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Pattern of Consumption of Dietary and Herbal Supplements by Individuals with Non-Communicable Diseases During Covid-19 Pandemic in Nigeria

Bamgboye M. Afolabi[1,2iD*], Susan A. Holdbrooke[1iD], Oluwatosin O. Odubela[1]
[1]*Department of Biochemistry and Nutrition, Nigerian Institute of Medical Research, 6 Edmond Crescent Yaba, Lagos State, Nigeria*
[2]*Health, Environment and Development Foundation, 18, Ogunfunmi Street, Surulere, Lagos State, Nigeria*

Corresponding Author: **Bamgboye M. Afolabi** ORCID iD
Address: Department of Biochemistry and Nutrition, Nigerian Institute of Medical Research, 6 Edmond Crescent, Yaba, Lagos, Nigeria; Tel: +234 (0) 803 049 0729; Email: bmafolabi@gmail.com
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Abstract

Abstract: Cognizance of the implication of Covid-19 pandemic on health and well-being resulted in an upsurge in use of several dietary and herbal supplements (DHS) for the prevention and/or prophylaxis against the new disease.

Objectives: To evaluate the pattern of DHS consumption among Nigerians with Non-Communicable Diseases (NCD) for the prevention and treatment of COVID-19.

Design: Cross-sectional questionnaire survey. Setting: Adolescents, and adults residing in Nigeria.

Participants: Participants with NCD (n = 165) from a larger study (n=645) were recruited from different geo-political zones and various ethnic groups.

Primary and Secondary Outcomes: Prevalence and determinants of the use of different DHS for the prevention and treatment of COVID-19 in Nigeria, and sources of information for DHS use.

Results: Hypertension was the most prevalent NCD (63.6%) in the study and both breast cancer and anxiety disorder were the least (0.6%). Overall, 75.2% of the respondents had less than 8 hours of sleep daily and almost all did not smoke cigarette at all. The proportion of male and female hypertensives who believed that dietary supplements are necessary during infectious disease outbreak such as Covid-19 was moderately high (55.2%), higher among asthmatics (65.0%), diabetes (68.4%), those with kidney disease (100.0%) and ulcer (83.3%). All or almost all the respondents with hypertension (96.2%), asthma (95.0%), diabetes (100.0%) and kidney disease (100.0%), consumed supplements more during Covid-19 pandemic in Nigeria. The proportion of those who consumed supplements more during the pandemic in Nigeria was higher among male (56.4%) than among the female (43.6%) hypertensives, though the difference was not statistically significant (χ^2=2.93, P-value=0.09). Vitamin C was the commonest vitamin taken by respondents with ulcer (83.3%), kidney disease (83.3%), diabetes (57.9%), asthma (50.0%), hypertension (48.6%) and the two respondents with breast cancer (1, 100.0%) and anxiety disorder (1, 100.0%) respectively. Calcium and zinc were the commonest minerals taken by respondents with ulcer (50.0%, 16.7%), diabetes (10.5%, 5.3%), asthma (30.0%, 10.0%) and hypertension

(13.3%, 11.4%) respectively. High proportions (83.3%, 80.0%) of those with kidney disease and with asthma consumed DHS to maintain good health. Health workers were the dominant source of information for most on the use of supplements during Covid-19 pandemic in Nigeria.

Conclusions: The findings showed widespread use of DHS for the prevention and treatment of COVID-19 among persons with NCD. The use of DHS in this study was mainly guided by health workers with a marginal role of social media and Mass media. These findings call for a more robust consolidative tactic towards DHS to ensure its proper and safe use.

Keywords

Black Africans, Consumption, Covid-19, Dietary, Herbal, Micro-nutrients, Non-Communicable Diseases, Supplements

Introduction

The period 2019 to the end of 2021 witnessed crisis in global health that remains unprecedented in human history, caused by the Coronavirus Disease, eventually designated as COVID-19 by the World Health Organization (WHO). The disease is defined as a severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) which was formally known as 2019-nCoV, initially detected amid an outbreak of respiratory illness cases in Wuhan City, Hubei Province in People's Republic of China [1] in early December 2019 and reported to WHO later in the month. A series of events happened to identify, categorize, contain the spread and to inform the public, including the declaration of the disease as a Public Health Emergency of International Concern (PHEIC) by the WHO on January 30, 2020 [2-4], and as a global pandemic on March 11, 2020 [5]. By the end of 2021, over 200 countries have been affected causing a heavy health burden to individuals, families, communities, societies, countries, and health care systems throughout the world to deter and contain the pandemic [6]. Seven of the vast family of viruses known as Coronavirus are believed to be zoonotic, causing disease in humans [7].

On 23 December 2021, WHO decided that the main route by which humans get infected by SARS-CoV-12 is through exposure to respiratory droplets, generally within 6 feet radius [8]. Studies later found out other ways people are infected such as contact spread by shaking hands and airborne transmission [9] of "droplets that linger in the air over long distance (usually greater than 6 feet)" [10-12]. Covid-19 pandemic brought shock, panic, fear, uncertainty, distrust, conspiracy theories, disease, and death to spread throughout the world. This was brought about mainly by the rapidity with which the disease spread throughout the world causing over 175,850,000 infections and 3.8 million deaths by June 2020 [6]. Probably because of the rapidity with which many vaccines were developed, tested, and approved in order to mitigate the morbidity and mortality associated with Covid-19, many people distrusted the efficacy of such vaccines. There were a flurry of misinformation and conspiracy theories that were circulated through the social and mass media on side effects of vaccines and most people doubted the safety and effectiveness of these vaccines.

World Health Organization reported a wide range of symptoms including fever, chills, muscle or body aches, anorexia, and headache which make Covid-19 resemble malaria infection; cough, sore throat, nasal congestion, or rhinorrhea render it flu-like; prolonged cough, fever, and dyspnea probably confirm pneumonia; and added to these are diarrhea, and loss of taste and/or smell [13]. The possibility of severe disease rises with people's age while, regardless of the age, those with underlying medical ailments such as cardiac, metabolic, pulmonary or neoplastic diseases may be at higher risk of severe Covid-19 infection relative to others without these conditions [13]. The virus itself, discovered using metagenomic RNA sequencing and virus sequestration from bronchoalveolar lavage fluid samples from patients with severe pneumonia, is a beta-coronavirus previously unknown [14-16].

Nigeria, a developing and the most populated country in Africa, experienced some measures of severe outbreak of the Covid-19 pandemic during the study period. The trepidation caused by Covid-19 pandemic, the globally high morbidity and mortality rates, coupled with the already-known weak health systems in most parts of Africa probably drove many people, especially those with non-communicable diseases, who are more prone to Covid-19 infection, to seek other ways of maintaining good health during the pandemic. This also is probably why some increased the consumption of dietary and herbal supplements. Dietary supplements, defined as usable amounts of micronutrients, have become a growing interest during the Covid-19 as they are widely used to potentially improve immune health [17]. A study reports that supplementation of a combination of magnesium, vitamin D and vitamin B12 resulted in significant reductions in clinical deterioration, need for oxygen support and intensive care support of elderly Covid-19 patients [18]. Also, the hypothetical impacts of supplementing vitamin C, zinc, vitamin D, and probiotics on Covid-19 consequences have also been studied with diverse findings, and several studies are also still underway [19].

Nigerian governments at all levels, the Nigerian Center for Disease Control (NCDC), primary, secondary, and tertiary health facilities across the country and the Nigerian Institute of Medical Research mobilized all resources to gather data, curtail the spread of the disease and give vaccines to as many people as possible. However, there is paucity of data on dietary and herbal supplements consumed by those with non-communicable diseases during the pandemic. The primary objective of this paper therefore was to evaluate the pattern of consumption of dietary and herbal supplements during the Covid-19 pandemic among persons with NCDs. The secondary objectives were to assess the knowledge, attitude, practice, and perception of dietary and herbal supplements at this period and document the source of information on use of DHS by this cohort.

The authors of this paper are not aware of any authorization from or by the National Food and Drugs Administration and Control (NAFDAC) in Nigeria for anyone to consume any dietary and herbal supplement for the prevention, treatment, or management of Covid-19.

Materials and Method

Study Design:

This questionnaire-based cross-sectional study was designed and served to Nigerians aged 18 years and above to explore and describe their consumption pattern of dietary and herbal supplements (DHS) during the Covid-19 pandemic. Almost all the study subjects, were able to read and understand English. Information collected from respondents included socio-demographic characteristics (age, sex, educational status, employment status, and marital status), health status, knowledge, attitude, and behavioral pattern on the use of DHS.

Nigerian Institute of Medical Research, where this study was developed, conducted, and analyzed is the sole medical research institute of the Federal Government. The Institute consists of the departments of Biochemistry and Nutrition (where the study was designed), Human Virology, Clinical Trials, Public Health, and Microbiology. Because of restriction of movements due to lock-down policy by the government, hard copy questionnaire survey was conducted in Lagos State. However, Google form questionnaire was sent to other parts of the country using the internet. Though a minimum of 500 responses were expected, filled questionnaires were received from only 216 people.

Reasons for non-response included (i) time limit of one week that was given (ii) the survey took place during the pandemic when people were stressed because of lock-down, social distance and other restrictions (iii) many questionnaires were circulating online during the pandemic and (iv) response fatigue on the part of the study subjects. This poor response rate from Google form prompted the administration of hard copies of the questionnaire in various communities in metropolitan Lagos, southwest Nigeria, a multi-ethnic city of about 20 million people. Five questionnaire administrators, trained in inter-personal communication, retrieved responses from the study subjects. These questionnaire administrators had received their Covid-19 vaccine, and observed all precautions such as wearing face mask, using hand sanitizers, and maintaining social distance when conducting face-to-face interviews. In addition, all questionnaires and materials for writing were equally disinfected appropriately before and after use. Any respondents not wearing a face-mask or whose face-mask was defective was provided with a new face-mask to wear properly. Each respondent had his or her hand thoroughly sanitized. The very few respondents who could not read or write had the questionnaire read to them. Participants' unique identifier, as well as the intention of the survey, the process and the duration of time needed to finish each questionnaire were specified in the early part of each questionnaire.

Inclusion/Exclusion Criteria:

The only inclusion criteria to participate in the study were age of 18 years and above and residence within Nigeria as there were hardly any visitor from outside the country during the Covid-19 pandemic.

Ethical Clearance:

The study protocol, the questionnaire and the consent form were reviewed and approved by the Research and Ethics Committee at the Nigerian Institute of Medical Research (IRB/20/039). Both in the hard copy and Google form of the questionnaire, study participants were assured of concealment of personal identity, confidentiality, and choice to decline at any point in the filling of the questionnaire before the survey started. On-line study responders had to accept to participate after agreeing to terms and conditions of the study before the questionnaire could be accessed electronically.

Definition:

For the purpose of this study, dietary and/or herbal supplements were defined as any ingredient (except tobacco products) that are consumed as nutrients or micronutrients to prevent and treat Covid-19 infection.

Statistical Analysis of Data:

Data was first extracted from Google Form as a Microsoft Excel Spreadsheet (Microsoft Corporation) and concatenated with data from hard copy questionnaire. The completed data in the Excel spreadsheet was then cleaned, coded, and exported into NCSS v2022 (Kaysville, Utah, USA) statistical software for Windows before it was analyzed, using appropriate commands. Descriptive statistical analyses concerning frequency and percentage distribution were performed for all demographic variable and the results of these were specified as numbers (n) and percentages (%). Continuous variables were reported as mean (±standard deviation [SD]) for normally distributed variables. Pearson correlation (χ^2) with Odd Ratio (OR) at 95% Confidence Interval (CI) were carried out to determine the relationship between categorical variables of interest. P-values <0.05 were considered statistically significant. Results were rendered as Tables, Graphs and Figures

Results

Data of NCDs that occurred in very low frequencies – kidney disease (6, 3.6%), ulcer (6, 3.6%), sickle cell disease (5, 3.0%), liver disorder (2, 1.2%), breast cancer (1, 0.6%) and anxiety disorder (1, 0.6%) – are not included in any of the Tables or Figures (except Figures 3 and 4) but are written as narratives under appropriate sub-headings.

Flowchart of Recruitment of Study Participants (**Fig-1**):

This paper is part of a larger study from which data of participants with NCDs have been extracted for analysis. The flow chart which illustrates participants' recruitment into the study is shown in Figure 1. Of the 782 questionnaires served, 726 (92.8%) were filled out of which 81 (11.2%) were excluded due to incomplete data, leaving 645 questionnaires that were finally analyzed. Of the remaining 645 completely filled questionnaires, 9 domains of NCD were identified in which 105 respondents were hypertensives, 20 were asthmatics, 19 were diabetics, 6 had renal disease, another 6 had ulcer, 5 had Sickle Cell Disease, 2 were with hepatic disease and one each with breast cancer and anxiety disorder.

Socio-Demographic Characteristics of Respondents Relative to Disease Entity (**Table-1**):

Among the 645 respondents in this questionnaire-based survey, 165 (25.6%) have been diagnosed with various non-communicable diseases (NCD) categorized

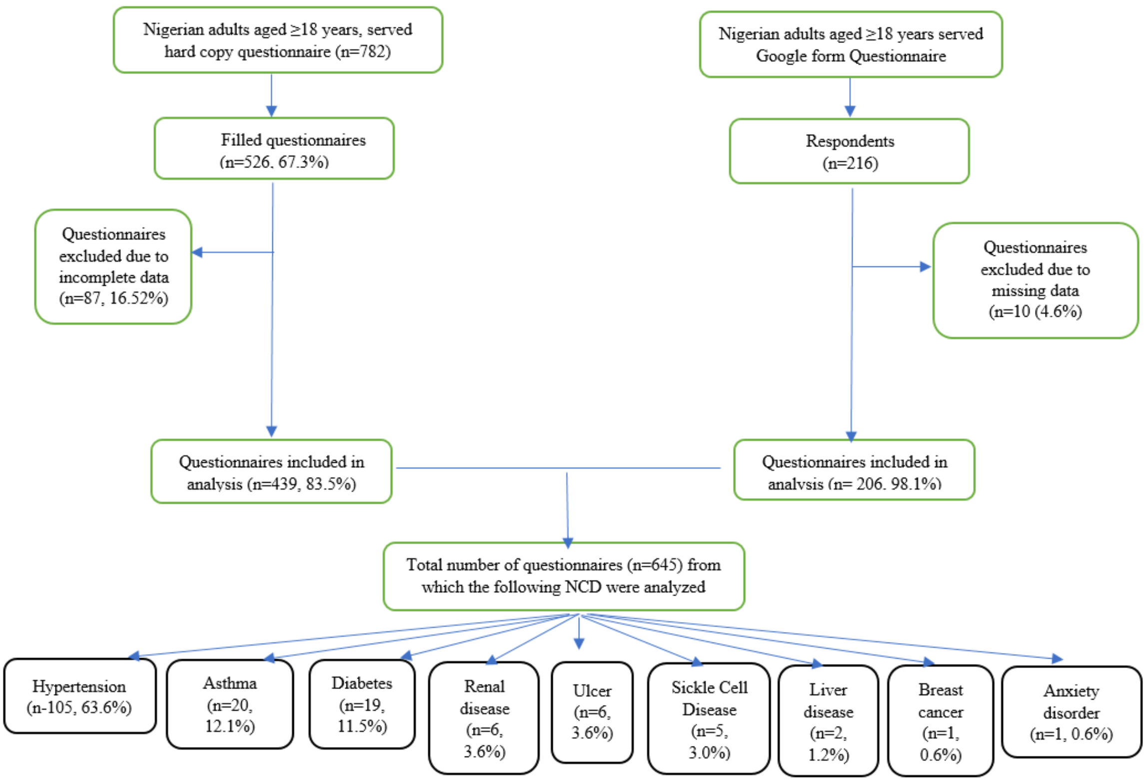

Fig-1: Flowchart of Recruitment of Study Participants

Table-1: Socio-Demographic Characteristics of Respondents Relative to Disease Entity

Variable	Category	Statistics	Non-communicable Disease entity		
			Hypertension	Asthma	Diabetes
	Total (%)		105 (63.6)	20 (12.1)	19 (11.5)
Age (yrs)		Mean (±sd)	52.0 (12.2)	46.5 (15.3)	54.4 (10.2)
		Median	50	45	59
		Min./Max.	28/80	24/69	36/66
Age group (yrs)	<50	Frequency (%)	48 (45.7)	10 (50.0)	7 (36.8)
	≤50		57 (54.3)	10 (50.0)	12 (63.2)
Gender	Male		57 (54.3)	4 (20.0)	14 (73.7)
	Female		48 (45.7)	16 (80.0)	5 (26.3)
Marital status	Single		5 (4.8)	5 (25.0)	2 (10.5)
	Ever married		100 (95.2)	15 (75.0)	17 (89.5)
Educational status	Primary		2 (1.9)	1 (5.0)	2 (10.5)
	Secondary		27 (25.7)	5 (25.0)	5 (26.3)
	Tertiary		76 (72.4)	14 (70.0)	12 (63.2)
Occupation	Employed		63 (60.0)	14 (70.0)	4 (21.1)
	Unemployed		28 (26.7)	6 (30.0)	10 (52.6)
	Trader		5 (4.8)	0 (0.0)	3 (15.8)
	Retired		9 (8.6)	0 (0.0)	2 (10.5)
Religion	Christianity		79 (75.2)	18 (90.0)	9 (47.4)
	Islam		26 (24.8)	2 (10.0)	10 (52.6)

as high, low, and very low prevalence. The NCD with high prevalence was hypertension (105, 63.6%), those with low prevalence were asthma (20, 12.1%), and diabetes (19, 11.5%) and those with very low prevalence were kidney disease (6, 3.6%), ulcer (6, 3.6%), sickle cell disease (5, 3.0%), liver disorder (2, 1.2%), breast cancer (1, 0.6%) and anxiety disorder (1, 0.6%). The socio-demographic characteristics of subjects with hypertension, asthma and diabetes are as illustrated in Table 1 which shows hypertension as the most prevalent NCD followed by asthma and diabetes mellitus. There was no significant difference (F-statistic=1.23, P-value=0.29) in the overall mean ±sd ages (years) of respondents with hypertension (52.0±12.2), asthma (46.5±15.3) or diabetes (54.4±10.2). Pooled analysis shows no significant difference (χ^2=0.73, P-value=0.69) in the proportion of hypertensive (48, 45.7%; 57 54.3%), asthmatic (10, 50.0%; 10, 50.0%;) and diabetic (7, 36.8%, 12, 63.2%) respondents in the age groups of <50 years or ≥50 years. However, there was a significant difference (χ^2=12.01, P-value=0.003) in the distribution, by sex, of hypertension (male: 57, 54.3%, female: 48, 45.7%), asthma (male: 4, 20.0%, female: 16, 80.0%) and diabetes (male: 14, 73.7%, female: 5, 26.3%). Pooled analysis shows a significant difference (F-statistics=3.97, P-value=0.04) in the mean ages of respondents with renal disease (n=6, 64.3±17.9), ulcer (n=6, 50.0±6.0), and SCD (n=5, 46.2±3.4) but not in the mean ages (F-statistics=2.21, P-value=0.43) of those with hepatic disorder (n=2, 27.0±9.9), breast cancer (n=1, 50.0±0.0) and anxiety disorder (n=1, 45.0±0.0).

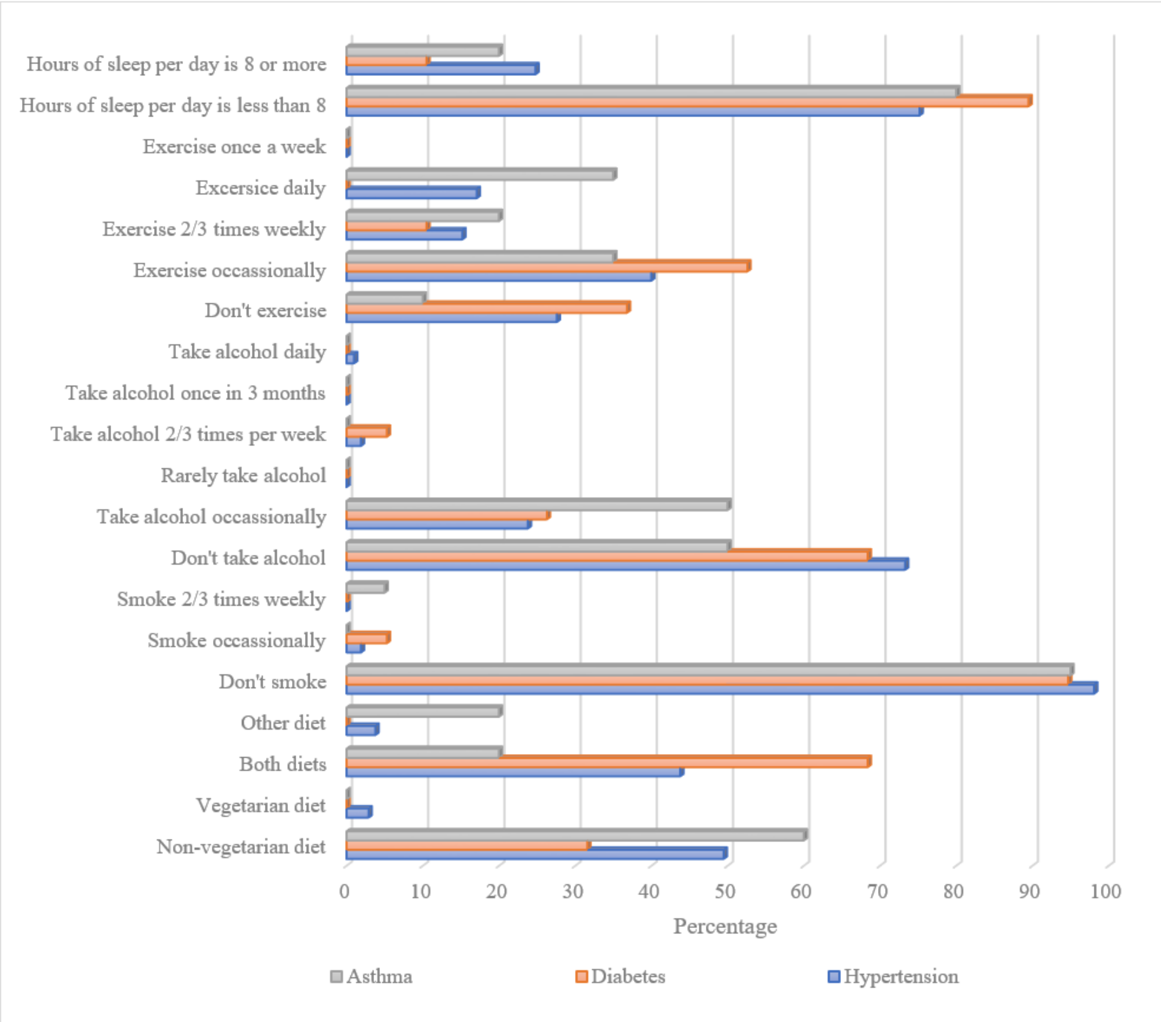

Fig-2: Frequency Distribution of Dietary Pattern, Social Habits, and Daily Sleep Duration

Frequency Distribution of Dietary Pattern, Social Habits, and Daily Sleep Duration (**Fig-2**):

Majority of the study participants, irrespective of their disease entity, did not smoke at all, while those with kidney disease and anxiety disorder never took alcoholic drink. The only total vegetarian was the respondent with breast cancer who also did not engage in any formal exercise. The highest proportion (50.0%) of those who engaged in formal exercise on daily basis was among those with kidney disease. Interestingly, respondents with most of the NCDs reported having less than 8 hours of sleep per day while 10.5% of the diabetics and the respondent with breast cancer reported having more than 8 hours of sleep per day. Almost all respondents with other NCDs never smoked cigarette, a minimum of 50% never took alcohol and in a minimum of 66.7% was the hours of sleep less than 8 hours per day.

Knowledge of Dietary Supplements by Persons with Non-Communicable Diseases Relative to Sex and Age Group (**Table-2**):

The proportion of hypertensives (males and females) who believed that dietary supplements are necessary during infectious disease outbreak such as Covid-19 was moderately high (58/105, 55.2%; 57.9% males, 52.1% females) while the proportion was higher among those with low prevalent NCD such as asthma (13/20, 65.0%) and diabetes (58/105, 68.4%) and still higher among respondents with kidney disease (2/2,

Table-2: Knowledge of Dietary Supplements by Persons with Non-Communicable Diseases Relative to Sex and Age Group

Disease	Variable	Category	Dietary supplements are necessary during infectious disease outbreak such as COVID-19			Supplements can be used exclusively to treat COVID-19			Supplements can be used in conjunction with other drugs to treat COVID-19		
			Yes	No	Don't know	Yes	No	Don't know	Yes	No	Don't know
Hypertension (n=105)	Sex	All	58 (55.3)	18 (17.1)	29 (27.6)	8 (7.6)	60 (57.1)	37 (35.3)	58 (55.3)	18 (17.1)	29 (27.6)
		Male	33 (57.9)	10 (17.5)	14 (24.6)	1 (1.8)	32 (56.1)	24 (42.1)	32 (56.1)	7 (12.3)	18 (31.6)
		Female	25 (52.1)	8 (16.7)	15 (31.2)	7 (14.6)	28 (58.3)	13 (27.1)	26 (54.2)	11 (22.9)	11 (22.9)
		χ² (P-value)	0.59 (0.74)			7.53 (0.03) *			2.45 (0.29)		
	Age group (yrs.)	<50	22 (45.8)	11 (22.9)	7 (31.3)	4 (8.3)	32 (66.7)	12 (25.0)	29 (60.4)	8 (16.7)	11 (22.9)
		≥50	36 (63.1)	7 (12.3)	14 (24.6)	4 (7.0)	28 (49.1)	25 (43.9)	29 (50.9)	10 (17.5)	18 (31.6)
		χ² (P-value)	3.74 (0.15)			4.36 (0.13) *			1.15 (0.56)		
Asthma (n=20)	Sex	All	13 (65.0)	2 (10.0)	5 (25.0)	0 (0.0)	18 (90.0)	2 (10.0)	15 (75.0)	4 (20.0)	1 (5.0)
		Male	1 (25.0)	1 (25.0)	2 (50.0)	0 (0.0)	3 (75.0)	1 (25.0)	1 (25.0)	2 (50.0)	1 (25.0)
		Female	12 (75.0)	1 (6.3)	3 (18.7)	0 (0.0)	15 (93.8)	1 (6.2)	14 (87.5)	2 (12.5)	0 (0.0)
		χ² (P-value)	3.46 (0.18) *			1.02 (0.31) *			7.12 (0.03) *		
	Age group (yrs.)	<50	6 (60.0)	1 (10.0)	3 (30.0)	0 (0.0)	8 (80.0)	2 (20.0)	8 (80.0)	1 (10.0)	1 (10.0)
		≥50	7 (70.0)	1 (10.0)	2 (20.0)	0 (0.0)	10 (100.0)	0 (0.0)	7 (70.0)	3 (30.0)	0 (0.0)
		χ² (P-value)	0.28 (0.87) *			3.00 (0.08) *			2.50 (0.29) *		
Diabetes mellitus (n=19)	Sex	All	13 (68.4)	3 (15.8)	3 (15.8)	3 (15.8)	13 (68.4)	3 (15.8)	9 (47.4)	4 (21.0)	6 (31.6)
		Male	10 (71.4)	3 (21.4)	1 (7.2)	1 (7.2)	12 (85.7)	1 (7.2)	6 (42.9)	3 (21.4)	5 (35.7)
		Female	3 (60.0)	0 (0.0)	2 (40.0)	2 (40.0)	1 (20.0)	2 (40.0)	3 (60.0)	1 (20.0)	1 (20.0)
		χ² (P-value)	4.04 (0.13) *			7.36 (0.03) *			0.54 (0.76) *		
	Age group (yrs.)	<50	2 (28.6)	0 (0.0)	5 (71.4)	0 (0.0)	5 (71.4)	2 (28.6)	1 (14.3)	2 (28.6)	4 (57.1)
		≥50	11 (91.7)	0 (0.0)	1 (8.3)	3 (25.0)	8 (66.7)	1 (8.3)	8 (66.6)	2 (16.7)	2 (16.7)
		χ² (P-value)	8.44 (0.004) *			3.87 (0.14) *			5.55 (0.06) *		

**=Fisher's exact test applied*

100.0%), ulcer (5/6, 83.3%) and liver disease. While only 15.8% of the hypertensives believed that supplements can be used exclusively to treat Covid-19 infection, none of the asthmatics and 7.6% of those with diabetes believed such notion. However, 55.2% of the hypertensives, 75.0% of the asthmatics and 47.4% of the diabetics asserted that supplements can be used in conjunction with other drugs to treat Covid-19. Among respondents with low frequency NCD, the highest proportion of those who asserted that supplements can be used in conjunction with other drugs to treat Covid-19 were those with ulcer (83.3%).

Consumption and Frequency of Dietary Supplements Use During Covid-19 Pandemic in Nigeria Relative to Sex and Age Group (**Table-3**):

Almost all the respondents with hypertension (101/105, 96.2%), asthma (19/20, 95.0%), diabetes (19/19, 100.0%) and kidney disease (6/6, 100.0%), consumed supplements more during Covid-19 pandemic in Nigeria. The proportion of those who consumed supplements more during the pandemic in Nigeria was higher among male (57/101, 56.4%) than female (44/101, 43.6%) hypertensives, though the difference was not statistically significant

Table-3: Consumption and Frequency of Dietary Supplements Use During Covid-19 Pandemic in Nigeria Relative to Sex and Age Group

Variable		Category	Did you take dietary supplements more during this Covid-19		If yes, how often did you take dietary supplements				
			Yes	No	Occasionally	Alternate days	Daily	Once a week	Twice a week
Hypertension	All		101 (96.2)	4 (3.8)	23 (22.8)	23 (22.8)	38 (37.6)	10 (9.9)	6 (5.9)
	Sex	Male	57 (56.4)	0 (0.0)	12 (21.1)	15 (26.3)	19 (33.3)	7 (12.3)	4 (7.0)
		Female	44 (43.6)	4 (100)	11 (25.0)	8 (18.2)	19 (43.2)	3 (6.8)	2 (4.5)
	χ^2 (P-value) / OR (95% CI)		2.93 (0.09) / undefined		9.16 (0.10)				
	Age group (yrs.)	<50	45 (44.6)	3 (6.7)	12 (26.7)	16 (35.6)	14 (31.1)	3 (6.7)	2 (4.4)
		≥50	56 (55.4)	1 (25.0)	11 (19.6)	7 (12.5)	24 (42.9)	7 (12.5)	4 (7.1)
	χ^2 (P-value) / OR (95% CI)		0.47 (0.49) / 0.27 (0.03, 2.66); 0.47 (0.49) / 3.73 (0.38, 37.12)		9.08 (0.11)				
Asthma	All		19 (95.0)	1 (5.0)	2 (10.5)	2 (10.5)	12 (63.2)	1 (5.3)	1 (5.3)
	Sex	Male	4 (21.1)	0 (0.0)	0 (0.0)	0 (0.0)	3 (75.0)	0 (0.0)	0 (0.0)
		Female	15 (78.9)	1 (100.0)	2 (13.3)	2 (13.3)	9 (60.0)	1 (6.6)	1 (6.6)
	χ^2 (P-value) / OR (95% CI)		0.00 (1.00) / undefined		9.82 (0.83)				
	Age group (yrs.)	<50	9 (47.4)	1 (100.0)	2 (22.2)	0 (0.0)	6 (66.7)	0 (0.0)	0 (0.0)
		≥50	10 (52.6)	0 (0.0)	0 (0.0)	2 (20.0)	6 (60.0)	1 (10.0)	1 (10.0)
	χ^2 (P-value)		0.00 (1.00) / undefined		11.09 (0.049)				
Diabetes mellitus	All		19 (100.0)	0 (0.0)	1 (5.3)	5 (26.3)	11 (57.9)	1 (5.3)	1 (5.3)
	Sex	Male	14 (76.7)	0 (0.0)	1 (7.2)	5 (35.7)	8 (57.1)	0 (0.0)	0 (0.0)
		Female	5 (26.3)	0 (0.0)	0 (0.0)	0 (0.0)	3 (60.0)	1 (20.0)	1 (20.0)
	χ^2 (P-value) / OR (95% CI)		3.31 (0.07) / undefined		7.75 (0.45)				
	Age group (yrs.)	<50	7 (36.8)	0 (0.0)	1 (14.3)	2 (28.6)	2 (28.6)	1 (14.3)	1 (14.3)
		≥50	12 (63.2)	0 (0.0)	0 (0.0)	3 (25.0)	9 (75.0)	0 (0.0)	0 (0.0)
	χ^2 (P-value)		3.31 (0.07) / undefined		7.85 (0.10)				

(χ^2=2.93, P-value=0.09). Interestingly, hypertensives aged ≥50 years were approximately 4 times more likely to consume supplements more during the Covid-19 pandemic than those aged <50 years (χ^2=0.47, P-value=0.49, OR=3.73, 95% CI:0.38, 37.12). Those with SCD were the lowest in proportion (3/5, 60.0%) among those who consumed supplements more during the Covid-19 pandemic in Nigeria. When respondents were asked about the frequency of consumption of supplements during Covid-19 pandemic in Nigeria, the only respondent with breast cancer reported consuming supplement daily, while of those who took supplements, 60.0% of the asthmatics, 57.9% of the diabetics, 36.5% among the hypertensives, and only 33.3% of those with kidney disease took them daily. Remarkably, the daily consumption of supplements during the Covid-19 pandemic in the country was higher among female respondents with hypertension (19/44, 43.2%), diabetes (3/5, 60.0%), kidney disease (2/2, 100.0%) and among ≥50 years with hypertension (24/56, 42.9%), asthma (6/10, 60.0%) and diabetes (9/12, 75.0%). Almost all respondents with other NCDs increased their intake of DHS during the Covid-19 pandemic in Nigeria in varying frequency but mostly daily and on alternate days.

Dietary Supplements Consumed by Persons with Non-Communicable Diseases During Covid-19 Pandemic in Nigeria (**Table-4**):

The dietary and herbal supplements as well as fruits taken by respondents in each disease entity are shown in Table 4. Vitamin C was the commonest vitamin taken by respondents with ulcer (83.3%), kidney

Table-4: Dietary Supplements Consumed by Persons with Non-Communicable Diseases During Covid-19 Pandemic in Nigeria

Supplement		Non-communicable diseases		
		Hypertension	Asthma	Diabetes
Types of Supplements mentioned as taken				
Vitamins	Vitamin B co	12 (11.4)	3 (15.0)	4 (21.1)
	Vitamin C	51 (48.6)	10 (50.0)	11 (57.9)
	Vitamin D	10 (9.5)	7 (35.0)	2 (10.5)
	Vitamin E	0 (0.0)	3 (15.0)	0 (0.0)
	Folic Acid	8 (7.6)	4 (20.0)	3 (15.8)
	Multivitamin	28 (26.7)	8 (40.0)	4 (21.1)
Minerals	Selenium	3 (2.9)	0 (0.0)	1 (5.3)
	Iron	1 (0.9)	0 (0.0)	1 (5.3)
	Calcium	14 (13.3)	6 (30.0)	2 (10.5)
	Zinc	12 (11.4)	2 (10.0)	1 (5.3)
Types of herbal supplements mentioned as consumed				
Garlic		24 (22.9)	3 (15.0)	5 (26.3)
Ginger		27 (25.7)	2 (10.0)	7 (36.8)
Tumeric		26 (24.8)	4 (20.0)	9 (47.4)
Moringa		11 (10.5)	1 (5.0)	5 (26.3)
Ginseng		2 (1.9)	0 (0.0)	0 (0.0)
Herbal tea		16 (15.2)	2 (10.0)	2 (10.5)
Others		0 (0.0)	3 (15.0)	0 (0.0)
Types of citrus fruits mentioned as consumed				
Lime/Lemon		1 (0.9)	0 (0.0)	0 (0.0)
Apple Cider		2 (1.9)	3 (15.0)	2 (10.5)
Fruits		0 (0.0)	1 (5.0)	0 (0.0)

disease (83.3%), diabetes (57.9%), asthma (50.0%), hypertension (48.6%) and the two respondents with breast cancer (1, 100.0%) and anxiety disorder (1, 100.0%) respectively. Calcium and zinc were the commonest minerals taken by respondents with ulcer (50.0%, 16.7%), diabetes (10.5%, 5.3%), asthma (30.0%, 10.0%) and hypertension (13.3%, 11.4%) respectively. The commonest herbal supplements consumed by respondents with hypertension were ginger (25.7%), turmeric (24.8% and garlic (22.9%). However, a higher proportion of respondents with diabetes consumed ginger (36.8%), turmeric (47.4%) and garlic (26.3%) while a lower proportion of those with asthma consumed ginger (10.0%), turmeric (20.0%) and garlic (15.0%). Surprisingly, negligible proportion of respondents took fruits, which was observed only in 1 (5.0%) respondent with asthma, though slightly higher proportion of them (10.5%) took apple cider during the Covid-19 pandemic. Except for the respondents with liver disorder, almost all other low-frequency NCDs increased their intake of Vitamin C, and to a lesser extent, Vitamin D. Hardly did anyone in low-frequency NCD take mineral supplement. Respondents with gastric ulcer increased their intake of calcium (50.0%) and zinc (16.7%). The only respondent with anxiety disorder also increased his intake of zinc (100.0%). Very few of them consumed either herbal supplements or fruits.

Reasons for The Consumption of DHS During Covid-19 Pandemic in Nigeria (**Fig-3**):

Respondents were then asked for the reasons why they took dietary and herbal supplements during the Covid-10 pandemic in Nigeria. Their responses are illustrated in Figure 2 which shows that "to maintain good health" was the main reason why the two respondents with breast cancer and anxiety disorder, 83.3% of those with kidney disease, 80% of the asthmatics, 64.8% of the hypertensives and 63.2% of the diabetics took supplements during that period. The respondent with anxiety disorder as well as 33.3% of respondents with ulcer and with kidney disease and 26.3% of the diabetics also took supplements to "hasten recovery from current illness".

Source of Information of Practices Related to Food and Dietary Supplements Used to Prevent/Treat COVID-19 (**Fig-4**):

Health workers were the dominant source of information on the use of supplements during Covid-19 pandemic in Nigeria as stated by all the respondents with kidney disease, liver disease, breast cancer and anxiety disorder. However, only 60.0% of asthmatics, 56.2% of the hypertensives and 47.4% of the diabetics got information related to use of supplements at that period from health workers. Social media was also the main source of information of supplement use during

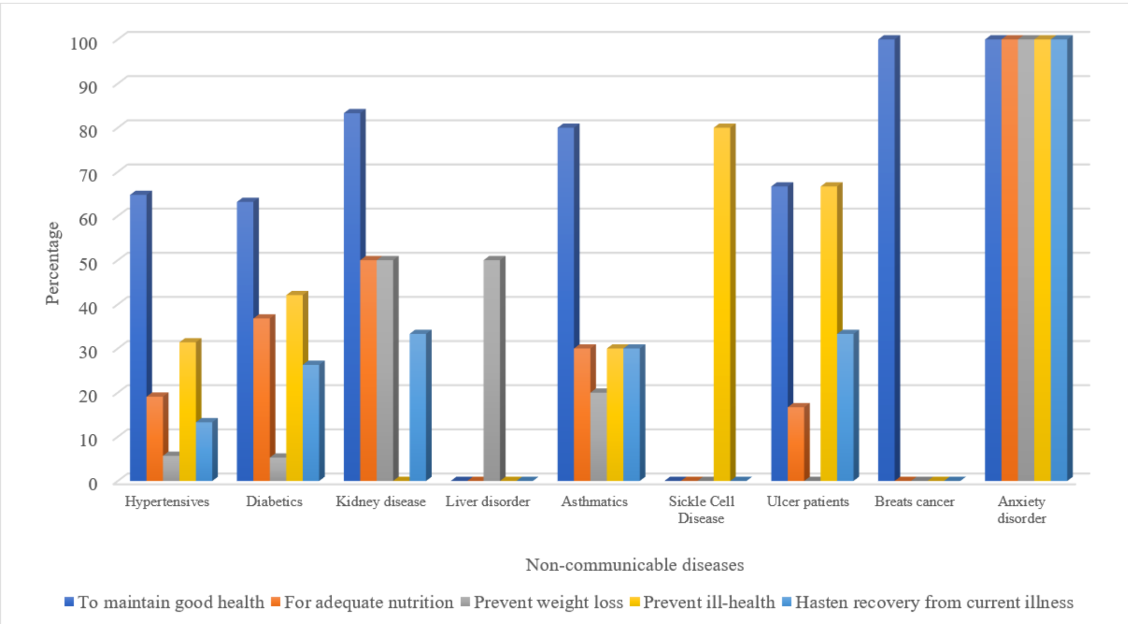

Fig-3: Reasons for The Consumption of DHS During Covid-19 Pandemic in Nigeria

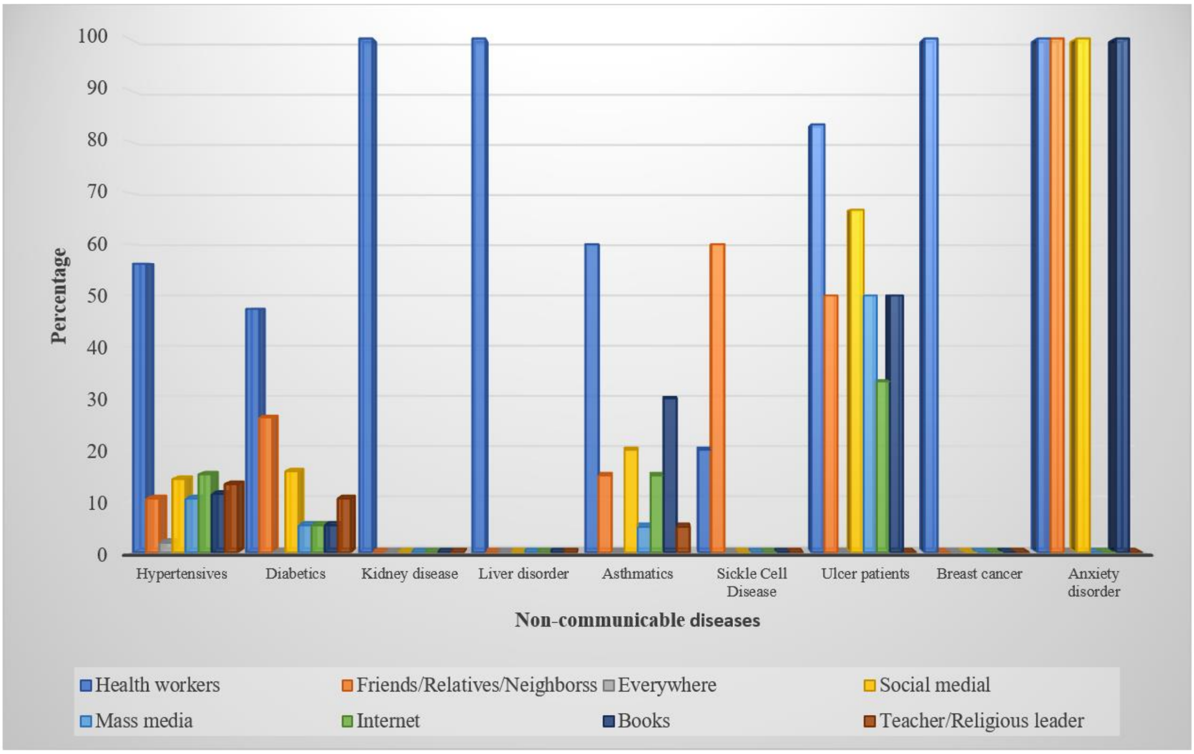

Fig-4: Source of Information of Practices Related to Food and Dietary Supplements Used to Prevent/Treat COVID-19

Covid-19 pandemic in Nigeria for the respondent with anxiety disorder, 66.7% of those with ulcer, and just 20.0%, 15.8% and 14.3% of the asthmatics, diabetics, and hypertensive respectively. The internet as source of information for use of supplements at the time of study was not prominent as only 33.3 % of respondents with ulcer, 15.0% of the asthmatics, 15.2% of the hypertensives and a mere 5.3% of the diabetics sourced information of supplement consumption using this medium of information. Mass media did not feature well as source of information. Only 50.0% of ulcer patients, 15.0% of the asthmatics, 15.2% of the hypertensives and a mere 5.3% of the diabetics used mass media to source for relevant information on supplement use a that period.

Discussion

In this cohort of respondents with non-communicable diseases, hypertension claimed the highest prevalence, followed by asthma and diabetes. The hypertensives, probably the most prevalent of NCDs, are one of those who are highly susceptible to severe outcomes of COVID-19 infection [20]. Nikoloski et al (2021) reported that patients with NCDs such as diabetes, hypertension, chronic respiratory illnesses, chronic kidney, and liver conditions are more likely to be affected by Covid-19 and are more likely to develop a severely critical form of the illness or even die [21]. This is probably due to (i) elevated level of ACE2 (angiotensin-converting enzyme 2) receptor expressions, which assists the viral penetration into host's body and (ii) cytokine storm, a hyperinflammatory response [21].

A plethora of dietary supplements are currently being evaluated for their proficiency in safeguarding and enhancing human immune response to COVID-19, including omega-3 fatty acids, melatonin, and vitamin D, in patients with COVID-19 [22]. This probably is because, as stated by National Institute of Health, "many people are searching for ways to protect themselves against COVID-19" and that sales of supplements increased notwithstanding dearth of dependable indication that these supplements are effective at averting SARS-CoV-2 infection or lessening COVID-19 disease severity [22].

Human immune system consisting of intrinsic reactions in the vanguard of defense, and adaptive responses, protects the body against disease-causing pathogens [23-25]. Though COVID-19 vaccines are reliable and highly efficient at lowering the threat against human health posed by diseases [26,27] and though medications for treatments are also existing and accessible, still no permanent remedy has been found for COVID-19 [22]. For this and probably more reasons, awareness, interest in, and attention to DHS that might boost immune function in the prevention or management of COVID-19 illness was high during the pandemic. Of all the three major NCDs, a higher proportion of diabetics (68.4%) agreed that dietary supplements are necessary during infectious disease outbreak such as Covid-19, more than asthmatics (65.0%) or hypertensives (55.3%). This might be due to many factors including aspiration for lessened disease severity which might be stronger among diabetics, stronger will to prevent Covid-19 infection among diabetics because of their easy susceptibility, current medication taken, affordability of the medication and accessibility to health care. This concept is supported by the result that all diabetics increased consumption of DHS during the pandemic mostly on daily basis (57.9%).

Although a high proportion of hypertensives also increased consumption of DHS during the pandemic, however, the proportion that did so on daily basis was less (37.6%) than the proportion among the diabetics. Diabetes, as a chronic disease, may reduce the quality of life more than hypertension and sufferers may probably indulge more in taking supplements in an attempt not only to prevent Covid-19 infection but also to improve their quality of life. Vitamin C was the most consumed supplements, mainly by diabetic respondents (57.9%), followed by the asthmatics (50.0%) and least by the hypertensive (48.6%).

Studies have shown that, due to its antioxidant effects, Vitamin C has a vital function in both innate and adaptive immunity, in antimicrobial and antiviral actions, and in influencing immune system modulators [28-31]. Report from the study of Carr and Maggini shows that Vitamin C supports epithelial integrity, enhances the diversity and proliferation of B cells and T cells, improves phagocytosis, normalizes cytokine production, and lowers histamine levels [29] while it may also impede viral replication [32]. Interestingly, diabetic respondents were also those who consumed Vitamin B complex mostly (21.1%), than asthmatics (15.0%) and hypertensives (11.4%). Probably, diabetics may have taken their illness more seriously, especially during the pandemic, than hypertensives or asthmatics.

More study, especially in resource-limited countries, need to be conducted on this. While selenium was the mineral least consumed by the diabetics (5.3%), hypertensives (2.9%) and asthmatic (0.0%), a high proportion of asthmatics (30.0%), more than hypertensives (13.3%) and diabetics (10.5%) increased their intake of calcium during the pandemic. While selenium is known to augment the immune systems through enhancing T-cell maturation and role and in natural killer cell function, it is also known to lower the risk of infections [24,33-39]. Studies have also shown that selenium's anti-oxidant property may assist in reducing systemic inflammatory response causing acute respiratory distress syndrome and organ failure [35,37,40]. Alexander et al [40] ascertained that selenium and other minerals and vitamins such as zinc and vitamin D are indispensable for fighting viral infections, for optimal immune function, lowering inflammation and protecting against the novel coronavirus SARS-CoV-2. Vitamin E, which was not consumed by diabetic or hypertensive responders and by a mere 15.0% of asthmatics is known to reduce inflammation by preventing the production of pro-inflammatory cytokines [41]. Studies found that Vitamin E deficiency weakens humoral and cell-mediated immunity and elevates vulnerability to infections [36,42,43]. More diabetic respondents increased their consumption of garlic (26.3%), ginger (36.8%), turmeric (47.4%) and moringa (26.3%) than asthmatics (15.0%, 10.0%, 20.0% and 5.0% respectively) or hypertensives (22.9%, 257%, 24.8% and 10.5% respectively). In a case control study, Wang et al reported that, among other observations, patients with Covid-19 who received garlic essential oil had lesser duration of symptoms, shorter time to negative nucleic acid testing (NAT) results and shorter time to improvement on the computed tomography (CT) [44]. The use of ginger, garlic, and turmeric among respondents with diabetes, asthma and hypertension in this study was much less than the 87.1%, 78.9%, 57.9% use of these herbal supplements among the general public in another study [45].

Of the respondents with high frequency NCDs, asthmatics were those who mostly (60.0%) depended on health workers as source of information for use of supplements during the Covid-19 pandemic, followed by the hypertensives (56.2%) and the diabetics (47.4%) while 20.0% or less depended on social media for such information. This may be due to uncertainty, circulating conspiracy theories and fake news on social media and print media. To confirm what Jayaseelan et al [46] stated that incorrect or deceptive information could be dispersed willingly or malevolently through the internet for concealed purposes, another study evaluated Twitter contents during the pandemic and reported that 25% of information on Covid-19 were deceptive [47].

Study Limitations

This study has some potential limitations which are (i) the study did not meet the expected number of respondents from Google Form which was sent to all the six geo-political zones of the country. This necessitated face-to-face interviews in Lagos City populated by all ethnic groups. (ii) Bias into the study may have been introduced by convenient sampling (iii) Respondents who filled the Google Form on-line may have misconstrued or misinterpreted the questions, and responded without elucidation. Vulnerable population may have been excluded. The interviewer-mediated survey may have presented latent social desirability and interviewer biases. Moreover, it is important to note that the study population consisted of a relatively high proportion of persons with hypertension and fewer proportion of other non-communicable diseases, especially cancer, anxiety disorder and Sickle Cell Disease.

This, however, may be representative of the profile of NCDs among the general population in Nigeria. Therefore, the relatively small sample size of the NCDs and the cross-sectional survey design restricts causal associations between study variables. There are hardly any studies conducted in Nigeria or in Africa on the advantages and benefits of using dietary and herbal supplements for preventing and treating COVID-19 infection, especially among hypertensives, asthmatics, and diabetics, which weakened this current study to compare its findings with those of other African countries. Further studies, preferably multi-center and multidiscipline, and in different parts of continental Africa are needed to determine the exact predictive value of findings in this current study.

Conclusion

This study evaluated the proportion of Nigerians with Non-communicable diseases, especially hypertension, asthma, and diabetes, who took dietary and herbal supplements to boost their immunity during the COVID-19 pandemic in the country. Hypertension was the most prevalent non-communicable disease. Almost all respondents increased their consumption of one form of dietary supplements or another during the Covid-19 pandemic, more among male than female hypertensives. Vitamin C was the most common vitamin consumed and calcium and zinc were the minerals that were also moderately consumed by those with ulcer, diabetes, asthma, and hypertension. The most prevalent reason why a high proportion of respondents, especially those with kidney disease and with asthma, increased their consumption of dietary supplement was to maintain good health.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Contributors

BMA, SJAH and OOO conceived and designed the initial research questions and coordinated the data collection. BMA, SH and OOO had full access to the study's data and take responsibility for the integrity and accuracy of the data analysis. BM and SH completed the statistical analysis and supervised the conduct of the research. BMA and SH drafted the final paper. BMA, SH, and OOO critically reviewed the write up of the manuscript. All authors approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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