

Application of WHO 2007 growth reference in assessing the anthropometric status of Nigerian adolescents; A systematic review and meta analysis

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ABSTRACT

Objectives: The study was designed to assess the application of WHO 2007 growth reference by local studies published from 2009 to 2020 in data generation of Nigerian adolescents' anthropometric status.

Methods: Meta-analysis of literatures on anthropometric status of adolescents in Nigeria by articles published from 2009 to 2020 was conducted. A bibliographic survey was carried out in several databases –Google Scholar, PubMed and African Journals Online. Review of abstracts and full texts followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The methodology for anthropometric assessment of these eligible studies were compared to WHO 2007 growth reference. Data was analyzed using IBM SPSS version 25.

Results: A total of 24 articles which captured 12,482 adolescents met the inclusion criteria. Less than one fifth (16.7%) of the studies adopted the WHO 2007 growth references in their data generation while the adult recommendations for BMI application dominated the reviewed studies. A slow increase in the adoption of the WHO 2007 growth reference was observed.

Conclusion: The low application of the recommended growth reference by local researchers is of concern. Hence, the need to ensure quick adoption of standard indicators/guidelines in local studies will not only promote the generation of pooled evidence to reveal cross-cutting gaps but also ensure that the public health situation is not under/over-estimated.

1. Introduction

Adolescent nutrition is becoming increasingly popular in the past few years [1,2]. Evidence has shown that this current crop constitute the largest generation of adolescents in history –presently, the world is a home to 1.8 billion adolescents, about 90% of them live in low- and middle-income countries [3].

Adolescence is the only time in life besides early infancy when the velocity of growth increases [4]. During puberty, adolescents gain ~15% of their final adult height. By about age 20 years, 90–95% of total peak bone mass is attained, 45% of which is built during adolescence [4–6].

Attention to adolescent nutrition has greatly increased over the years reflective in the scientific reviews [7–10], global guidelines [11], international meetings [12–14], and policy/program activities [15,16].

Previously, different definitions for assessing child and adolescent malnutrition have been used, with no definitive standard or reference agreed upon internationally. This has prompted the need for a widely applicable growth reference for older children and adolescents as countries attempt to assess the magnitude of the growing public health problem using diverse multiple indicators such as the 1977 NCHS curves, the International Obesity Task Force (IOTF) reference 2000, Centre for Disease Control 2000 etc.

In response to the need to conceptually harmonize growth assessment tools for adolescents, WHO 2007 reference was developed which addressed the known limitations of the 1977 NCHS curves and other standards, and acknowledged a transition at 5 years of age from the WHO references for under-fives to these new curves for school-aged children and adolescents [17].

In Nigeria, evidence on the adoption of the WHO growth references

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for under-5 and even school age children in national [18] and local studies [19] are well documented, however there is a dearth of data on the utilization of WHO 2007 growth reference in data generation for adolescents in Nigeria. Sufficient research is needed to fill the huge data gaps related to nutrition and growth during adolescence which forms the basis for development of appropriate interventions that will enhance growth, improve human capital and curb the intergenerational cycle of growth failure [9].

Therefore the purpose of this paper is to reveal the application of application WHO 2007 growth reference in assessing the anthropometric status of adolescents in Nigeria.

2. Methods

Search Strategy: Meta-analysis of literatures on anthropometric status of adolescents in Nigeria by articles published from 2009 to 2020 was conducted. A bibliographic survey was carried out in several databases –Google Scholar, PubMed and African Journal Online. Review of abstracts and full texts followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Fig. 1). The descriptors used in English were Adolescents, 11–19 years, anthropometry, undernutrition, Obesity, Nigeria combined with Boolean “OR” and “AND” operators. Full text/abstracts of studies identified in the electronics databases were screened by two independent reviewers.

Inclusion/Exclusion Criteria: Studies were included if; conducted in Nigeria, comprise of respondents within the 10-19 adolescent age range, published from 2009 to 2020, clear statement of reference standard used in the methodology.

Studies not conducted in Nigeria, did not capture adolescent’s age range, published outside 2009–2020, had no clear statement of reference standard used in data generation were excluded from this study.

Data Extraction and Analysis: Data were extracted into an MS Excel spread sheet. The data extracted comprised; authors’ details, year of publication, study location, sample size, growth reference standard. Descriptive statistics was computed for the variables. All analysis were done using SPSS Version 25.

3. Results

The electronic database retrieved a total of 3,688 articles. The titles and abstracts were screened and it was observed that most of articles (3626, 98.3%) were not relevant to this study. Sixty two (62) articles were reviewed in full and total of 24 articles which captured 12,482 adolescents met the inclusion criteria (Table 1). The articles were excluded after full text review due to unclear methodologies and distinct age range of the subjects in the reviewed studies. Results revealed a sparse data representation on adolescents’ anthropometry from all geopolitical zones, more than half of the reviewed studies were

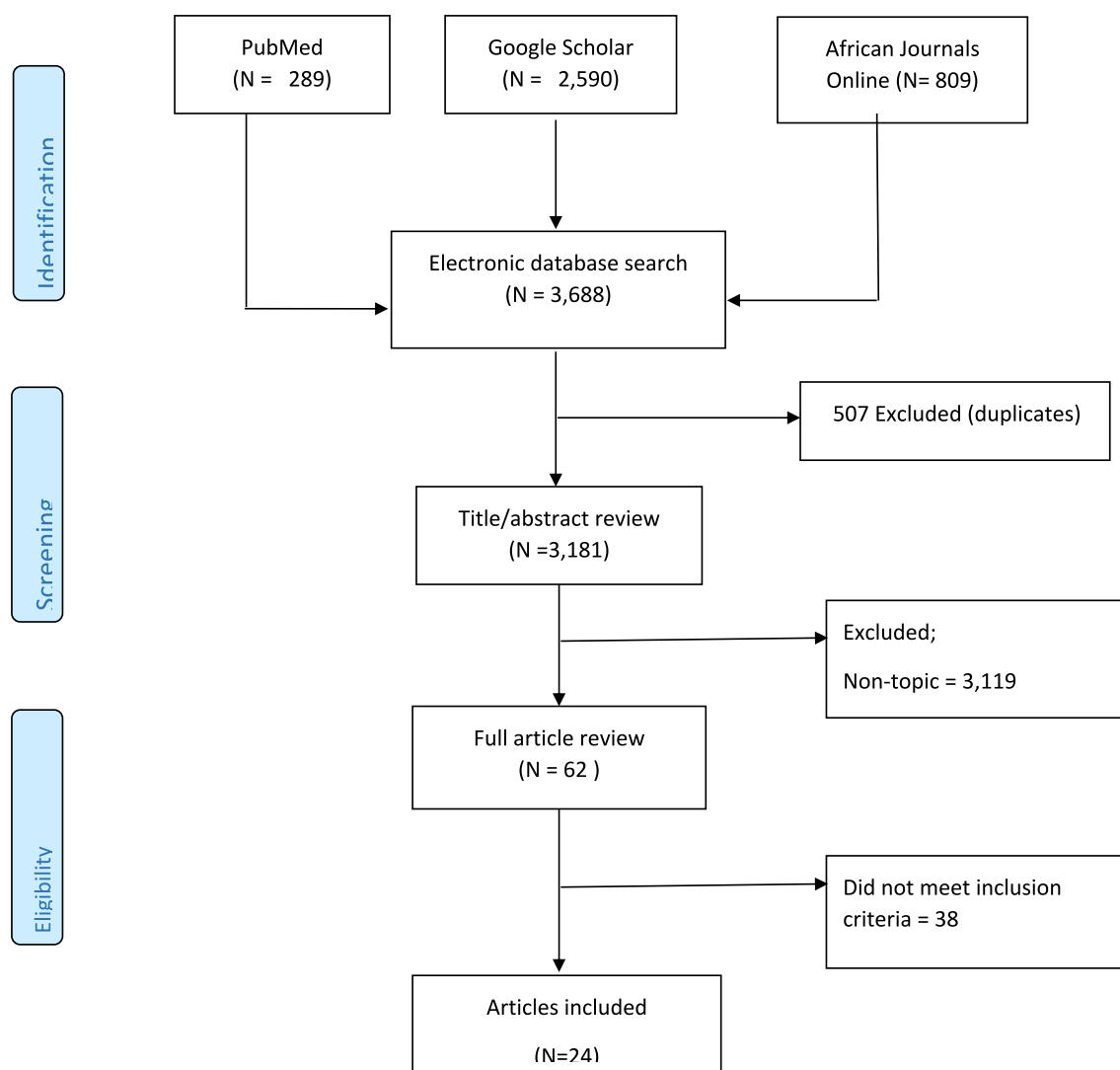


Fig. 1. Flow chart of article selection based on PRISMA recommendations.

Table 1
Characteristics of reviewed studies.

Reference	Year	Location	Age Range	Sample Size	Growth Reference
Atiku and Yunusa [20],	2009	Kano, Nigeria	13–19	2100	Body Mass Index
Olayinka et al. [21],	2010	Ibadan, Oyo State	10–19	2,000	WHO 2007
Ejike et al. [22],	2010	Ajaokuta, Kogi State	10–19	625	NCHS/WHO 1977
Goon et al. [23],	2010	Benue State,	12–18	722	Body Mass Index
Asiniobi and Nwankwo [24],	2010	Imo State	10–19	283	NCHS/WHO 1977
Senbanjo et al. [25],	2011	Abeokuta, Ogun State	5–19	570	NCHS/WHO 1977
Hafiz et al. [26],	2012	Kastina State	10–19	567	Body Mass Index
Ene-Obong et al. [27],	2012	Lagos, Port Harcourt, Nsukka, and Aba	5–18	1,599	IOTF, 2000
Adesina et al. [28],	2012	PortHarcourt, Rivers State	10–19	960	NCHS/WHO 1977
Onyiruka and Egbagbe [29],	2013	Oredo LGA, Edo State	10–19	2,166	Body Mass Index
Omobuwa et al. [30],	2014	Ibadan, Oyo State	13–18	93	CDC, 2000
Oluseye and Oladimeji [31]	2014	Ogun State	10–19	127	NCHS/WHO 1977
Ayogu et al. [32],	2016	Nsukka, Enugu State	12–18	400	WHO 2007
Mbagwu et al. [33],	2016	Lagos State	10–17	320	Weight and sitting Height
Akinola et al. [34],	2016	Illorin, Kwara State	13–19	400	Body Mass Index
Anochie et al. [35]	2016	Portharcourt, Rivers State	10–19	960	Body Mass Index
Kola-Raji et al. [36],	2017	Ibadan, Oyo State	10–19	490	NCHS/WHO 1977
Usman et al. [37],	2018	Illorin, Kwara State	10–19	500	Body Mass Index
Omisore et al. [38],	2018	Osun State	10–19	1000	IOTF, 2000
Iyalomhe et al. [39],	2018	Ekpoma, Edo State	10–19	400	Body Mass Index
Adeomi et al. [40],	2019	OsunState	10–19	313	WHO 2007
Uba et al. [41],	2020	Ganjuwa, Bauchi State	10–19	250	Body Mass Index
Ekpenyong et al. [42],	2020	Cross River State	10–19	454	IOTF, 2000
Ukoha et al. [43],	2020	Enugu State	2–18	350	WHO 2007

conducted in the South-Western (37.5%) [21,25,30,31,33,36,38–40] and South Southern (20.8%) part of Nigeria [28,29,35,39,42], while 16.7% of the studies were conducted in North-Central Nigeria [22,34,37,41]. The sample size of adolescents in the reviewed studies ranged from 93 [21] to 2,166 respondents [20].

Results from Fig. 2 revealed that only 16.7% of the selected peer-reviewed studies utilized the WHO 2007 reference in data generation of adolescents' anthropometric status while 41.7%, 25.0%, 12.5% and 4.2% applied the adult Body Mass Index recommendations, NCHS/WHO 1977, IOTF 2000, and CDC 2000 growth references for older children and adolescents.

Information on the trends in the mean utilization of WHO 2007 growth reference is summarized in Fig. 3. Results revealed a low but increased adoption of WHO 2007 growth reference over the years by published studies on adolescents.

4. Discussion

The sparse representation of adolescents' data from Northern Nigeria may be attributed to the diverted research/intervention priority accorded to other pertinent issues such as high maternal/under 5-malnutrition [18,44] and security heightened tension [45,46] when compared to their Southern counterparts. The adolescent like the school age child is a survivor in an environment of the high under-five mortality/under-nutrition and should not be neglected to ensure attainment of full potentials [19].

The low application of WHO 2007 growth reference by less than one fifth of the reviewed studies compares well with a findings by a similar study on school aged children where a preponderant uptake of other old recommendations such as NCHS 1999 & CDC references were reported [19].

The application of Body Mass Index for adults by almost half of these selected studies does not conform with WHO recommendations that although BMI in adolescents is calculated with same formular as adults, it is interpreted differently – relative to teens of the same sex and age [17]. The 2007 growth reference provides an age and sex specific BMI reference which extends from age 5 where the curves match WHO under-five curves almost perfectly and further up to 19 years of age, where the 2007 BMI values for both sexes at +1 SD (25.4 kg/m² for boys and 25.0 kg/m² for girls) are equivalent to the overweight cut-off used for adults (>25.0 kg/m²), while the +2 SD value (29.7 kg/m² for both sexes) compares closely with the cut-off for obesity (>30.0 kg/m²) [47].

The gradual adoption of WHO 2007 growth reference overtime strengthens the evidence for inclusion of adolescents' health and nutritional status in the demographic and health surveys to promote visibility of methods across countries. Estimating the magnitude and distribution of adolescent malnutrition using appropriate assessment tools is fundamental to identifying priorities, designing and targeting interventions, and measuring progress over time.

5. Conclusion

Study reports revealed that application of adult BMI recommendations usurped the utilization of WHO 2007 growth references in the reviewed adolescents focused studies. However, this was found to gradually reduce overtime. Promoting the visibility of harmonized references/standards to local researchers through the inclusion of adolescents' health and nutritional status in demographic health surveys is encouraged.

Availability of data and material

The datasets used and/or analyzed during this study are available from the corresponding author on reasonable request.

Author statement

G.I, C.U and H.E were responsible for the formulation of research concept and design. C.N., E.O and S.M. contributed to the acquisition and screening of data. G. I and S.M were responsible for the statistical analysis. G.I, C.N and E.O. drafted the manuscript while G.I., C.U. and H. E critically reviewed the manuscript. All authors read and approved the final draft of this manuscript.

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Declaration of competing interest

The authors declare that they have no known competing financial

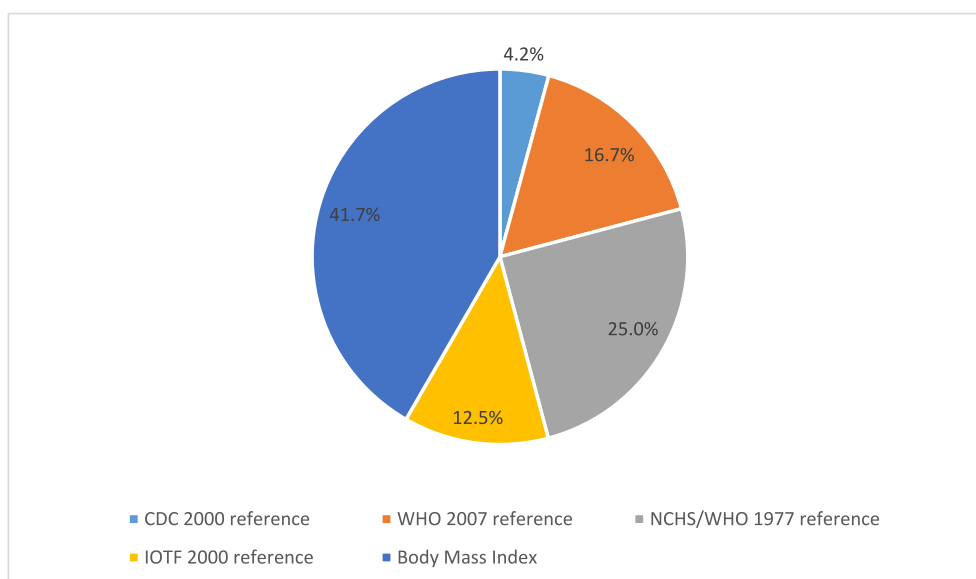


Fig. 2. Growth references utilized in data generation for adolescents.

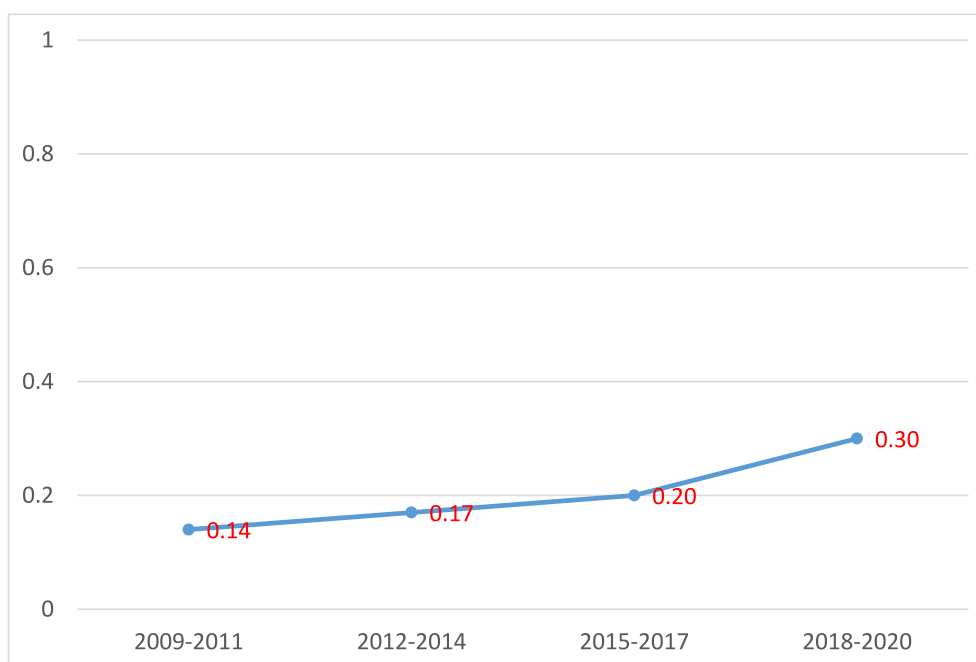


Fig. 3. Trends in the mean utilization of WHO 2007 growth reference.

interests or personal relationships that could have appeared to influence the work reported in this paper.

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