to accelerate smoking cessation. Therefore, to address this  
45  
46 knowledge gap, we aimed to examine the prevalence of tobacco smoking among different  
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48 socio-demographic groups' levels and factors associated with tobacco smoking in The Gambia  
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50 using the Demographic and Health Survey 2019-20 data.  
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## Methods

### Study Design and Data Source

We analysed data from The Gambia Demographic and Health Survey (DHS), 2019-2020. DHS is a nationally representative data stratified by local government areas (LGAs) and rural-urban areas.<sup>14</sup> The sample was two stages cluster in design. The sampling unit was the enumeration area (EA) that was selected based on the 2013 Population and Housing Census conducted by the Gambia Bureau of Statistics. In the first stage of sampling, 281 EAs were obtained from the sample frame. The sample had 14 strata, 12 strata from six LGAs (urban and rural), and two in municipalities (Banjul and Kanifing, no rural area in municipalities). In the second stage, systematic random sampling was used to choose a fixed number of 25 households from each EA. Trained data collectors interviewed only in pre-selected households. The sampling selection method is illustrated in figure 1. The detailed sampling procedure is given in the DHS final report in 2019-2020.<sup>14</sup> In this study, the STROBE statement (Strengthening the Reporting of Observational Studies in Epidemiology) was followed.<sup>15</sup>

**Figure 1 Flow chart of selection of sample**

### Study Population

Women aged 15-49 years and men aged 15-59 years were interviewed using separate questionnaires during data collection in The Gambian DHS. However, we analysed data of both participants aged between 15-49 years to get a pooled estimate.

### Outcome variables

The outcome was the prevalence of current tobacco smoking in this study. Respondents were asked, "Do you currently use smokeless tobacco every day, some days, or not at all?" The response was taken as "every day", "some days," or "not at all". We made the response dichotomous by coding "every day" and "some days" responses as "Yes" and "not at all" as "No". Smoked tobacco included manufacture, hand-rolled cigarettes, e-cigarettes, pipe full of tobacco, cigars, and cheroots tobacco forms.

### Independent variables

We identified tobacco smoking variables based on prior research on tobacco usage in the Sub-Saharan African region.<sup>16-18</sup> The independent variables were age, sex, union with men/women, ethnicity, religion, parity, place of residence, region (LGA), education level, occupation, wealth status, and access to information (television, radio, and newspapers). Age was grouped as 15-19, 20-29, 30-39, and 40-49. Both men and women were included in this study. Union status of respondents are either categorized as 'never union' and 'currently/formally union'. 'Never union' is defined as respondents who were unmarried and never lived together with men/women in her/his life. Ethnic groups were grouped into five categories (non-Gambian, Mandinka/Jahanka, Wollof, Fula/Tukulur/Lorobo, and others).

The religion of participants was categorized as Islam and others. The parity of respondents was grouped into three categories (respondents with no child, one child, and one+ children).

Rural and urban areas were the place of residence. Regions were six local government areas and two municipalities. Education level was grouped into four categories, no education (0 schooling year), primary (1-5 schooling years), secondary (6-12 schooling years), and higher (12+ schooling years). Occupation of respondents was divided as not working,

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3 professional/technical/managerial/clerical/sales/services/armed forces/other, agriculture,  
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5 and skilled/unskilled manual categories. The wealth status of households was grouped into  
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7 five quintiles (poorest, poorer, middle, richer, and richest). Implementing partners of the DHS  
8  
9 program classified wealth status depending on the household asset and dwelling  
10  
11 characteristics. Information access, newspapers/magazines, television, and radio were all  
12  
13 divided into three categories (not use at all, less than once a week, at least once a week).  
14  
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### 17 18 **Statistical Analysis**

19  
20 We performed descriptive statistics to assess the distribution of participants and presented  
21  
22 them as frequencies (n) and proportions (%). The prevalence of tobacco smoking was  
23  
24 estimated among the independent variables. The prevalence was reported as a percentage  
25  
26 with the 95% confidence interval (CI). To examine the relationship between variables and  
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28 tobacco smoking, we used the Chi-square test. We also conducted univariable and  
29  
30 multivariable logistic regression to investigate factors of tobacco smoking, presented as  
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32 unadjusted odds ratio (UOR), and adjusted odds ratio (AOR) with 95% CIs and *p*-value. All of  
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34 the analyses were two-tailed. Statistical significance was defined as a *p*-value of less than 0.05.  
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36 Multi-collinearity of independent variables was checked. The prevalence, univariable,  
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38 multivariable regression model took into account the complicated sample design and  
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40 sampling weight (weight was adjusted for women and men). Missing values were excluded  
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42 before conducting the final analysis (Figure 1). The statistical program R 4.0 was used to  
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44 analyse the data.  
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### 51 52 **Ethical Consideration**

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54 We analysed the publicly available DHS dataset with the approval of the DHS program. The  
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56 DHS survey followed standardized data collection procedures. They received permission from  
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58 the relevant authority's ethical review committees while conducting the primary study.  
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3 According to the DHS, informed consent was taken from respondents/ households who  
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5 enrolled in the survey.  
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9 **Patient and Public Involvement** No patient was involved  
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## 11 12 13 14 15 **Results**

### 16 17 **Socio-demographic Characteristics**

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20 The response rate was 93%. Of the 16,066 participants, 73.9% were women. A total of 35.2%  
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22 of participants' age was between 20-29 years, and 65.1% were currently or formally in a union  
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24 with men or women. The majority of participants were from the Islam (97.5%) religion, while  
25  
26 the Mandinka/Jahanka (30.7%) group was the majority in ethnic background. Almost half of  
27  
28 the participants had more than one child. About 56.1% of respondents were living in rural  
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30 areas, and 1 in 5 participants was from the Brikama region (local government area). In socio-  
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32 economic position, only 6% (970) of the participants had a higher level of education, and  
33  
34 40.2% of them were involved in  
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36 professional/technical/managerial/clerical/sales/services/armed forces works, while 27.4%  
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38 of respondents were from the poorest households (Table 1).  
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**Table 1 Characteristics of participants and prevalence of tobacco smoking among The Gambians<sup>a</sup>**

Factor	Total	Smoking tobacco			P-value
	N (%) <sup>b</sup>	Yes n (%) <sup>b</sup>	No n (%) <sup>b</sup>	Prevalence, % (95% CI) <sup>c</sup>	
<b>Participants</b>	16066 (100)	869 (100)	15197 (100)	9.9 (8.9-11.0)	
<b>Age</b>					<0.001
15-19	3766 (23.4)	75 ( 8.6)	3691 (24.3)	3.3 (2.3-4.5)	
20-29	5648 (35.2)	269 (31.0)	5379 (35.4)	8.9 (7.6-10.3)	
30-39	4136 (25.7)	297 (34.2)	3839 (25.3)	13.6 (11.6-15.6)	
40-49	2516 (15.7)	228 (26.2)	2288 (15.1)	16.7 (14.2-19.4)	
<b>Sex</b>					<0.001
Women	11865 (73.9)	58 ( 6.7)	11807 (77.7)	0.65 (0.4-0.8)	
Men	4201 (27.1)	811 (93.3)	3390 (22.3)	19.3 (17.4-21.3)	
<b>Union</b>					0.421
Never Union	5603 (34.9)	357 (42.1)	5246 (34.5)	9.6 (8.3-11)	
Currently or formally union	10463 (65.1)	512 (58.9)	9951 (65.5)	10.2 (9-11.5)	
<b>Religion</b>					0.437
Islam	15671 (97.5)	849 (97.7)	14822 (97.5)	10 (9-11)	
Others	395 (2.5)	20 ( 2.3)	375 ( 2.5)	8 (4.3-13.4)	
<b>Ethnic group</b>					0.014
Non-Gambian	1639 (10.2)	70 ( 8.1)	1569 (10.3)	7 (5.1-9.2)	
Mandinka/Jahanka	4932 (30.7)	293 (33.7)	4639 (30.5)	11.4 (9.7-13.3)	
Wollof	2294 (14.3)	104 (12.0)	2190 (14.4)	8.5 (6.6-10.8)	
Fula/Tukulur/Lorobo	3528 (22.0)	194 (22.3)	3334 (21.9)	8.7 (7-10.7)	
Others	3673 (22.9)	208 (23.9)	3465 (22.8)	10.6 (8.7-12.7)	
<b>Parity</b>					0.137
No child	6584 (41.0)	391 (45.0)	6193 (40.8)	9.5 (8.2-10.8)	
One child	1880 (11.7)	106 (12.2)	1774 (11.7)	12.1 (9.7-14.8)	
One+ children	7602 (47.3)	372 (42.8)	7230 (47.6)	9.9 (8.6-11.3)	
<b>Place of residence</b>					0.0582
Rural	7060 (43.9)	335 (38.6)	6725 (44.3)	8.6 (7.3-9.9)	
Urban	9006 (56.1)	534 (61.4)	8472 (55.7)	10.3 (9.1-11.7)	
<b>Region</b>					0.066
Mansakonko	1361 (8.5)	59 ( 6.8)	1302 ( 8.6)	8.4 (6.2-11)	
Banjul	1414 (8.8)	102 (11.7)	1312 ( 8.6)	12.1 (10.4-13.9)	
Kanifing	2246 (14.0)	156 (18.0)	2090 (13.8)	12.1 (10.2-14.2)	
Brikama	3239 (20.2)	177 (20.4)	3062 (20.1)	9.6 (7.8-11.5)	
Kerewan	1857 (11.6)	87 (10.0)	1770 (11.6)	8.3 (6.1-10.9)	
Kuntaur	1693 (10.5)	81 ( 9.3)	1612 (10.6)	8.9 (6.4-11.9)	
Janjanbureh	1715 (10.7)	91 (10.5)	1624 (10.7)	8.8 (7.3-10.5)	
Basse	2541 (15.8)	116 (13.3)	2425 (16.0)	9 (7-11.4)	
<b>Education</b>					<0.001
No education	6214 (38.7)	241 (27.7)	5973 (39.3)	7.5 (6.2-8.9)	
Primary	2720 (16.9)	190 (21.9)	2530 (16.6)	14.2 (11.8-16.8)	
Secondary	6162 (38.4)	389 (44.8)	5773 (38.0)	10.7 (9.2-12.3)	
Higher	970 (6.0)	49 ( 5.6)	921 ( 6.1)	5.7 (4-7.9)	
<b>Wealth status</b>					0.9198
Poorest	4402 (27.4)	231 (26.6)	4171 (27.4)	10.3 (8.7-12.1)	
Poorer	3116 (19.4)	172 (19.8)	2944 (19.4)	10.6 (8.5-12.9)	
Middle	3104 (19.3)	165 (19.0)	2939 (19.3)	9.6 (7.6-11.9)	
Richer	2719 (16.9)	133 (15.3)	2586 (17.0)	9.8 (7.8-12.2)	
Richest	2725 (17.0)	168 (19.3)	2557 (16.8)	9.5 (7.6-11.6)	
<b>Occupation</b>					<0.001

Factor	Total	Smoking tobacco			P-value
	N (%) <sup>b</sup>	Yes n (%) <sup>b</sup>	No n (%) <sup>b</sup>	Prevalence, % (95% CI) <sup>c</sup>	
Not working	4869 (30.3)	52 ( 6.0)	4817 (31.7)	1.9 (1.3-2.8)	
Professional/technical/managerial/clerical/sales/services/armed forces/other	6454 (40.2)	526 (60.5)	5928 (39.0)	12.9 (11.5-14.4)	
Agricultural-self employed	3651 (22.7)	114 (13.1)	3537 (23.3)	7.1 (5.2-9.4)	
Skilled/unskilled manual	1092 (6.8)	177 (20.4)	915 ( 6.0)	21 (17.3-25)	
<b>Access to information</b>					
<b>Reading newspaper/magazine</b>					<0.001
Not at all	13853 (86.2)	677 (77.9)	13176 (86.7)	9 (8-10)	
Less than once a week	1586 (9.9)	118 (13.6)	1468 ( 9.7)	13.5 (10.7-16.5)	
At least once a week	627 (3.9)	74 ( 8.5)	553 ( 3.6)	13.9 (9.6-18.9)	
<b>Watching television</b>					0.0843
Not at all	3439 (21.4)	142 (16.3)	3297 (21.7)	8.1 (6.3-10.2)	
Less than once a week	4106 (25.6)	211 (24.3)	3895 (25.6)	9.2 (7.6-11.1)	
At least once a week	8521 (53.0)	516 (59.4)	8005 (52.7)	10.6 (9.4-11.9)	
<b>Listening radio</b>					<0.001
Not at all	3507 (21.8)	82 ( 9.4)	3425 (22.5)	4.9 (3.6-6.4)	
Less than once a week	5186 (32.3)	169 (19.4)	5017 (33.0)	5.9 (4.6-7.3)	
At least once a week	7373 (45.9)	618 (71.1)	6755 (44.4)	14 (12.5-15.7)	
<sup>a</sup> Data are from Standard Demographic and Health Survey (DHS) conducted in The Gambia 2019-20. The age of respondents was 15-49 years old. <sup>b</sup> Column percentages. Data are not weighted in this column. <sup>c</sup> Data are weighted in this column. N- number of respondents CI- confidence interval Union- respondent live/lived together with men/women					

### Prevalence of tobacco smoking

The prevalence of any type of tobacco usage among all adults aged between 15-49 years was 9.94%, while 9.92% and 0.08% of adults used smoked and smokeless tobacco (SLT) respectively in The Gambia in 2019-20. However, 81% of users smoked tobacco daily (data not shown). The prevalence of any tobacco consumption among men was 30 times higher than women (19.3% vs. 0.65%). Smoking prevalence among men was 19.26% (95% CI 17.35 - 21.27) and among women was 0.60% (95% CI 0.41 - 0.85). Regarding smoking forms of tobacco, cigarettes were the popular form of tobacco use among both men and women in The Gambia (Figure 2).

1  
2  
3 **Figure 2 Prevalence of tobacco use in The Gambia in 2019-20** Prevalence is shown in percentage  
4 with a 95% confidence interval (CI) value. The black-coloured error bar shows 95% CI. The left bar graph shows  
5 the tobacco prevalence of all adults aged 15-49 years, the middle bar graph shows the tobacco prevalence of  
6 men, and the right bar graph shows the tobacco prevalence of women. SLT- smokeless tobacco.  
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16 The prevalence of tobacco smoking increased with the increase of age among the Gambians  
17 (3.3% in 15-19 years to 16.7% in 40-49 years' group). Non-Gambian (7%, 95% CI 5.1-9.2%) had  
18 lower smoking prevalence than other ethnic groups, while individuals with one child (12.1%)  
19 were the most prevalent class of parity. The prevalence of smoking was the lowest in the  
20 higher education category (5.7%) among all education groups. Smoking prevalence decreased  
21 among higher wealthy status. In occupation, not working groups had a smoking prevalence  
22 <2%, while the population involved in manual work had a smoking prevalence >20%. In access  
23 to information, smoking prevalence increased with the increased access to  
24 newspaper/magazines, television, and radio (Table 1).  
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### 38 **Factors associated with Smoking**

39 Men (AOR 32.9;  $p < 0.001$ ) were more likely to smoke tobacco compared with women in The  
40 Gambia (Table 2). Age was associated with smoking in this country. The strength of  
41 association increased with the increase of age (AOR 3.41 in 20-29, AOR 6.50 in 30-39, and  
42 AOR 9.08 in 40-49; reference group 15-19;  $p < 0.001$ ). Those who attained primary education  
43 level had a higher odds ratio (AOR 5.35, 95% CI 3.35-8.54) than participants with secondary  
44 education (AOR 3.26, 95% CI 2.17-4.9) and no education (AOR 2.73, 95% CI 1.68-4.44) had  
45 lower odds of self-reporting tobacco smoking compared with the individuals with higher  
46 education ( $\geq 12$  schooling year).  
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The occupation was referenced to not working group, and all other occupations had a significant positive association with tobacco smoking in both univariable and multivariable regression. In wealth status, poorest (AOR 1.86, 95% CI 1.16-2.98,  $P=0.01$ ) and poorer group (AOR 1.48, 95% CI 1.02-2.14;  $p=0.042$ ) had increased odds ratio of reporting smoking compared with richest households. Mandinka/Jahanka ethnic group smoked 142% more likely tobacco ( $p < 0.001$ ), compared with the non-Gambian category. Individuals who had one child had an increased odds ratio (AOR 1.88, 95% CI 1.27-2.77), where the reference group was the population with more than one child. In Gambia, individuals' union status with men or women, religion, place of residence, region, and access to the information (newspaper/magazine, television, radio) had an insignificant association with tobacco smoking.

**Table 2 Logistic regression to identify factors associated with tobacco smoking in The Gambia<sup>a</sup>**

Factors	Univariable regression		Multivariable regression	
	Unadjusted OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
<b>Age</b>				
15-19	1 (ref)		1 (ref)	
20-29	2.86 (1.99-4.11)	<0.001	3.41 (2.24-5.19)	< 0.001
30-39	4.61 (3.11-6.84)	<0.001	6.5 (3.66-11.54)	< 0.001
40-49	5.89 (3.98-8.71)	<0.001	9.08 (5.08-16.22)	< 0.001
<b>Sex</b>				
Women	1 (ref)		1 (ref)	
Men	39.33 (27.08-57.13)	<0.001	32.9 (21.94-49.32)	< 0.001
<b>Union</b>				
Currently or formally union	1 (ref)		1 (ref)	
Never union	0.93 (0.77-1.11)	0.420	1.14 (0.78-1.68)	0.497
<b>Religion</b>				
Islam	1.27 (0.7-2.32)	0.44	1.19 (0.58-2.44)	0.645
Others	1 (ref)		1 (ref)	
<b>Ethnic group</b>				
Non-Gambian	1 (ref)		1 (ref)	
Mandinka/Jahanka	1.73 (1.21-2.46)	0.003	2.42 (1.58-3.72)	< 0.001
Wolof	1.25 (0.84-1.85)	0.269	1.46 (0.9-2.37)	0.124
Fula/Tukulur/Lorobo	1.28 (0.86-1.88)	0.223	1.47 (0.93-2.32)	0.101
Others	1.59 (1.07-2.36)	0.023	1.96 (1.22-3.13)	0.006
<b>Parity</b>				
No child	0.95 (0.79-1.16)	0.64	1.29 (0.86-1.93)	0.214
One child	1.25 (0.97-1.61)	0.08	1.88 (1.27-2.77)	0.001
One+ children	1 (ref)		1 (ref)	

Factors	Univariable regression		Multivariable regression	
	Unadjusted OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
<b>Place of residence</b>				
Rural	1 (ref)		1 (ref)	
Urban	1.23 (0.99-1.52)	0.059	1.45 (0.98-2.13)	0.067
<b>Region</b>				
Mansakonko	1 (ref)		1 (ref)	
Banjul	1.5 (1.07-2.11)	0.020	1.39 (0.87-2.23)	0.167
Kanifing	1.5 (1.06-2.13)	0.025	1.48 (0.93-2.36)	0.102
Brikama	1.15 (0.8-1.67)	0.442	1.08 (0.69-1.71)	0.729
Kerewan	0.99 (0.64-1.51)	0.947	1.07 (0.66-1.73)	0.788
Kuntaur	1.07 (0.69-1.65)	0.766	1.22 (0.76-1.96)	0.422
Janjanbureh	1.06 (0.74-1.51)	0.758	1.19 (0.78-1.82)	0.429
Basse	1.09 (0.73-1.62)	0.679	1.09 (0.7-1.7)	0.687
<b>Education</b>				
No education	1.33 (0.89-1.99)	0.17	2.73 (1.68-4.44)	< 0.001
Primary	2.73 (1.85-4.03)	<0.001	5.35 (3.35-8.54)	< 0.001
Secondary	1.98 (1.38-2.82)	<0.001	3.26 (2.17-4.9)	< 0.001
Higher	1 (ref)		1 (ref)	
<b>Wealth status</b>				
Poorest	1.1 (0.82-1.47)	0.53	1.86 (1.16-2.98)	0.010
Poorer	1.13 (0.82-1.56)	0.46	1.48 (1.02-2.14)	0.042
Middle	1.01 (0.72-1.42)	0.95	0.98 (0.66-1.47)	0.940
Richer	1.04 (0.75-1.44)	0.81	1 (0.7-1.42)	0.976
Richest	1 (ref)		1 (ref)	
<b>Occupation</b>				
Not working	1 (ref)		1 (ref)	
Professional/technical/managerial/clerical/sales/services/armed forces/other	7.53 (4.99-11.38)	<0.001	2.11 (1.32-3.36)	0.002
Agricultural/self employed	3.9 (2.38-6.39)	<0.001	2.01 (1.2-3.37)	0.008
Skilled/unskilled manual	13.47 (8.62-21.06)	<0.001	2.73 (1.67-4.48)	< 0.001
<b>Access to information</b>				
<b>Reading newspaper/magazine</b>				
Not at all	1 (ref)		1 (ref)	
Less than once a week	1.57 (1.19-2.08)	0.002	1.34 (0.98-1.84)	0.071
At least once a week	1.63 (1.1-2.42)	0.016	1.01 (0.67-1.52)	0.958
<b>Watching television</b>				
Not at all	1 (ref)		1 (ref)	
Less than once a week	1.15 (0.86-1.53)	0.337	0.85 (0.59-1.23)	0.383
At least once a week	1.34 (1.02-1.76)	0.036	0.86 (0.62-1.19)	0.372
<b>Listening radio</b>				
Not at all	1 (ref)		1 (ref)	
Less than once a week	1.21 (0.83-1.77)	0.32	0.97 (0.66-1.42)	0.862
At least once a week	3.17 (2.34-4.29)	<0.001	1.28 (0.95-1.73)	0.106

<sup>a</sup>Data are from Standard Demographic and Health Survey (DHS) conducted in The Gambia 2019-20. The age of respondents was 15-49 years old. Data are weighted in this column.  
OR- odds ratio  
CI- confidence interval  
Ref- reference group  
Union- respondent live/lived together with men/women

## Discussion

Despite two decades of efforts to control tobacco smoking in The Gambia,<sup>19</sup> this country has a high prevalence of tobacco use among adults aged 15-49 years. Moreover, one in ten adults smoked tobacco in 2019-20, while 81% of users smoked tobacco daily. The smoking prevalence in The Gambia was higher than the average prevalence of tobacco smoking in the Western Sub-Saharan Africa region and lower than Guinea, Mauritania, and Sierra Leone.<sup>7</sup> Chisha et al. (2020) also found most smokers in The Gambia were daily users.<sup>20</sup> The explanation can be other Western Sub-Saharan African countries has evidence-based tobacco cessation strategies, other tobacco control policies, higher taxation, and smoking cessation support more than The Gambia has. For example, Ghana has a national tobacco cessation strategy and clinical guidelines.<sup>21</sup> Tobacco smoking among men was significantly higher than women in this country in 2019. Smoking prevalence was significantly higher among older people. A study on 30 sub-Saharan African countries also found a higher prevalence of smoking among men than women and among older people.<sup>22</sup> We found people involved in manual work were the most prevalent group of smoking (21%) in The Gambia. Manual workers smoked more also found in Ethiopia.<sup>23</sup>

Sex, age, education level, occupation, and household wealth were significantly associated with tobacco smoking in The Gambia. We found that the prevalence of tobacco smoking is comparatively higher among men than women. Another multi-country study conducted sub-Saharan Africa found men smoked higher than women.<sup>24</sup> This might be the result of the unacceptability of smoking practices towards women in this country. Older people smoked tobacco more likely than younger people. This finding is in line with previous tobacco studies conducted in Sub-Saharan Africa.<sup>18,22,25,26</sup> We can explain this by the age effects of tobacco

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3 smoking. Individuals progressively initiate tobacco smoking as they grow older, and the rate  
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5 of smoking cessation is lower than the smoking initiation rate.  
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8 People with a lower level of education smoked tobacco more than people with higher  
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10 education in The Gambia. This finding aligns with previous studies performed in Sub-Saharan  
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12 Africa and Asia.<sup>17,22</sup> The protective effect of households' wealth was coherent with the finding  
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14 in other Sub-Saharan African countries.<sup>16,18</sup> People who have lower education were less aware  
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16 of their health risks.<sup>27</sup> The tobacco epidemic initiates among higher socioeconomic groups in  
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18 developed countries and then extends to poorer and less educated individuals,<sup>28</sup> while in  
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20 developing countries, the less educated may take up smoking owing to a lack of information  
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22 and awareness about the harmful consequences of smoking.<sup>27</sup> In addition to this, poor people  
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24 have less control to deal with the management of stress from their economic situations.<sup>29</sup>  
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30 People involved in any work had a positive association with tobacco smoking compared to  
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32 those not working. Manual workers had the strongest association with smoking in The  
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34 Gambia. A similar finding was observed in Sub-Saharan African studies<sup>22,26</sup> and the United  
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36 States of America.<sup>30</sup> Working individuals may experience work stress. At the same time,  
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38 manual work represents the social status, education, and income of people, all of which have  
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40 an impact on healthy habits and seeking medical help.<sup>31</sup>  
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### 48 **Public Health Implications**

49 The Gambia implemented diverse tobacco control initiatives and ratified the WHO  
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51 Framework Convention on Tobacco Control;<sup>19,21</sup> however, only 3% of smoking prevalence was  
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53 reduced among men since 2013.<sup>14,32</sup> The reduction rate of smoking prevalence can be  
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55 accelerated by increasing smoking cessation and reducing the initiation rate of smoking  
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57 through the proper support in this country. First, the government should develop a national  
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3 tobacco cessation strategy.<sup>21</sup> Advertising and promotion of tobacco are banned. However, we  
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5 found that access to media did not act as a protective factor against smoking. We also found  
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7 poor, manual workers and lower educated people smoked more likely in The Gambia.  
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9 Awareness about the dangers of tobacco smoking can help to reduce early initiation of  
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11 smoking and increase smoking cessation. Anti-tobacco campaigns should include television,  
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13 radio, and newspapers to spread anti-smoking messages. Price incentive initiatives can be  
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15 effective in this country. Currently, the excise tax rate of tobacco is 33% in The Gambia;  
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17 however, WHO has recommended 70% of taxation of retail tobacco price.<sup>33</sup> It is documented  
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19 that increasing taxes reduced tobacco smoking in this country.<sup>34</sup> Increment revenue from tax  
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21 can be allocated to implement smoking cessation support from primary care to tertiary  
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23 hospitals, and the community, and initiate free nicotine replacement therapy and quitline,  
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25 which are still absent in The Gambia.<sup>21</sup>  
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### 36 **Strengths and limitations**

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38 The major strength of this study is that it analysed data from the nationally representative  
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40 survey, which included both men and women aged between 15-49 years with a high response  
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42 rate. It provided enough power to investigate the prevalence of and factors linked to tobacco  
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44 smoking. Therefore, the findings are generalizable among the population aged 15-49 years  
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46 old and in similar settings. In all analyses in this study, sample weight, cluster effect, and  
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48 complex sampling design were employed and generated with 95% CI with point estimates. It  
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50 improves the precision of the results in this study. However, this study had a few limitations.  
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52 A major limitation is that we drew the data from a cross-sectional study. The smoking habit  
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54 of respondents could not be followed over a period due to the study design. Causal inferences  
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3 could not be drawn. Another drawback is that the sample included men and women aged 15  
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5 to 49 years, which does not reflect the whole population of The Gambia. The findings might  
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7 be underestimated as we found tobacco smoking increases with age; we can hypothesize that  
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9 people aged >49 years would smoke more in this country who were not included in this study.  
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11 Furthermore, this questionnaire-based and self-reporting data were gathered based on  
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13 events; there is a risk of recall bias and bias owing to social stigma and norms. The findings  
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15 may have selection bias as some participants did not respond or missed the complete  
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17 interview.  
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## 23 **Conclusions**

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26 The key findings from this paper are the prevalence of tobacco smoking and its determinants  
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28 in The Gambia. Men, elderly people, manual workers, those with lesser education, and  
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30 people with lower wealth status were the most vulnerable to tobacco smoking. In addition  
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32 to monitoring current tobacco use, policies, and tailoring interventions, the government  
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34 should launch a public awareness campaigns using different state-of-art platforms along with  
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36 regular strategies focusing on the adverse effect of smoking and appropriate cessation  
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38 support services focusing on those risk groups irrespective of their health status.  
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53  
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55  
56 Ferdous conducted the literature search. M Shariful Islam analysed the data. M Shariful Islam,  
57  
58 MG Rabbani, D Konka and H AlWajeah prepared the original draft. AN Zafar Ullah supervised  
59  
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11  
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14

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16 study. To carry out data collection from the sample, implementing partners of the DHS  
17 program have taken ethical approval from the responsible authority in The Gambia. More  
18 information about DHS data and ethical standards can be found at: <http://goo.gl/ny8T6X>.  
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22 **Data sharing statement** DHS data is available publicly. To use data, prior request explaining  
23 reason is required at <https://dhsprogram.com/data/available-datasets.cfm>  
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4 [toolkit](https://www.worldbank.org/en/topic/health/publication/economics-of-tobacco-toolkit)  
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7 34. Nargis N, Manneh Y, Krubally B, et al. How effective has tobacco tax increase been in  
8 the Gambia? A case study of tobacco control. *BMJ Open*. 2016;6(8):e010413.  
9 doi:10.1136/ bmjopen-2015-010413  
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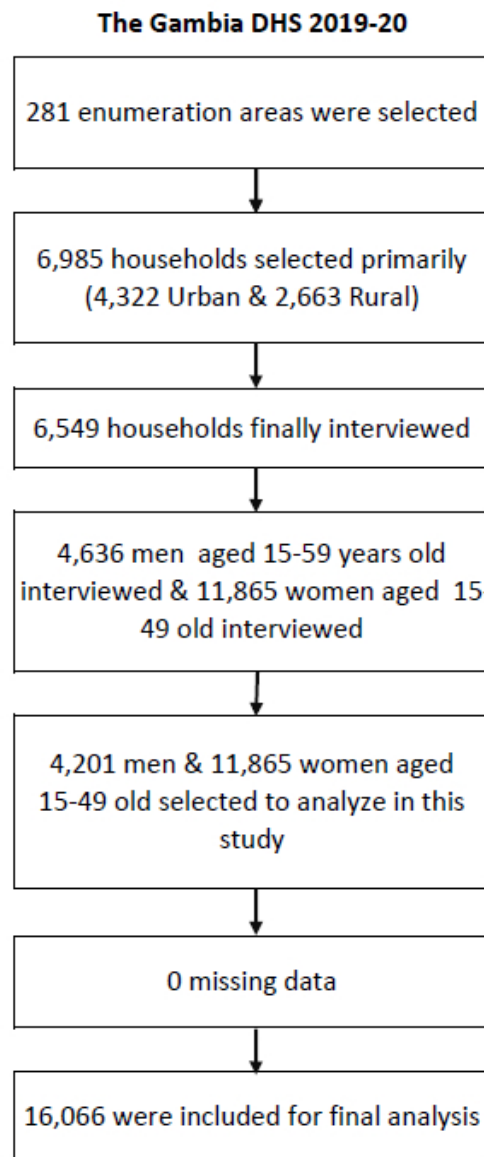


Figure 1 Flow chart of selection of sample

174x379mm (47 x 47 DPI)

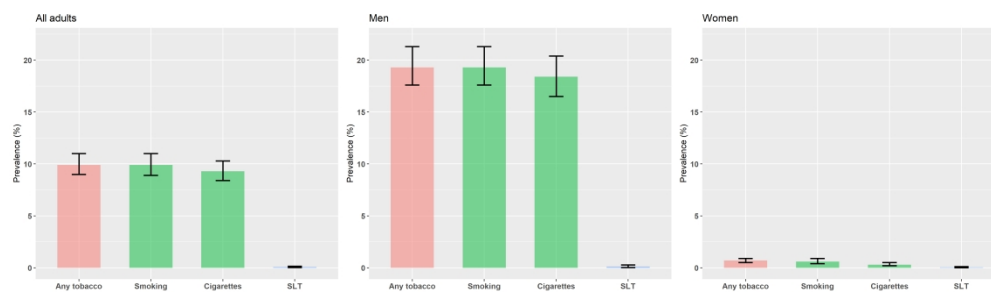


Figure 2 Prevalence of tobacco use in The Gambia in 2019-20 Prevalence showed in percentage with a 95% confidence interval (CI) value. The black-coloured error bar shows 95% CI. The left bar graph shows the tobacco prevalence of all adults aged 15-49 years, the middle bar graph shows the tobacco prevalence of men, and the right bar graph shows the tobacco prevalence of women. SLT- smokeless tobacco.

1162x357mm (118 x 118 DPI)

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3,4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6,7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6,7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	7
		(c) Explain how missing data were addressed	7
		(d) If applicable, describe analytical methods taking account of sampling strategy	NA
		(e) Describe any sensitivity analyses	NA
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8,9
		(b) Indicate number of participants with missing data for each variable of interest	7
Outcome data	15*	Report numbers of outcome events or summary measures	8,9
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10,11

		(b) Report category boundaries when continuous variables were categorized	6
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14,15
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).