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Epidemiology of harmful use of alcohol in Nigeria: a systematic review and meta-analysis

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ABSTRACT

Background: Nigeria, the most populous country in Africa, has reported relatively high levels of alcohol misuse, yet limited resources to guide effective population-wide response. There is a need to integrate existing empirical information in order to increase the power and precision of estimating epidemiological evidence necessary for informing policies and developing prevention programs.

Objectives: We aimed to estimate nationwide and zonal prevalence of harmful use of alcohol in Nigeria to inform public health policy and planning.

Methods: Epidemiologic reports on alcohol use in Nigeria from 1990 through 2018 were systematically searched and abstracted. We employed random-effects meta-analysis and meta-regression model to determine the number of harmful alcohol users.

Results: 35 studies (n=37,576 Nigerians) were identified. Pooled crude prevalence of harmful use of alcohol was 34.3% (95% CI: 28.6-40.1); twice as high among men (43.9%, 31.1-56.8) compared to women (23.9%, 16.4-31.4). Harmful alcohol use was higher in rural settings (40.1%, 24.2-56.1) compared to urban settings (31.2%, 22.9-39.6). The number of harmful alcohol users aged ≥ 15 years increased from 24 to 34 million from 1995 to 2015. However, actual age-adjusted prevalence of harmful use of alcohol in Nigeria decreased from 38.5% to 32.6% over the twenty-year period.

Conclusions: While the prevalence of the total population that drinks harmfully appears to be dropping, absolute number of individuals that would be classified as harmful drinkers is increasing. This finding highlights the complexity of identifying and advocating for substance abuse policies in rapidly changing demographic settings common in Africa, Asia, and other developing countries.

INTRODUCTION

Alcohol (mis)use and related problems vary around the world and is substantial in several countries (1). In 2016, the World Health Organization (WHO) reported that more than 3 million people died worldwide as a result of harmful use of alcohol, accounting for 1 in 20 global deaths and representing the world's third largest risk for disease and disability (1). In specific terms, harmful use of alcohol accounted for 28.7% of deaths due to injuries, 21.3% of digestive diseases, 19% of cardiovascular diseases, and 12.6% of cancers globally (1, 2).

In Nigeria, and many African settings, alcohol is culturally tolerated during festivities and ceremonies, especially in the absence of any religious restrictions (3, 4). Recent reports, however, have shown increased and alarming daily consumption of alcohol among adolescents and young adults, with Nigeria now ranked among the leading countries with the highest per capita consumption of alcohol globally (5). Consequently, there have been increases in several related social and health issues including alcohol dependence, domestic violence, traffic injuries, and several chronic diseases, suggesting a need to develop more comprehensive population-wide preventive measures (3, 6, 7).

Current data suggests that there has not been a decline in alcohol consumption in Nigeria since 2009, with the rate of consumption sustained at 10-12 liters of pure alcohol per capita per year in the last five years (1, 2). Gureje and colleagues (8) note that heavy episodic drinking is prevalent among alcohol users in Nigeria, and that alcohol is the most commonly abused drug in the country. Some authors further reported that due to unrestricted access to alcohol products in the country, age at initiation has been as low as 11 years in some settings (8, 9). It appears that the continued promotion and popularity of alcohol products and competition between leading companies, has resulted in cheaper alcoholic beverages, and thus more young persons who can now afford them (10). Further, alcohol in Nigeria has subsumed different roles as drinking patterns are evolving, with some alcoholic beverages associated with social class, status, and recognition (11-13).

One basic challenge in describing the epidemiology of harmful use of alcohol in Nigeria, and across many African countries is appropriate case definitions for epidemiological surveys. We identified this in this study, and first defined “harmful” according to the International Classification of Disease (ICD-10) diagnostic criteria for research, described as “a pattern of psychoactive substance use that is causing damage to health, be it physical or mental (14). Thus, in terms of alcohol use, experts have described any alcohol intake in excess of 14 units a week for women and men as harmful to the health (15). This is equivalent to consumption of more than 6 pints of average-strength beer (4% alcohol by volume (ABV)) or 7 medium-sized glasses of wine (175ml, 12% ABV) in a week (15). In Nigeria, many studies have described this as “heavy”, “excessive” or “continuous” use of alcohol products over a specific period (8, 9, 11-13) (see *case definitions*).

An understanding of the consumption of alcohol in Nigeria may provide insights into the rate of consumption in some African settings, being the most populous country on the continent. Besides few studies in some African countries (16-19), there is generally limited national epidemiological studies on alcohol consumption in Africa, which appears to limit public health response and comparisons with other world regions. Across many African countries, alcohol mis(usage) is less addressed, as there are no clear regulations for alcohol marketing, with this even worse in the absence of representative and up-to-date epidemiologic reports on alcohol consumption (20). The most recent national epidemiological study on alcohol consumption in Nigeria was conducted in 2007, with prevalence of ever and current users of alcohol estimated at 56% and 14%, respectively, and harmful alcohol use at 20%, although this was mainly part of an assessment of overall substance use in the country (21). We therefore conducted a comprehensive review of publicly available epidemiological evidence, and provided an updated estimate of the prevalence of harmful alcohol use in Nigeria to inform relevant public health response locally and internationally. We further examined variations across geopolitical zones and main demographic indices in the country.

METHODS

Search terms and strategy

We searched broadly for epidemiologic studies or reports on alcohol use in Nigeria. Searches were conducted on four main databases where Nigeria-focused research studies are typically indexed—MEDLINE, EMBASE, Global Health, and Africa Journals Online (AJOL). Combination of search terms employed are shown in **Table 1**. Searches were conducted on 21 August 2018 and limited to studies published after 1 January 1990. Unpublished documents were sourced from Google Scholar, Google searches and websites of national and regional health organizations, including the World Health Organization (WHO), Nigeria Federal Ministry of Health (FMoH), Nigeria Centre for Disease Control (NCDC) and the National Primary Health Care Development Agency. Titles and abstracts of studies were reviewed for relevance, and full-texts of studies on alcohol prevalence accessed for further screening. The reference lists of accessed full-texts were also hand-searched for additional studies. If necessary, we contacted authors of selected papers for any missing information.

Eligibility criteria

We primarily selected original population-based studies reporting on the prevalence of alcohol use in a Nigerian setting. However, we ensured such studies provided estimates on the prevalence of harmful use of alcohol to be considered for the review. We excluded hospital-based or clinical reports, studies on Nigerians in diaspora, reviews, view-points, commentaries, and editorials.

Case definitions

A number of studies described harmful use of alcohol as “heavy”, “excessive” or “continuous” use of alcohol products over a specific period, while some noted that the risks from alcohol may start from any level of regular use and rise with continuous use and/or the amount being consumed. Given the varying views, we considered any study that presented prevalence estimates of harmful use of alcohol based on the above descriptions, or when defined broadly as heavy or excessive use of alcoholic beverages, including distilled liquors, beers, spirits or wines either on individual

occasions (binge drinking) or as a regular practice in the last one month prior to conduct of study.

Data extraction

Assessment of eligible studies was conducted independently by two reviewers (DA and AA), with an eligibility guideline to ensure that selection of studies was consistent. Any disagreement in study selection was resolved by consensus. Data on the location, study period, study design, study setting (urban or rural), case definition and mean age of the population were extracted. The extraction also included corresponding data on harmful alcohol users, sample population, prevalence of harmful use of alcohol in each study.

Quality assessment

In assessing the quality of each study, we adapted previously used criteria (22-25) which broadly reflects the representation of a larger population around study settings, appropriate study design and an accepted or justified definition of harmful alcohol use. Specifically, for each full text selected, we checked the sampling strategy (was it representative of a target subnational population?), statistical methods (was it appropriate for the study outcome?), and case definition (was it based on an accepted definition or parameter?). Studies were graded as *high* (4-5), *moderate* (2-3), or *low quality* (0-1) (see **Tables 2 and 3**, for details of all full-text manuscripts accessed and quality grading).

Outcome measures and data analysis

A random-effects meta-analysis, using the DerSimonian and Laird Method (26), was employed on the individual study estimates to generate national and sub-national pooled crude estimates of the prevalence of harmful use of alcohol in Nigeria. Standard errors were determined from the reported crude estimates and population denominators, assuming a binomial (or Poisson) distribution. Heterogeneity between studies was assessed using I-squared (I^2) statistics, and subgroup analysis were conducted to detect the causes of heterogeneity. We assessed publication bias using Egger's regression test for funnel plot asymmetry (27). A meta-regression epidemiologic model accounting for sample size, study period, and age was developed to determine

prevalence distribution of harmful use of alcohol by age of the Nigerian population. The model was based on aggregated mean age from each study (as these had more data points), and adjusted for study period and sample size. In a preliminary analysis, we tested various models (linear, exponential, polynomial, logarithmic, etc) to determine which was most predictive (*ie.* the model with the greatest proportion of variance (R^2) of prevalence of harmful use of alcohol as explained by age). This was applied to the final model, and the best fit was used to estimate the absolute number of harmful alcohol users in Nigeria at midpoints of the United Nations population 5-year age groups (≥ 15 years) for Nigeria for the years 1995 and 2015 (28) (estimated prevalence was multiplied by the population for each five-year age-group to arrive at respective number of cases, with this summed up to give total number of cases in the country). Our approach to data analysis has been described in detail in previous studies (29-31). All statistical analyses were conducted on Stata 14 (Stata Corp, Texas, USA).

Review guide

This study is a review of publicly available literature and data on harmful use of alcohol in Nigeria. Ethical review was therefore not required. The protocol for this study was not registered, but was shared and reviewed by experts in social sciences and evidence synthesis within the country. The study was conducted in accordance with the **MOOSE** guidelines of systematic reviews of observational studies (32).

RESULTS

Search results

The databases returned a total of 3472 studies (MEDLINE 1569, EMBASE 1877, Global Health 19, and AJOL 7). Additional eight studies were identified through Google Scholar, Google searches, websites of health organizations, and hand-searching reference lists of relevant studies. After duplicates were removed, 1678 titles were screened for relevance (*i.e.* any epidemiologic studies on alcohol use in Nigeria). On further screening, 1554 studies were excluded. One hundred and twenty-four (124) full-

texts were assessed and screened explicitly using the selection and quality criteria, following which 89 studies were excluded (mainly studies without prevalence or risk estimates of harmful use of alcohol). A total of 35 studies (21, 33-66) were finally selected for the review (**Figure 1**).

Study characteristics

The South-west had the highest number of studies (13), followed by South-east (9) and South-south (8). North-central and North-west had two (2) studies each, while one-study was on a national sample. There was no study from the North-east. Most studies were conducted in urban settings (17), while rural settings had 5 studies, and mixed settings (a mix of urban and rural dwellers) had 13 studies. Studies were conducted between 1992 and 2017, with most conducted within a one-year period. Total population covered from all studies was 37,576, with mean age of population ranging from 15 to 65 years (**Table 3 and Supplemental file**). When the quality criteria were applied, 14 studies were rated as high quality (40%), while 21 studies rated moderate (60%) (**Table 3 and Supplemental file**). Heterogeneity was high, with I-squared (I^2) estimated at 99.5% ($P < 0.001$). Funnel plot was asymmetrical (Egger's test: -1.778 , -2.7334 to -0.8213 , $P < 0.001$), suggestive of publication bias (**Figure 2**), although the high number of studies retained could apparently minimize this effect, with the bias tending more towards heterogeneity from study designs, sampling, and case definitions.

Prevalence of harmful use of alcohol in Nigeria

From all studies, the highest prevalence of harmful use of alcohol was reported in 1992 in Benin, Edo State, South-south Nigeria with prevalence estimated at 64.9% (59). The lowest prevalence of harmful use of alcohol was reported in 2013 in Ibadan, Oyo State, South-west Nigeria with a prevalence of 5.1% (42). From all studies, the mean age at initiation of alcohol use ranged from 13.5 years to 20.5 years.

The pooled crude prevalence of harmful use of alcohol in Nigeria was 34.3% (28.6-40.1) (**Figure 3**), with prevalence in men (43.9%, 31.1-56.8) almost double that estimated among women (23.9%, 16.4-31.4) (**Figures 4 and 5**). The prevalence in the South-south was highest at 50.2% (38.9-61.4), followed by South-east and North-central at

36.0% (23.0-48.9) and 31.0% (17.3-44.7), respectively. The South-west and North-west had almost similar estimates at 25.4% (16.7-34.1) and 25.6% (13.8-65.0), respectively (**Table 4**). The prevalence of harmful use of alcohol was higher among rural dwellers at 40.1% (24.2-56.1) compared to the estimate among urban dwellers at 31.2% (22.9-39.6) (**Table 4**).

Estimated number of harmful alcohol users in Nigeria

As observed from the distribution of the crude prevalence estimates, the modelling revealed a decreasing adjusted prevalence of harmful use of alcohol with increasing age (see **Figure 6**, and **Supplemental file** for meta-regression model). Using the United Nations demographic projections for Nigeria, we estimated about 24 million current users of alcohol among persons aged 15 years or more in 1995 who consume at a rate harmful to their physical and mental health cases in Nigeria in 1995. This number increased by 41.4% to 33.6 million harmful alcohol users in Nigeria in 2015 in the same age group (i.e. ≥ 15 years). However, over this 20-year period (1995-2015), the actual age-adjusted prevalence of harmful use of alcohol in Nigeria decreased from 38.5% to 32.6% (**Table 5**).

DISCUSSION

This study employed comprehensive and strategic criteria to identify high-quality studies that best represent the current status of alcohol consumption in Nigeria. Pooling information from all available studies, we estimated that in 2015, the prevalence of harmful use of alcohol in both sexes was 32.6%. Although, it may be inappropriate to compare our estimate with the 56% and 14% ever and current users of alcohol reported by Gureje *et al.* (21) in 2007 due to different outcomes measured, the 20% harmful alcohol use reported could possibly have been an under-estimate at that time, as the sample was only representative of 57% of the Nigerian population. However, our estimate is similar to values reported for current alcohol drinkers in the WHO African region in 2016 at 32.2% (1). We cannot say with all certainty if the WHO estimate represents the proportion of harmful alcohol users in the region, events in many African

settings however suggest that many current users of alcohol have also used it in a way that is harmful to their health (2, 21). Though the absolute number of harmful drinkers has increased, we estimated a 6% reduction in the prevalence of harmful alcohol use between 1995 and 2015, or an average annual reduction of 0.3%. This estimate is supported by International Wines and Spirits Records (IWSR), who reported a global decline in alcoholic consumption at 0.3% per year between 2010 and 2015 (67). Increasing health risk awareness of alcohol consumption, especially among the high social class, may possibly account for these declining rates. While this may be seen as a positive finding, the absolute number and prevalence of harmful drinking is still high by any measure and should not be understated.

When compared to other African countries, the prevalence of harmful use of alcohol in Nigeria is relatively higher. For example, the prevalence of self-reported binge drinking was 14.1% in South Africa (16) and 16% in Ghana (17), while hazardous users of alcohol were estimated at 12.7% in Uganda (18) and 22.4% in Botswana (19). Despite a declining rate, Nigeria appears to be at the high-end of alcoholic beverage consumption in Africa, as the reported rates are comparable to some estimates in Europe and the Americas, where the prevalence of harmful users ranged from 37-53% (1, 68). The population of Nigeria offers a relatively good market for producers and marketers of alcoholic beverages, who are now increasingly adopting small sachet packaging with lower prices in a bid to increase sales among the lower socio-economic class, possibly explaining the higher consumption rates in the country (69).

Meanwhile, we noted that our estimate was almost twice as high among men compared to women. Many studies support this sex distribution. For example, the WHO report showed that between 2010 and 2016 the prevalence of alcohol consumption in the WHO Africa region was consistently twice as high among men compared to women, with the 2016 prevalence at 43.6% for men and 21.0% for women, which is similar to rates reported in this study (1). An important aspect of a successful public health campaign in Nigeria will involve the identification and intervening on social norms that support this disparity in alcohol misuse among men.

Harmful use of alcohol was highest in the South-south, South-east and North-central regions of Nigeria. This may have historical roots as South-south and North-central Nigeria lead in the production of traditional alcoholic beverages in the country, such as *ogororo*, *burukutu*, and *oguro*. There is a desire to have these specific drinks become nationally branded and sold to the international community as the Nigerian wines and spirits in a bid to generate more revenue for the government (70, 71). This may have led to increased production, availability, and consumption of these local beverages in this region, especially in the rural settings, where we also estimated higher rates of alcohol consumption. Although a number of studies in urban settings were among younger populations, it is surprising to observe that the prevalence of harmful use of alcohol was higher in rural populations, with relatively higher number of adults. It appears the increasing effects of urbanization in rural settings have led to gradual erosion of communal values, disciplines and punitive measures, which in years past had provided some forms of restrictions to the younger population groups in these settings, reflecting in the higher rates estimated (3). Several harmful practices thus support harmful use, including alcohol drinking contests in which many adolescents and youths risk their health in return for financial rewards. The lack of any public policy, advert restrictions, nor tax regulations in Nigeria (20) imply a need for more awareness, advocacy by key action groups and relevant stakeholders, and presenting research findings to the government and policymakers to prompt necessary reforms and actions.

Our study is not without limitations. First, we could not specifically describe alcohol users in terms of current use, *i.e.* lifetime abstainers, former drinkers, and current drinkers. Second, our definition of harmful use of alcohol could be seen as lacking a clear standardization in regards to measurement, as this was mainly based on data on heavy or excessive use of alcoholic beverages over a period of time. This particularly should guide interpretation of our findings, as there were no clear studies in Nigeria based on standard (quantifiable) measurements of harmful use of alcohol. Indeed, we acknowledge the concerns of many authors on the challenges in the definition of harmful use of alcohol, suggesting this needs to be standardized for future studies (1). Second, heterogeneity across studies was high, which largely reflects the varying

designs, case definitions and overall conduct of surveys. The significant publication bias in this study is also reflective of the heterogeneity from study designs, case definitions sampling and varying population characteristics covered. Third, there were very limited studies from Northern Nigeria, with no studies retrieved from the North-east, a region with six states and representing over 13% of Nigeria's population. In addition, some studies mainly covered specific populations (e.g. students, street hawkers, prison officials, etc.); although such groups help to further understand variations in alcohol use across different settings in the country, they however have implications for the overall representativeness of our estimates. Besides, we could not explore other socio-demographic characteristics, including social class, wealth index, and religion in our analysis, which could have provided a more robust understanding of variation in alcohol use in the country. However, with 35 studies covering a total population sample of about 40000, we believe our estimates closely represent the state of harmful alcohol consumption in Nigeria, and provides useful reference for further studies.

CONCLUSION

Although harmful use of alcohol may be decreasing in Nigeria, the prevalence is still unacceptably high. This finding highlights the complexity of identifying and advocating for substance abuse policies in rapidly changing demographic settings common in Africa, Asia, and other developing countries. Our findings may have also provided useful insights on the use of alcohol in Africa, necessary for relevant regional and global comparisons. There is need to increase awareness on health risks, particularly in rural areas and urban slums, where the consumption of locally brewed alcoholic beverages is relatively higher. Applying higher taxes on alcohol products and restricting age access are proven preventive measures. Relevant studies on the epidemiology and prevention of harmful use of alcohol need to be sustained, especially in the North.

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FIGURE 1. Flow chart of selection of studies on alcohol use in Nigeria.

FIGURE 2. Funnel plot showing distribution of selected studies. Note: Egger's test: -1.778 (-2.7334 to -0.8213) $P < 0.001$

FIGURE 3. Crude prevalence rate of harmful use of alcohol in Nigeria, by geopolitical zones.

FIGURE 4. Crude prevalence rate of harmful use of alcohol in Nigeria, men.

FIGURE 5. Crude prevalence rate of harmful use of alcohol in Nigeria, women.

FIGURE 6. Meta-regression epidemiologic model showing relationship between harmful use of alcohol and mean age of the population.

Note: prevalence of harmful use of alcohol (y), mean age (x), year (z) and size of the bubble correspond to study sample size. Coefficients of 'x' and 'z' are ' -0.036 ' and ' -0.298 ' for the meta-regressed line, with an intercept of ' $+634.298$ '. Model statistics and all data employed are presented in the **Supplemental file**.

TABLE 1. Search terms on alcohol use in Nigeria

#	Searches*
1.	africa/ or africa, sub-sahara/ or africa, western/ or nigeria/
2.	(incidence* or prevalence* or morbidity or mortality).tw.
3.	(disease adj3 burden).tw.
4.	2 or 3
5.	exp alcohol / or wine, beer, or spirits / or harmful use / or heavy drinking / or binge drinking
6.	Exp NCDs risks/
7.	5 or 6
8.	1 and 5 and 7
9.	Limit 8 to "1990-current"

'1' broadly targets studies in Nigeria, '2 or 3' broadly targets epidemiologic studies, '5 or 6' targets alcohol use, and '1 and 5 and 7' specifically targets epidemiologic studies on alcohol use in Nigeria, with this limited to studies from 1990 upwards in '9'. Searches were conducted on Medline, EMBASE, Global Health and AJOL, with slight variations between databases.

TABLE 2. Quality assessment of selected studies

Quality criteria	Assessment	Score	Maximum score
Sampling method (was it representative of a target subnational population?)	Nationally representative	2	2
	Ambiguous	1	
	Not representative	0	
Appropriateness of statistical analysis	Yes	1	1
	No	0	
Case ascertainment (was it based on accepted definition, or not reported?)	Standard case definition	2	2
	Unclear	1	
	Not-reported	0	
Total (<i>high (4-5), moderate (2-3), or low quality (0-1)</i>)			5

See supplemental file for details of quality scoring

TABLE 3. Characteristics of studies on harmful use of alcohol in Nigeria

Author	Study period	Location	Zone	Study design	Study setting	Study quality	Mean age (years)	Sample	Prevalence (%)
Agaba et al (33)	2014	Jos, Plateau State	North-central	Descriptive cross-sectional study	Urban	High	44	883	24.0
Azodo et al (34)	2011	Abuja, Nassarawa & Kano	North-central, North-west	Descriptive cross-sectional study	Urban	Mode rate	32.5	146	45.9
Anyanwu et al (35)	2015	Abakaliki, Ebonyi State	South-east	Population-based cross-sectional study	Urban	Mode rate	17	620	29.0
Fatoye & Morakinyo (36)	2001	Ilesa, Osun State	South-west	Descriptive cross-sectional study	Semi-urban	High	17	567	13.4
Ibekwe (37)	2012	Oghara, Delta State	South-south	Descriptive cross-sectional study	Rural	Mode rate	36.7	272	43.4
Makanjuola et al (38)	2004	Ilorin, Kwara State	North-central	Descriptive cross-sectional study	Urban	High	22.4	961	38.0
Morakinyo et al (39)	2000	Ibadan, Oyo State	South-west	Population-based cross-sectional study	Urban	Mode rate	15	180	30.6
Odugbemi et al (40)	2010	Tejuosho, Lagos	South-west	Descriptive cross-sectional study	Urban	Mode rate	43.3	400	22.5
Lawoyin et al (41)	1998	Idikan Ibadan, Oyo State	South-west	Population-based cross-sectional study	Rural	Mode rate	55	214 4	17.6

Ige et al (42)	2013	Ibadan, Oyo State	South-west	Descriptive cross-sectional study	Urban	High	37.4	525	5.1
Ugwuja et al (43)	2008	Abakaliki, Ebonyi State	South-east	Descriptive cross-sectional study	Urban	High	40.9	205	23.9
Onofa et al (44)	2016	Abeokuta, Ogun State	South-west	Descriptive cross-sectional study	Urban	Mode rate	23.6	123 3	34.3
Onyeonoro et al (45)	2015	Umuahia, Abia State	South-east	Population-based cross-sectional study	Semi-urban	Mode rate	40.5	298 3	55.6
Oshodi et al (46)	2008	Surulere, Lagos State	South-west	Descriptive cross-sectional study	Urban	Mode rate	15.9	402	8.5
Owonaro & Eniojukan (47)	2015	Amassoma, Bayelsa State	South-south	Descriptive cross-sectional study	Urban	High	24	254	53.9
Yisa et al (48)	2009	Ibadan, Oyo State	South-west	Descriptive cross-sectional study	Urban	Mode rate	15	510	6.7
Abasiubong et al (49)	2005	Eket, Akwa-Ibom State	South-south	Descriptive cross-sectional study	Mixed	Mode rate	17.1	254	56.3
Abayomi et al (50)	2013	Abeokuta, Ogun State	South-west	Descriptive cross-sectional study	Urban	Mode rate	21	443	40.6
Abiona et al (51)	2006	Ile-Ife, Osun State	South-west	Descriptive cross-sectional study	Semi-urban	Mode rate	34.5	399	47.0
Chikere et al (52)	2009	Owerri, Imo State	South-east	Descriptive cross-sectional study	Urban	Mode rate	24.7	482	27.0
Eze et al (53)	2017	Nsukka, Enugu	South-east	Descriptive cross-sectional study	Semi-urban	Mode rate	17.2 5	130 2	50.0
Gureje et al	2007	National	National	Population-based	Mixed	High	34	675	19.9

(21)				cross-sectional study				2	
Chukwuonye et al (54)	2012	Abia State	South-east	Descriptive cross-sectional study	Mixed	High	41.7	297 7	30.5
Lasebikan et al (55)	2015	Ibadan, Oyo State	South-west	Descriptive cross-sectional study	Urban	High	40.7 7	111 9	39.5
Lasebikan et al (56)	2015	Oyo State	South-west	Population-based cross-sectional study	Mixed	High	65	214 9	7.8
Lasebikan et al (57)	2011	Oyo State	South-west	Population-based cross-sectional study	Rural	High	24.4 5	120 3	57.9
Odenigbo et al (58)	2008	Asaba, Delta State	South-south	Population-based cross-sectional study	Semi-urban	Mode rate	41.5 9	100	42.0
Forrest et al (59)	1992	Benin, Edo State	South-south	Population-based cross-sectional study	Urban	High	41.1	464	64.9
Oguoma et al (60)	2015	Kwale, Delta State	South-south	Population-based cross-sectional study	Mixed	Mode rate	39.9	422	54.6
Ezejimofor et al (61)	2014	Niger Delta, Delta State	South-south	Community-based cross-sectional study	Rural	High	44.3 2	202 8	28.3
Ezekwesili et al (62)	2016	Anambra State	South-east	Population-based cross-sectional study	Mixed	Mode rate	38	912	6.5
Ogah et al (63)	2012	Umuahia, Abia State	South-east	Population-based cross-sectional study	Mixed	High	41.7	298 3	46.9
Suleiman et al (64)	2011	Amassoma, Bayelsa State	South-south	Descriptive cross-sectional study	Semi-urban	Mode rate	50.5	400	43.8
Ugwuja et al (65)	2015	Igbeagu, Ebonyi State	South-east	Population-based cross-sectional study	Rural	Mode rate	41	267	53.9

Wahab et al (66)	2006	Katsina, Katsina State	North-west	Population-based cross-sectional study	Urban	Mode rate	37.6	300	5.70
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Table 4. Pooled crude estimates of prevalence of harmful use of alcohol in Nigeria

		Both sexes		Men		Women	
		<i>Prevalence % (95% CI)</i>	<i>I², P-value</i>	<i>Prevalence % (95% CI)</i>	<i>I², P-value</i>	<i>Prevalence % (95% CI)</i>	<i>I², P-value</i>
Nation-wide		34.3 (28.6-40.1)	99.5, <0.001	43.9 (31.1-56.8)	99.4, <0.001	23.9 (16.4-31.4)	99.1, <0.001
Geopolitical zone	North-central	31.0 (17.3-44.7)	97.7, <0.001	33.8 (29.8-37.8)	-	9.9 (6.8-13.0)	-
	North-west	25.6 (13.8-65.0)	98.8, <0.001	34.2 (11.8-80.1)	98.5, <0.001	11.3 (8.9-31.4)	91.4, <0.001
	South-east	35.9 (23.0-48.9)	99.6, <0.001	51.8 (34.7-68.9)	98.4, <0.001	33.0 (22.0-43.9)	96.6, <0.001
	South-south	50.2 (38.9-61.4)	98.1, <0.001	73.5 (66.6-80.4)	74.5, 0.008	39.5 (31.2-47.8)	76.8, 0.005
	South-west	25.4 (16.7-34.1)	99.4, <0.001	29.1 (14.4-43.7)	99.2, <0.001	17.4 (6.8-28.0)	99.6, <0.001
Settings	Rural	40.1 (24.2-56.1)	99.4, <0.001	40.5 (4.0-85.0)	99.7, <0.001	34.9 (1.0-68.8)	99.6, <0.001
	Mixed	31.6 (20.1-43.0)	99.7, <0.001	49.2 (6.7-91.8)	99.8, <0.001	26.2 (3.8-48.6)	99.6, <0.001
	Urban	31.2 (22.9-39.6)	99.1, <0.001	40.3 (22.6-58.0)	99.2, <0.001	18.5 (11.8-25.2)	97.0, <0.001

TABLE 5. Absolute number of harmful alcohol users in Nigeria, aged 15 years or more, 1995 and 2015

Age (years)	1995			2015		
	Prevalence (%)	Population (000)	Cases (000)	Prevalence (%)	Population (000)	Cases (000)
15-19	39.2	11875.9	4652.735	33.2	18603.9	6179.8
20-24	39.0	9732.1	3795.3	33.0	15981.8	5280.1
25-29	38.8	7814.7	3033.5	32.9	14051.0	4616.9
30-34	38.6	6586.9	2545.1	32.7	12102.3	3954.8
35-39	38.5	5534.3	2128.3	32.5	9982.6	3244.2
40-44	38.3	4611.6	1765.2	32.3	7767.7	2510.4
45-49	38.1	3894.2	1483.6	32.1	6008.7	1931.1
50-54	37.9	3330.8	1263.0	32.0	4993.8	1595.9
55-59	37.7	2690.9	1015.5	31.8	4146.1	1317.6
60-64	37.6	2091.0	785.3	31.6	3325.7	1050.9
65-69	37.4	1544.5	577.3	31.4	2554.200	802.5
70-74	37.2	1031.8	383.8	31.2	1821.5	569.0
75-79	37.0	581.5	215.3	31.1	1077.6	334.7
80+	36.7	353.3	129.8	30.8	721.8	222.0
All (15+)	38.5	61673.5	23773.8	32.6	103138.8	33609.8

Note: Estimates based on the epidemiologic modelling from all datapoints (see **Figure 6** and **Supplemental file**).