Original Research Article

Contribution of eggs and other cholesterol-containing foods to total dietary cholesterol intake, and their influence on serum lipid profile of adults in Calabar, Nigeria.

ABSTRACT – leave the space before mentioning of units

Aim: Eggs have sometimes been regarded as unhealthy foods due to their relatively high cholesterol content. The aim of this study is to determine contribution of eggs and other cholesterol containing food to total dietary cholesterol and their influence on serum lipid profile of adults.

Study design: Cross sectional and experimental.

Place and Duration of Study: Department of Biochemistry, University of Calabar, Calabar. February to July 2017.

Methodology: A cross-sectional survey to determine consumption pattern was carried out on 400 respondents using food frequency questionnaire (FFQ) and 24hour dietary recall. The respondents were further grouped into four based on their reported weekly egg consumption. A detailed follow-up study was conducted on 50 participants selected from across the 4 groups, using a 3-day repeated 24hour dietary recall to determine their consumption of egg and other cholesterol-containing foods. Serum blood lipid profile of these 50 participants was also determined using Randox cholesterol test kits. Food composition tables were used to calculate dietary cholesterol intake (DCI). The mean DCI of the 4 groups were cross-tabulated with mean serum cholesterol levels. Percentage contribution of eggs and other frequently consumed cholesterol-containing foods to total DCI was calculated. Statistical significance was accepted at $p<0.05$.

Results: It was observed that results of correlations between DCI and the lipid profile parameters showed mostly negative correlation (at $p < 0.01$) in both males and females, except slight positive correlations between cholesterol intake and HDL-c (r=0.191) among the males, and cholesterol with TC (r=0.265) among the females. Apart from this, no association was observed between DCI and the lipid profile parameters. Furthermore, the > 5eggs/week group had the lowest TC and LDL-c (4.23±0.19 mmol/L and 2.38±0.10 mmol/L). Based on the respondents' consumption patterns, eggs (boiled and fried) contributed the highest- 34.8% to total DCI, followed by milk (15.9%); salad cream contributed lowest (0.3%) to total DCI.

Conclusion: Increased DCI from cholesterol-containing foods (such as eggs), did not cause an adverse increase in serum cholesterol levels of normocholesterolemic people.

Keywords: blood lipid profile, eggs, cholesterol, foods

1. INTRODUCTION – leave the space before mentioning of the units

With the increase in the prevalence of malnutrition and non-communicable diseases (NCDs) worldwide, it has become necessary to study the aetiology of growing number of diet-related diseases which populations are being faced with, in a bid to proffer solutions [1]. Dietary adjustments/modifications have also become quite popular and effective in the treatment and management of non-communicable diseases **[2][3]. – make as [2, 3]**

Healthy foods/diets are essential for maintaining good health and preventing diseases. The recent increase in the incidence of many NCDs worldwide has brought about a lot of research on the effect of various foods on people's health and wellbeing. Some foods are considered healthy depending on their nutrient content while others are considered unhealthy. The nutrient composition of various foods depends on several factors which include species, breeds, cultivars, ecological factors, post-harvest handling, preservation and storage techniques [4].

Foods are either of plant or animal sources and comprise of various species/breeds. These foods may be grouped broadly into: cereal grains, legumes, nuts and seeds, fruits, vegetables, milk and milk products, meat and poultry, fish, eggs, fats and oils, fat replacers, roots and tubers, herbs and spices, sweeteners [5]. Each of these groups consist of a wide variety of foods rich in the various essential nutrients. Animal foods contain more complete proteins compared to plant foods which usually have what are called limiting amino acids, but most animal-source foods have also been found to contain cholesterol – a compound which has recently attracted quite some attention in the medical field. This is because increased serum cholesterol levels (hypercholesterolaemia) is reported to be a major risk factor for cardiovascular diseases such as hypertension and stroke [6].

Cholesterol, one of the most important and abundant steroids in the body, is found in the liver, bile salts and skin where it forms vitamin D. Cholesterol in the body is obtained from animal food sources like eggs, milk and meat; it is also synthesized in the liver from fats, carbohydrates and proteins. There is no cholesterol in vegetables and plant foods [7]. There was also a fad that 'eggs are bad for your health' because an egg yolk contains about 250mg of cholesterol. In 2000, the American Heart Association (AHA) revised its dietary guidelines and declared eggs to be nutritionally fit for healthy adults. The AHA guidelines now allow an egg a day for healthy adults while still advising a total of daily cholesterol limit of 300mg [5].

An article by the Cancer Care Ontario [8] reports that a healthy food/diet is one that helps maintain or improve overall health. It provides the body with the above listed essential nutrients in their right proportions. On the other hand, an unhealthy diet is a major risk factor for many disease conditions like obesity, hypertension, cardiovascular disease and cancer. Globally, unhealthy diets are estimated to cause about 19% of gastrointestinal cancer, 31% of ischemic heart disease, and 11% of strokes [9,10], thus making it one of the leading preventable causes of death worldwide [11]. According to WHO [12], NCDs such as heart disease, stroke, cancer, chronic respiratory diseases and diabetes are the leading cause of mortality in the world. About 38 million of the 56 million global deaths in 2012 were due to NCDs; and 48% of NCD deaths in low- and middle- income countries in 2012 occurred before the age of 70. In Nigeria, NCDs are estimated to account for 24% of total deaths and the probability of dying between the ages of 30 and 70 years from the four main NCDs (which are cancer, diabetes, cardiovascular diseases, and chronic respiratory disease) is 20% [13].

Hypercholesterolaemia is a major risk factor for hypertension. Some research has also shown that the effects of cholesterol-rich foods on serum cholesterol are small and clinically insignificant when compared with the much greater effects of dietary saturated fatty acids on serum cholesterol [14]. Others suggest that dietary cholesterol increases the ratio of total cholesterol (TC) to HDL-cholesterol (HDL-c) and hence adversely affects an individual's lipid profile [15]; while other studies show that moderate consumption of eggs, up to an egg a day, does not appear to increase the risk of heart disease in healthy individuals [16].

This study therefore, seeks to ascertain the influence of dietary consumption of cholesterol on the serum profile of adults. It also aims at evaluating the contribution of some frequently consumed foods to the total dietary cholesterol intake of a population.

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2. METHODOLOGY – leave the space before mentioning of the units

2.1 Consumption survey and Dietary assessment

2.1.1 Area of study

The study was carried out in the University of Calabar, Calabar in Cross River State. Cross River State has a population of about 4million people with Calabar the State capital having a population of about 330,000 people (National Population Commission, 2006). The University of Calabar was established in October, 1975. It is located in Calabar Municipal of Cross River State. This Federal University has one Graduate School, 10 Faculties and 3 Institutes. Currently, from the records available at the University's Registry, the student population stands at about 40,000, while the staff are about 3,000 bringing the total population to about 43,000. The University community is comprised of people from different ethnic groups in Nigeria and other nationalities like Cameroun, Ghana and Liberia; but the predominant tribes are the Efiks, Ibibios and Ibos.

2.1.2 Population of the study

The population for the cross-sectional study consisted of the 3,000 staff- men and women within the age range of 25 to 65 years, working at the University of Calabar, Calabar.

2.1.3 Sample size determination

This was calculated using Cochran's formula [17] as shown below:

$$n = \frac{t^2 \times p\,(1-p)}{m^2}$$

n = required sample size
t = confidence level at 95% (standard value of 1.96)
p = estimated prevalence of hypercholesterolaemia in the area. According to a recent study by Akpa *et al.* [18] carried out in Port Harcourt (South-South, Nigeria), the prevalence of hypercholesterolaemia was 31.5%.
m = margin of error at 5% (standard value of 0.05)

The calculated sample size of 332 was increased by 20% (66) to make room for contingencies like dropouts, non-responses or incorrectly-filled questionnaires. The total sample size was rounded up to 400 adults 2.1.4 Sampling procedure

A two-stage sampling technique was employed for selecting the sample of the study. In the first stage, University of Calabar was stratified into the 10 Faculties, 3 Institutes, Bursary, Registry and Vice Chancellor's office (16 sample clusters in all). A list of staff in each of the 16 sample clusters was obtained (sampling frame). In the case of faculties, the staff list was obtained from the various departments. In the second stage, a number of participants proportional to the size of each cluster was randomly selected for the study.

2.1.4.1 Exclusion criteria: Participants who did not meet the desired sample criteria- those who were chronically ill, diabetic, hypertensive patients, pregnant and lactating mothers, were dropped from the study (particularly the detailed dietary assessment) and replaced by others in the same sample cluster.

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The health status of the participants was determined by observation and interaction, during which medical history was taken.

2.1.4.2 Ethical approval: Appropriate ethical approval was obtained from the University of Calabar Teaching Hospital (UCTH) for this research work.

2.1.4.3 Informed consent: An informed consent form was designed containing information on this research.

The participants were made to read and then sign the informed consent form to formally indicate their consent to participate in this study.

2.1.4.4 Questionnaire design and administration: A semi-structured questionnaire was designed to gather information from the 400 participants who had read and signed the consent form. The questionnaire was structured to gather socio-economic data, medical history, information on dietary intake (including egg consumption pattern) and lifestyle of the participants. A food frequency questionnaire and 24 hour dietary recall form was also attached. The questionnaires were filled mostly by interviewer-administered pattern (in order to minimize errors) except in some cases where the respondents were literate enough to complete them.

2.1.5 3-day 24 hour dietary intake study: Based on the responses from the questionnaire interviews respondent were grouped according to their reported egg as found below.

1. Those who consumed more than 5 eggs per week (frequent egg consumers)
2. Those who consumed 3 to 5 eggs per week (moderate egg consumers)
3. Those who consumed less than 3 eggs per week (occasional egg consumers)
4. Those who do not consume eggs at all.

A detailed dietary assessment was conducted on 50 randomly-selected participants, using Gibson [19] 24 hour multi-pass dietary recall method. The 24 hour dietary recall was conducted on three different days of the week (2 work days and 1 weekend day). Different sizes of solid materials and pictures from food model materials (representing foods which have already been weighed), were used in order to increase the accuracy of meat, fish, fruits and other foods quantification [19]. Standard measures and weights were used to calculate the foods consumed by the participants based on the descriptions and quantifications they gave. The weight of the foods consumed were converted into nutrients and calories by the use of the West African Food Composition Table [20] and USDA National Nutrient Database [21] was used in calculating the cholesterol content of the foods consumed and the dietary intake of cholesterol by the participants. The percentage contribution of eggs and other foods to total dietary cholesterol intake was also calculated and recorded. The mean individual's daily dietary cholesterol intake was compared with the recommended dietary allowance (RDA). After dietary intake assessment, the 50 participants were further grouped into 3 based on their DCI:

1. 0 – 150 mg/day
2. 151 – 300 mg/day
3. > 300 mg/day

After this, the mean serum cholesterol of the groups were calculated.

2.2.1 Lipid profile analysis

On the last day of the dietary intake assessment carried out on the 50 participants, their blood samples (5ml) were collected by venous puncture for fasting lipid profile tests, after a 12 hour overnight fast. Whole blood samples were stored in clean sample bottles in the refrigerator for 1 to 2 days before analysis. Serum lipid profile was determined using Randox Rx Monza analyser.

2.2.2 Statistical analysis

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Responses from the questionnaire, were coded, and entered into the computer and analysed using Microsoft Excel 2013 spreadsheets and SPSS version 20.0. Descriptive statistics such as frequencies, percentages, mean and standard deviation from the means were used to present the results. Chi-square analysis was used to determine the association between mean cholesterol intakes of the groups of participants (based on reported egg consumption and DCI) and their mean serum cholesterol levels. Linear correlation was also used to check the relationship between contribution of dietary cholesterol intake from different foods and serum lipid profile results of the 50 participants. Significance was accepted at $p < 0.05$.

3. RESULTS AND DISCUSSION- leave space before mentioning of the units

3.1 Food Frequency analysis and Egg consumption pattern

Analysis of the food frequency questionnaire showed that egg (both boiled and fried forms) was the most frequently consumed food item containing a significant amount of cholesterol. Pastries (such as cakes, pies and egg rolls) were also frequently consumed and most of them are usually prepared using eggs. The percentage frequency consumption of eggs by respondents, per week is shown in figure 1 below. Out of the 92.5% respondents who consumed eggs, majority (73%) of them consumed < 3 eggs/week; 21% of them consumed 3 - 5 eggs/week while only 6% consumed > 5 eggs/week.

Table 1 shows the egg consumption pattern of the respondents. Out of the 400 staff surveyed, 92.5% consumed eggs; 37.5% consumed only boiled eggs, 13.2% consumed only fried eggs while 34.3% consumed eggs in both boiled and fried forms. Only 7.4% of the respondents who consumed eggs drank them raw. The most frequently consumed species of eggs was the exotic chicken egg (83.5%). None of the respondents was found to consume guinea fowl eggs and turkey eggs. The least consumed egg species was quail egg which was consumed by only seven respondents (< 2%); out of which five persons (71.4%) drank raw quail eggs. Most of the people who drank raw eggs did so occasionally (88.5%), and not habitually (11.5%): only 4.2% drank up 3 -5 raw eggs in a week.

The result of the questionnaire survey showed that 91% of the respondents ate snacks and the most frequently consumed snacks were pastries such as cakes, meat pies, and egg rolls. These pastry snacks are usually made with eggs (as seen in the recipes), and this also contributed to the consumer's daily dietary cholesterol intake. Egg was also widely consumed by people in the study population (93% of the respondents either ate or drank eggs). Out of the five egg species, the exotic chicken egg was the most consumed (both among the raw and boiled forms), obviously as a result of its availability and accessibility (being relatively inexpensive). Scientific research has shown that exotic chicken egg is just as healthy as the other eggs; only that some species like the quail and guinea fowl eggs have significantly higher protein and micronutrient contents. Cholesterol content of the exotic chicken egg is lower than that of turkey and guinea fowl eggs but higher than that of local chicken and quail eggs [22]. Most of the respondents who consumed quail eggs took it in the raw form- probably for perceived health benefits. Also, over half of the number of people who consumed eggs, ate < 3 eggs/week while almost all those who drank raw eggs, did so occasionally (< 3 eggs/week). This was in line with the AHA [5] dietary recommendations which says that an egg a day is safe for healthy adults, except in conditions where the individual is genetically predisposed to hypercholesterolaemia. It was generally observed that the study population comprised of healthy individuals. Education and awareness go a long way in informing people of the need for consuming healthy diets and for healthy feeding practices, especially as a person ages. This enables people to make enlightened food choices. Adequate income also ensures increased purchasing power, access to healthy food and proper health care.

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Figure 1. Percentage frequency consumption of eggs

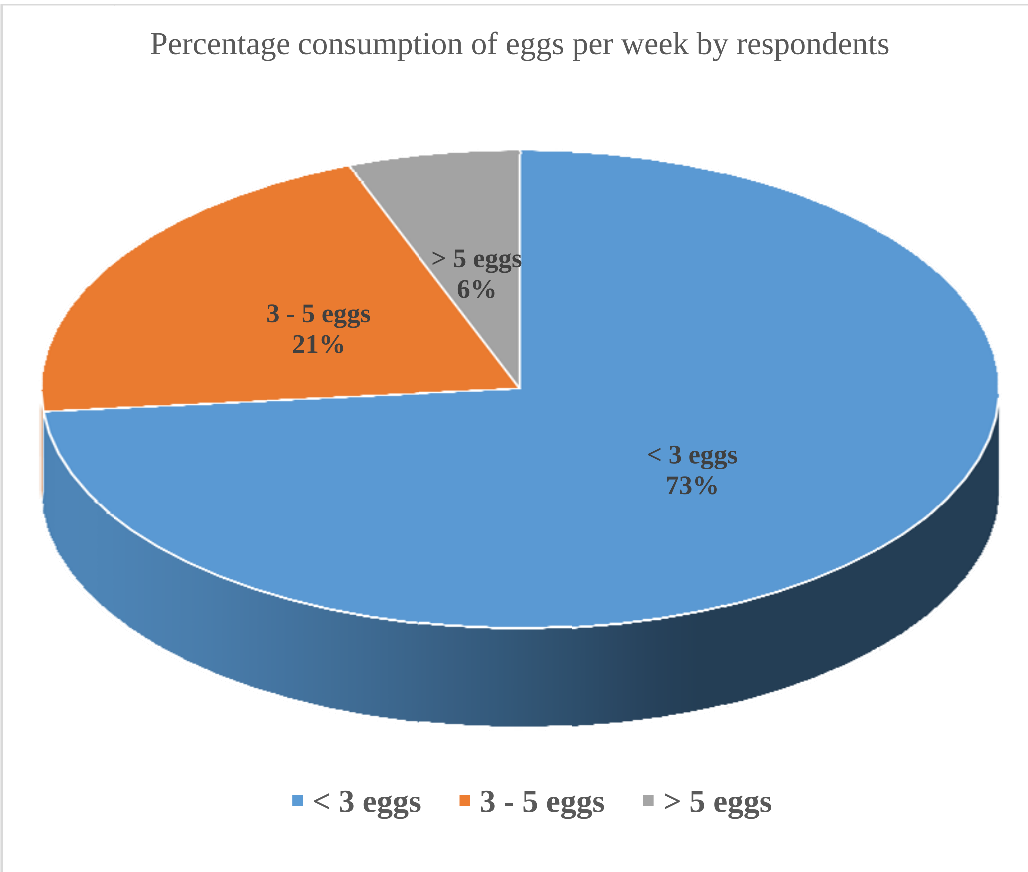

Table 1. Frequency distribution of egg consumption by respondents

Variable	Egg consumption	n	%
Consume eggs	Consume	368	92.5
	Do not consume	30	7.5
	Total	398	100
Form of consumption	Raw	28	7.4
	Boiled	142	37.5
	Fried	50	13.2
	Scrambled	4	1.1
	Boiled & Fried	130	34.3
	Boiled, Fried and Scrambled	25	6.6
	Total	379	100
Type of eggs eaten	Exotic chicken	319	83.5
	Local chicken	21	5.5
	Turkey	0	0
	Quail	7	1.8
	Guinea fowl	0	0
	Chicken (both)	35	9.2
	Total	382	100
Drinking of raw egg	Drink	29	7.4
	Do not drink	362	92.6
	Total	391	100
Manner of consumption of raw eggs	Habitually	3	11.5
	Occasionally	23	88.5
	Total	26	100
Type of egg drank	Exotic chicken	16	61.6
	Local chicken	5	19.2
	Turkey	0	0
	Quail	5	19.2
	Guinea fowl	0	0
	Total	26	100
Number of eggs drank weekly	< 3 eggs	23	95.8
	3 to 5 eggs	1	4.2
	Total	24	100

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3.2 Dietary cholesterol intake versus serum lipid profile.

Table 2 shows the total and mean nutrient intakes of the male and female respondents, and the recommended nutrient intakes (RNI). The mean energy intake of the male respondents (10,175KJ) exceeded the RNI (8400KJ) while that of the females (6,840KJ) was not up to the RNI (8400KJ). Also, the mean cholesterol intake of the males (150mg) and females (153mg), did not exceed the RDA for cholesterol (300mg). Only 3 males and 4 females exceeded the RDA for cholesterol intake; and a female participant had the highest cholesterol intake while 3 participants had the lowest cholesterol intake. Forty eight percent of the participants had fat intake that exceeded the RNI.

Table 3 shows the average results of the lipid profile parameters for the four groups of participants who were tested. The mean TC values for the four groups were all within normal range. Similarly, mean values of Low Density Lipoprotein cholesterol (LDL-c), Very Low Density Lipoprotein cholesterol (VLDL-c) and Triglycerides (TG) were within normal, only HDL values were slightly borderline high for all the groups except the > 5 eggs a week group. All the lipid profile mean values for the groups were statistically different ($p < 0.05$) from each other, despite having approximately similar values. The 3 - 5 eggs a week group had the highest mean TC (4.83 ± 0.34 mmol/L) but the < 3 eggs a week group had significantly ($p < 0.05$) higher LDL-c (2.78 ± 0.17 mmol/L) than the other three groups. The > 5 eggs a week group had the lowest TC and LDL (4.23 ± 0.19 mmol/L and 2.38 ± 0.10 mmol/L) and this was significantly ($p < 0.05$) different from the values of the other three groups. Table 4 showed similar result as table 3 but here the participants were grouped according to their level of dietary cholesterol intake: those who consumed 150-300mg of cholesterol per day showed slightly higher mean serum cholesterol values. The 3 groups had their mean lipid profile parameters also within normal range. Statistical correlations of these 2 groupings and their mean serum cholesterol levels showed no association between DCI and the serum lipid profile parameters (at $p < 0.05$) and showed mostly negative correlation (at $p < 0.01$) in both males and females, except slight positive correlations between DCI and HDL-c ($r=0.191$) among the males, and DCI with TC ($r=0.265$) among the females. Apart from this, no association was observed between DCI and the lipid profile parameters (at $p < 0.05$).

The mean nutrient intakes were compared with RNIs and RDA in the case of cholesterol and the mean energy intakes for males and females were not up to the RNI. This may be as a result of the awareness of the need for adults to reduce caloric intake in order to stay healthy and prevent the occurrence of NCDs such as obesity and diabetes. Despite this, the males and females exceeded the RNI for carbohydrates and fats, while the females did not meet up with the RNI for protein. It should also be noted that the participants (both males and females), did not meet up the RNI for dietary fibre which has been found to help in lowering fat and cholesterol levels in the body [23]. Some micronutrients have been found to play roles in cholesterol metabolism. Strong clinical and experimental evidence suggests that chronic vitamin C deficiency results in hypercholesterolaemia [24]. In a research carried out using rat models, Olivoros *et al. [*25] reported that vitamin A deficiency induced a hypolipidemic effect by reducing serum cholesterol levels. In the case of dietary cholesterol, most of the participants' intakes were within safe limits, with only seven people exceeding the RDA of 300mg. The contribution of eggs to each person's dietary cholesterol varied widely. In the case of a certain respondent where egg contributed 98% of the dietary cholesterol, the serum TC and LDL-c were within normal range. Similarly, in another respondent in whose case egg only made up 38% of the dietary cholesterol intake, the lipid profile was also very normal; hence, eggs do not appear to raise serum TC and LDL-c in normocholesterolemic individuals. In the overall picture, eggs contributed most to the total dietary cholesterol intake of the 400 respondents. This was followed by milk and meat pies.

As a result of the rising prevalence of NCDs such as hypertension and obesity, a lot of research is ongoing in the area of risk factors causing these diseases. The risk factors include hyperglycaemia, hypercholesterolaemia and unhealthy lifestyles. The results of this research showed that increase in dietary cholesterol intake did not cause a corresponding (unhealthy) increase in serum cholesterol levels. This agreed with the results of most similar researches carried out in different parts of the world such as that of Hu *et. al.* [16] and Natoli*et. al.* [26]. In studying the group of participants who consumed more than five eggs per week, it was observed that their TC and LDL-c levels were still within normal range. This implied that increased dietary cholesterol intake may only lead to hypercholesterolaemia in individuals with genetic or already-existing problems of dyslipidaemia. In order to maintain a healthy serum lipid profile, such individuals have to restrict their dietary intake of not only cholesterol but also that of fat (especially saturated and trans fats); not only from eggs but also from other dietary sources. On the other hand, the slight positive correlation (among the males) between dietary cholesterol intake and HDL-c indicates that certain cholesterol-containing foods (including eggs) may actually cause an increase in the HDL-c (good cholesterol) which helps to reduce the LDL-c (bad cholesterol) levels in the blood thereby reducing the risk of some NCDs. McNamara [27] reported a similar finding which indicated that increase in dietary cholesterol also increased HDL-c thereby reducing the LDL/HDL ratio and risk of CHD. This should go a long way to dispel the myth that ‘eggs are bad for your blood cholesterol’ thereby allowing a lot of people (not children only), to benefit from the exceptional nutritional value of various species of eggs.

Table 2. Mean nutrient intakes of participants.

	Protein (g)	Fat (g)	Carb (g)	Fibre (g)	Ash (g)	Energy (KJ)	Calcium (mg)	Vit A (mcg)	Vit C (mg)	Cholesterol (mg)
Males										
Mean	56.9	85.6	270.2	16.9	26.5	10176.0	421.9	1241.8	99.8	149.7
RNI	46.0	65.0	130.0	25.0	21.0	8400.0	1000.0	700.0	75.0	300
% met	123.7	131.7	207.8	67.6	126.2	121.1	42.2	177.4	133.1	49.9
Females										
Mean	53.3	43.7	203.9	16.4	18.8	6840.0	331.2	1165.5	89.5	153.3
RNI	46.0	65.0	130.0	25.0	21.0	8400.0	1000.0	700.0	75.0	300
% met	115.9	67.2	156.8	65.6	89.5	81.4	33.1	166.5	119.3	51.1

*% met refers to the percentage of RNI/RDA that is met by the mean nutrient intake; Source for RNIs and RDA (for cholesterol): FAO/WHO (2002); FNRI (2002).

Table 3. Lipid profile of subjects according to number of eggs consumed per week.

	N	TC (mmol/L)	TG (mmol/L)	HDL-c (mmol/L)	LDL-c (mmol/L)	VLDL-c (mmol/L)
Normal range		**3.6 - 5.2**	**0.6 - 1.7**	**0.9 - 1.5**	**1.9 - 3.5**	**<0.8**
No eggs	10	4.78 ± 0.28^{b}	1.21 ± 0.12^{d}	1.57 ± 0.10^{d}	2.65 ± 0.23^{c}	0.56 ± 0.06^{d}
< 3 eggs	20	4.83 ± 0.24^{d}	1.12 ± 0.09^{b}	1.54 ± 0.07^{b}	2.78 ± 0.17^{d}	0.52 ± 0.04^{b}
3 – 5 eggs	8	4.83 ± 0.34^{c}	1.20 ± 0.19^{c}	1.56 ± 0.10^{c}	2.59 ± 0.23^{b}	0.55 ± 0.09^{c}
>5 eggs	12	4.23 ± 0.19^{a}	1.04 ± 0.08^{a}	1.36 ± 0.11^{a}	2.38 ± 0.10^{a}	0.49 ± 0.04^{a}

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Note; expand Tc, TG, HDL, LDL and VLDL

Values are expressed as mean ± SEM

Values with different superscript in the same column are heterogeneous at $p < 0.05$

N represents number of persons in each group and differences in the size of N was responsible for similar numeric means being statistically different

Table 4. Lipid profile of subjects according to mean daily dietary cholesterol intake.

Cholesterol Intake (mg/day)	N	TC (mmol/L) **3.6 - 5.2**	TG (mmol/L) **0.6 - 1.7**	HDL-c (mmol/L) **0.9 - 1.5**	LDL-c (mmol/L) **1.9 - 3.5**	VLDL-c (mmol/L) **<0.8**
0 – 150 mg	37	4.69 ± 0.16^{a}	1.11 ± 0.06^{a}	1.51 ± 0.06^{a}	2.67 ± 0.12^{a}	0.51 ± 0.03^{a}
151 – 300 mg	7	4.84 ± 0.40^{a}	1.29 ± 0.19^{a}	1.60 ± 0.11^{a}	2.64 ± 0.26^{a}	0.60 ± 0.10^{a}
> 300 mg	6	4.22 ± 0.17^{a}	1.05 ± 0.11^{a}	1.38 ± 0.10^{a}	2.33 ± 0.09^{a}	0.50 ± 0.04^{a}

Note; expand Tc, TG, HDL, LDL and VLDL

Values are expressed as mean ± SEM

Values with similar superscript in the same column are homogeneous at $p < 0.05$

N represents number of persons in each group and differences in the size of N was responsible for varied numeric means being statistically similar

3.3 Percentage contribution of egg and other cholesterol-containing foods to total dietary cholesterol.

Figure 2 shows the percentage contribution of various cholesterol-containing foods to the overall dietary cholesterol intake of all the respondents at the end of the dietary assessment period. Eggs (both boiled and fried added together) contributed the highest- 34.8%. This was followed by milk which had a total contribution of about 15.9%; next to this was meat pies (7.2%) and beef (6.7%). Periwinkle and salad cream had the lowest percentage contributions of 0.4 and 0.3, respectively to the total dietary cholesterol intake. When the different forms of eggs consumed were calculated separately, boiled eggs contributed slightly higher than fried eggs to the overall dietary cholesterol intake.

These contributions are as a result of the cholesterol content of each food item and also the quantity of the food item consumed by the participants. Apart from eggs which have been reported to contain about 500mg/100g, other foods liver and the sea foods- crayfish, prawns, shrimps also have a relatively high content of cholesterol per 100g [28]. The reason why their percentage contributions may not be as high as that of egg is due to the fact that in this part of the world, such sea foods are not consumed in excessively large amounts nor are they consumed too frequently.

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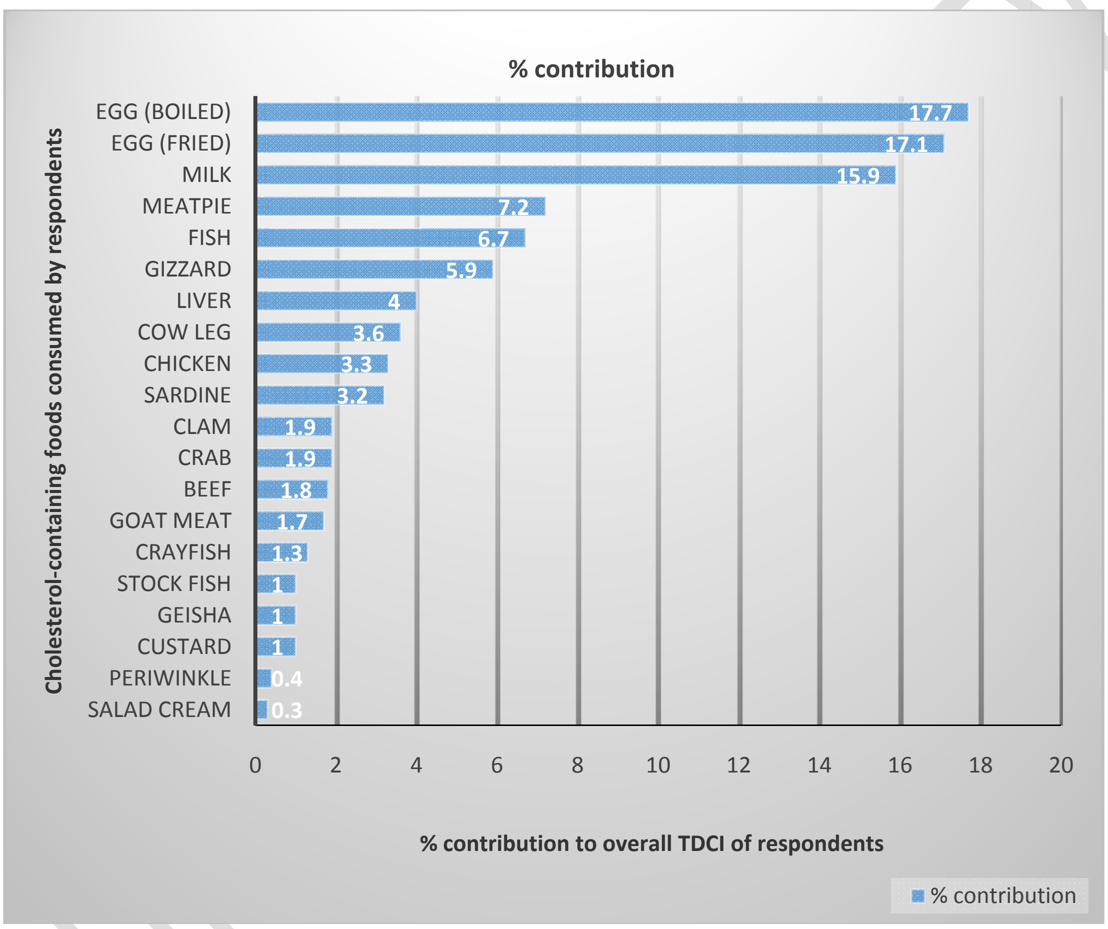
A correlation-regression analysis between the mean cholesterol intake from eggs, milk and fish (which were the three highest cholesterol-contributing foods in the study population), and the mean respondent's serum cholesterol levels, showed no association between DCI (in mg) from each of the foods and the mean serum cholesterol levels. Only a slight negative association (c = -0.714) was observed (at $p < 0.05$) between mean DCI from eggs and serum triglycerides concentration.

Figure 2. Percentage contribution of cholesterol-containing foods to total dietary cholesterol intake.



4. CONCLUSION

The results of the cross-sectional survey, dietary intake assessment and serum lipid profile tests showed no significant association between dietary cholesterol intake and the serum cholesterol levels since increased dietary cholesterol intake from cholesterol-containing foods (such as eggs), did not cause any adverse increase in serum cholesterol levels of normocholesterolemic people. Consequently, consuming an egg a day may not necessarily lead to hypercholesterolaemia (a risk factor for certain NCDs) in healthy individuals. It was also observed that among the study population, eggs contributed most to the total dietary cholesterol intake of the participants.

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