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Original article:

Effect of egg consumption on some baseline anthropometric parameters of some secondary school students in Ibadan

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Abstract:

Background: School feeding programs have gained popularity in developing countries. Eggs are an inexpensive source of micronutrients and high-quality protein which could be included in school feeding programs.

Objectives: This study was designed to assess the effect of egg consumption on some baseline anthropometric parameters of some secondary school students of two local Government areas in Ibadan.

Design: This study involved 160 students selected using random selection sampling method, aged between 13 and 23 years. Anthropometric parameters were measured using standard methods in all the subjects at baseline and two weekly for eight weeks. The test group of subjects was given one boiled averaged sized egg to eat while the control group was given 100mls of water to drink daily for one month. Data was analyzed using descriptive statistic.

Results: The age group 16 to 19 years constituted the highest age group. There were 99(61.9%) in this group out of which 49(61.2%) subjects were in the test group while 50(62.5%) were in the control group. The mean BMI was 23.06kg/m^2±1.32 for the test group and 23.15kg/m^2±0.23 for the control group. The mean WC was 75.56cm±1.61 for the test group and 75.42cm±1.57 for the control group. The mean HC was 65cm±0.91 for the test group and 65.99cm±0.95 for the control group. The mean WHR was 1.16±0.02 for test group and 1.15±0.02 for the control.

Conclusions There were increase Anthropometric parameters in the subjects who ingested egg and the increase is higher in males than females. Egg consumption improved anthropometric parameters.

Key words: Egg, Waist Circumference, Hip Circumference, Waist Hip Ratio

Introduction:

Nutrition is a basic human need, and although malnutrition has been declining in some regions throughout the world, it remains high in many developing countries, thus affecting vast number of children[1].Food supplements are substances that are added to foods to increase the nutritional value, enhance the flavor or texture, to prevent spoilage or improve the appearance .Egg Yolk (EY) and egg white (EW) are one of such food additives. It is well known that egg contain the highest quality food protein known. It is second to mother's milk for human nutrition; however, egg-eaters have trouble determining which part is actually healthiest. EW contains no dietary cholesterol with a fine balance of amino acids, and the amount of fat in an EW is extremely limited .But the yolk of an egg contains large amounts of dietary cholesterol and saturated fatty acids. Ingrid Seuss-Baum (2007)[2] pointed to them.

Nowadays, foods are not intended to only satisfy hunger and to provide necessary nutrients for humans, but also to prevent nutrition-related diseases and improve physical and mental wellbeing of consumers[3] However, human nutrition in developed countries is characterized by an excessive intake of protein, cholesterol, saturated fatty acids (SFA), *n*-6 polyunsaturated fatty acids (PUFA), calories or sodium, whereas consumption is deficient in *n*-3 PUFA, fiber and antioxidants. These imbalances are partly responsible for the high incidence of both obesity and the onset of chronic or degenerative non-transmissible diseases, from which cardiovascular diseases (CVD) are the leading cause of mortality and morbidity globally[4]

Anthropometry is the measurements of size and properties of human individual. It is taken from Greek language – anthropos-human and metron- measurements. It allows us to understand physical size variations. It is systematic measurements, primarily body size and shape on comparative basis. Principally, these measurements are of four types namely: Body mass index (BMI), Waist hip ratio (WHR), Skin fold tests and Bioelectric impedance.

WHR for woman should be less than 0.80 while in men it should be less than 0.90. Normal variables showed that that the waist circumference should be 25 percent less than shoulder, hip, bust measurements and 20 to 25cm less than hip and bust measurements. The visceral fat of less than 0.85 in female and 0.90 in male is good but when there is an increase in visceral fat, there is an increased risk of development of diabetes mellitus, cardiovascular disease and stroke. Hence, engaging in exercise and unsaturated fat intake will prevent all these[5]. BMI of less than 24.5, WHR of 0.86 and WC of 77cm are good. It suffices to say in females that Apple shape appearance is bad while Pears shape appearance is good. There are charts for all these measurements for example WHR greater than 1.0 can be a pointer to an increased risk of development of heart disease[6]. There is little of knowledge on egg consumption with relationship to anthropometric parameters and gender difference in this environment. Many previous studies obtained from literature search are from the Western world and none were from this region. The aim of this study is to determine the effect of egg consumption on anthropometric parameter measurements among secondary school students and gender differences if any.

Methodology:

This study involved cross-sectional selection of 160 secondary students living in Ibadan, Oyo state, South-West, Nigeria, aged between 12 and 23 years. They were from four secondary schools in Ibadan North and South Local Government areas.

The weight of subjects were recorded in kilograms (to the nearest 1.0 kg) without them wearing any heavy clothing like a coat, jacket, shoes or agbada, using a calibrated bathroom scale (Soehnle Waagen GmbH and Co. KG,D 71540 Murrhardt/Germany) positioned on a firm horizontal surface. Height in meters of subjects were measured (to the nearest 0.1m) using a stadiometer. Subjects stood erect, without shoes and headgears, on a flat surface with the heels and occiput in contact with the stadiometer (Prestige HM0016D) (India) and to the nearest 0.1 meter. The body mass index (B.M.I) was subsequently calculated using the formula: weigh (kg)/ height^2 (metres^2). The waist circumference of each subject was measured using a flexible tape measure to the nearest 1cm at the level of the umbilicus with the subject standing and breathing normally. The hip circumference of each subject was measured with the same tape measure to the nearest 1cm at the level of the greater trochanter. The waist to hip ratio (WHR) was then calculated.

All measurements were taken by researcher with the aid of an assistant to cross check that the tape measure did not slant.

Study procedure

The following definitions were utilized:

Central obesity: WC ≥102 cm (males) ≥88 cm (females) or WHR ≥0.90 (males) ≥0.85 (females)

BMI category

- Underweight: BMI <18.5 kg/m^2
- Normal weight: BMI 18.5-24.9 kg/m^2
- Overweight: BMI 25.0-29.9 kg/m^2
- Obesity: BMI ≥30 kg/m^2[21]

There were two groups of students (control and test group). Each test subject was given one average sized egg to eat daily for thirty days. The control group subject was given one cup of water (100ml) daily for thirty days. All participants signed an informed consent form, before answering the questionnaire. Estimation of anthropometric parameters were done, baseline and two weekly for eight weeks in each of the subject as described above.

Ethical Approval and Informed Consent

Ethical clearance for the study was obtained from the Health Research Ethics Committee, (HREC) University College Hospital (UCH), Ibadan. All participants (160) of this study signed an informed consent form, in accordance to the committee regulations, before answering the questionnaire and taking their anthropometric measurements.

Statistical analysis: The data obtained was analyzed using the computer statistical programme package SPSS version 25.0. Student t test was used to compare variability between male and female. Probability value of **P** less than 0.05 was considered statistically significant.

Results:

There were 160 subjects involved in the study groups. 80(50%) were male subjects while 80(50.0%) were female subjects. The mean age 16 to 19 years constituted the highest age group. There were 99(61.9%) in the group out of which 49(61.2%) subjects were in the test group while 50(62.5%) were in the control group. The group of subjects 20 to 23 years constituted the lowest age group with 24(15.0%) subjects. 12(15.0%) were in the test group while 12(15.0%) in the control group. However, in the test group 40(50.0%) were males while 40(50.0%) were female subjects. In the control group there were 40(50.0%) males and 50(50.0%) were female subjects also (table 1).

The mean weight was 60.44kg ±1.29 for the test group and 60.34kg±1.25 for the control group. The mean BMI was 23.06kg/m^2±1.32 for the test group and 23.15kg/m^2±0.23 for the control group. The mean WC was 75.56cm±1.61 for the test group and 75.42cm±1.57 for the control group. The mean HC was 65cm±0.91 for test group and 65.99cm±0.95 for control group The mean WHR was 1.16±0.02 for test group and 1.15±0.02 for control group (table 2).

The mean weight in male increased progressively and significantly from 62.28kg±1.84 at baseline to 65.85kg±1.78 after 8weeks of study period while in female it increased progressively and significantly from 58.46kg±1.77 at baseline to 62.03kg±1.69 after 8 weeks of study period($p<0.05$).

The mean BMI in male increased progressively and significantly from 22.09kg/m2±0.37 at baseline to 24.13kg/m2±0.37 after 8weeks of study period while in female it increased progressively and significantly from 24.11kg/m2±0.48 at baseline to 26.51kg/m2±0.53 after 8 weeks of study period($p<0.05$).

The mean WC in male increased progressively and significantly from 77.85cm±2.30 at baseline to 84.81cm±2.22 after 8weeks of study period while in female it increased progressively and significantly from 74.07cm±2.21 at baseline to 80.03cm+2.10 after 8 weeks of study period($p<0.05$).

The mean HC in male increased progressively and significantly from 72.96cm±1.06 at baseline to 74.09cm±1.13 after 8weeks of study period while in female it increased progressively and significantly from 73.71cm±1.37 at baseline to 75.39cm±1.63 after 8 weeks of study period. The mean WHR in male increased progressively and significantly from 1.06±0.03 to 1.15±0.03 after 8weeks of study period while in female it increased progressively and significantly from 1.00±0.03 at baseline to 1.06±0.03 after 8 weeks of study period ($p<0.05$)(tables 3 and 4).

The comparison between the test group and control groups in male and female were outlined in tables 5 and 6. However in overall, there was an increased in all the mean anthropometric parameters (Mean Weight, Mean BMI, Mean WC, Mean HC and Mean WHR) compared with control in both male and female subjects during the study period. The reduction was prominent in female than male subjects (tables 5 and 6).

Table 1: Demographical characteristics of study groups

Variable	Total (n=160)(%)	Test group (n=80)(%)	Control group (n=80)(%)
Age			
12-15 years	37 (23.1)	19 (23.8)	18 (22.5)
16-19 years	99 (61.9)	49 (61.2)	50 (62.5)
20-23 years	24 (15.0)	12 (15.0)	12 (15.0)
Gender			
Male	80 (50.0)	40 (50.0)	40 (50.0)
Female	80 (50.0)	40 (50.0)	40 (50.0)

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Table 2: Comparison of baseline characteristics in participants with variability of the anthropometric parameters.

Variable	Test group	Control group	t	P
Weight	60.44±1.29	60.34±1.25	0.059	0.953
Height	1.62±0.02	1.61±0.02	0.116	0.908
BMI	23.06±0.32	23.15±0.33	-0.198	0.843
WC	75.56±1.61	75.42±1.57	0.064	0.949
HC	65.72±0.91	65.99±0.95	-0.186	0.865
WHR	1.16±0.02	1.15±0.02	0.102	0.919

Table 3: Participants in test group with variability in anthropometric parameters over the study period.

Variables	Baseline	2wks	4wks	6wks	8wks	F	p
Weight	60.44±1.29	61.25±1.27	62.35±1.28	63.57±1.25	64.01±1.24	204.054	0.000*
Height	1.62±0.02	1.63±0.02	1.63±0.02	1.64±0.02	1.64±0.02	43.511	0.000*
BMI	23.06±0.32	23.78±0.33	24.23±0.35	24.73±0.36	25.28±0.35	217.427	0.000*
WC	75.56±1.61	77.81±1.59	79.19±1.60	80.71±1.56	82.52±1.55	287.760	0.000*
HC	73.72±0.91	73.87±0.96	74.45±1.06	74.68±1.09	75.60±1.06	640.325	0.000*
WHR	1.02±0.02	1.05±0.02	1.06±0.02	1.08±0.02	1.09±0.02	247.860	0.000*

*Significant at $p<0.05$

Table 4: Participants in control group with variability in anthropometric parameters over the study period.

Variables	Baseline	2wks	4wks	6wks	8wks	F	p
Weight	60.34±1.25	61.64±1.22	60.88±1.27	62.17±1.37	61.56±1.26	0.313	0.869
Height	1.62±0.02	1.62±0.02	1.62±0.02	1.62±0.02	1.62±0.02	1.200	0.287
BMI	23.15±0.34	24.44±0.83	24.19±0.87	24.41±0.74	24.32±0.76	1.029	0.390
WC	75.42±1.57	77.06±1.53	76.10±1.58	77.72±1.71	76.96±1.57	0.313	0.869
HC	72.99±0.95	72.60±2.43	72.34±2.60	73.41±2.22	73.66±2.33	0.530	0.673
WHR	1.03±0.02	1.06±0.02	1.05±0.02	1.06±0.02	1.04±0.02	1.174	0.356

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Table 5 Male participants in test and control groups with variability in anthropometric parameters over the study period.

Variables	Baseline	2wks	4wks	6wks	8wks	F	P
BMI test	22.09+0.37	22.74+0.37	23.16+0.40	23.55+0.40	24.13+0.37	114.199	0.000*
BMI control	21.99+0.40	22.09+0.99	22.20+1.11	22.46+0.99	22.91+1.13	0.262	0.890
WC test	77.85+2.30	80.03+2.25	81.50+2.31	82.75+2.23	84.81+2.22	125+738	0.000*
WC control	78.36+2.34	76.47+1.91	76.66+2.15	78.09+2.50	79.15+2.72	0.232	0.908
HC test	72.96+1.06	73.13+1.10	73.24+1.19	73.72+1.20	74.09+1.13	375.247	0.000*
HC control	72.67+1.13	73.74+2.90	73.39+3.32	74.84+3.00	75.33+3.47	1.828	0.134
WHR test	1.06+0.03	1.09+0.03	1.11+0.03	1.12+0.03	1.15+0.03	163.395	0.000*
WHR control	1.08+0.03	1.04+0.03	1.04+0.03	1.04+0.03	1.05+0.03	1.951	0.163

Table 6 Female participants in test and control groups with variability in anthropometric parameters over the study period.

Variables	Baseline	2wks	4wks	6wks	8wks	F	P
BMI test	24.11+0.48	24.90+0.49	25.39+0.54	26.00+0.55	26.51+0.53	108.689	0.000*
BMI control	24.12+0.47	26.39+1.21	25.85+1.26	26.03+1.01	25.49+1.00	1.292	0.278
WC test	74.07+2.21	75.41+2.19	76.69+2.14	78.51+2.15	80.03+2.10	170.370	0.000*
WC control	74.98+2.06	77.55+2.33	75.64+2.30	77.41+2.37	77.41+2.37	0.749	0.560
HC test	73.71+1.37	73.95+1.43	74.21+1.62	74.63+1.67	75.39+1.63	302.375	0.000*
HC control	73.10+1.34	73.31+3.55	74.30+3.76	75.60+3.05	75.26+3.07	1.208	0.327
WHR test	1.00+0.03	1.03+0.03	1.03+0.03	1.05+0.03	1.06+0.03	125.944	0.000*
WHR control	1.03+0.03	1.06+0.03	1.02+0.03	1.02+0.03	1.03+0.03	1.654	0.361

Discussions:

This study highlights the increase in all the anthropometric parameters in secondary school students, whether measured by BMI, WC, HC or WHR, and highlights the possible emergence of non-communicable diseases and their risk factors as major contributors to the burden of ill-health in Sub-Saharan Africa, particularly among urban populations like Ibadan.

Progressing to obesity as estimated by BMI (a measure of total body fat) and central obesity as estimated by WC was low among secondary school students. The anthropometric measurements except WHR were strongly correlated with each other. The correlation of indices of overall and central obesity is highly suggestive of an association

between increased overall obesity (as measured by BMI) with increased visceral fat (WC). We found that mean WC increased across board in both male and female subjects. Similar results were reported in the urban female population of Morocco by Belahsen et al[7] and by Sargeant et a[l7] in the urban adult population of Jamaica[8]. It is likely therefore that BMI and WHR provide different measures of almost the same phenomenon.

Visceral fat is more metabolically active than subcutaneous fat, and hence may be more deleterious to health[9]. Several studies have found a strong association between visceral fat and cardiovascular risk factors[10, 11, 12, 13]. WC is a practical measure of intra-abdominal fat mass[11] and recommendations have been formulated to use it in the identification of people in need of intervention for cardiovascular risk reduction[14, 15, 16]. These findings suggest that defining obesity on the base of waist circumference may be an equally or more valid and useful method for use in epidemiological research and clinical practice, though further research is needed to demonstrate this unequivocally

Studies in developed countries show an inverse (negative) relationship between education and obesity, particularly among women: the lower the education or the social class, the higher the prevalence of obesity. However, in developing societies, a strong positive relationship often exists between social economic status and obesity among men, women, and children [17]. The findings suggest that waist circumference as a measure of central obesity is a useful indicator for use in epidemiological studies and clinical practice. The study provides insights into the relationship between age, sex, socioeconomic overweight and obesity using a range of anthropometric parameters.

Eggs represent a very important food source, especially for some populations such as the elderly, pregnant women, children, convalescents and people who are sports training.

To our knowledge, this is the first study to examine the effects of egg supplementation in secondary school in Ibadan. The results of this study is similar to the one done in Ugandan where the concept that incorporating two eggs per day into school feeding programs can have a positive effect on markers of physical growth of children in rural Uganda and their anthropometric parameters.

Malnutrition in childhood has lasting effects on health and quality of life. Currently, 156 million children are stunted and another 50 million suffer from wasting[18] In Africa, the number of stunted children is rising[18]. Therefore, it is important to develop effective nutritional strategies for prevention and treatment. One possible strategy is through meals containing high quality protein, such as animal protein. Very little data exists examining the effects of animal protein-source foods on outcomes of growth and development in school-aged children at risk for malnutrition in developing countries in sub-Saharan Africa, especially Uganda which has 17.5 million caloric insecure individuals in 2005/2006[19]. In collaborating with this study, the study in Uganda found that supplementing young children living in rural Uganda with two-eggs per day, five days per week over six months resulted in a significant increase in height and weight compared to 0 eggs per day. The findings in Uganda study are supported by data from studies conducted in Kenya[20] and Guinea-Bissau[21], which found that supplementation with animal-source foods (e.g. meat and dairy) improved parameters of growth such as MUAC[20, 21] and weight-for-age *z* score[21] in children.

Limitations of the study:

Prospective study over years and inability to measure anthropometric parameters over long period of time and the other underlying health challenges in the subjects which were not identified at the time of study may be cofounding variables. This is an interesting issue for future investigations. However, continuous research is needed to validate our findings.

Conclusion:

The egg consumption over a period of time in these secondary students was related to differences in the anthropometric parameters in this study. The anthropometric parameter measurements of individual participants obtained from this study can be used as baseline for future study.

There are increases in anthropometric parameters in the subjects who ingested egg compared to control group who drank water. There is preponderance increase parameters in male subjects compared to female subjects. Egg consumption, however generally improved anthropometric parameters in the study group.

The research has proven that egg consumption improves anthropometric parameters and has a beneficial role on general health. Based on the outcome of this research, Government should introduce egg into the meals of secondary students to improve the wellbeing of the youth in the country at large.

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