

Asystematic Review Of Prevalence And Risk Factors That Affect Nutritional Status Of Adolescents.

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Abstract- Adolescents are nutritionally vulnerable due to their high requirements for growth and development and sex maturation. Inadequate nutrition also puts them at high risk of chronic diseases and their detrimental effects appear after a long time during adulthood. Prevalence of malnutrition in adolescent is brought about by their overconsumption of processed foods, junk foods, failure to consume high fiber diets and lack of physical exercise. They also suffer stunting and underweight especially during childhood which is due to poverty and food insecurity in such households where such adolescents reside. Double burden of malnutrition in children and adolescents has such indicators as over nutrition such as overweight and obesity and those of underweight such as stunting, wasting and underweight and these occur simultaneously in both young children and adolescents. Adolescents' high prevalence of malnutrition is brought about by food insecurity in households, poor hygiene and unsafe water consumption due to gastrointestinal infections. Poor diets which include processed carbohydrates and junk foods bring about high prevalence of overweight and obesity in adolescents and so is lack of physical activities. There is need therefore to engage adolescents in nutrition education and enlighten them on need to engage in physical activities.

Key words- Adolescents; risk factors; prevalence; nutrition status; sedentary lifestyle;

I. INTRODUCTION

Adolescents are defined as a sub-set of children aged between the ages of 11-19 years ((Bekele et al, 2017). Globally adolescents contribute to 16% of the world's population and 23% in the Sub-Saharan Africa (Moher et al., 2009). Malnutrition can be categorized as undernutrition which leads to stunting and underweight of ≤ 2 Standard Deviation, and overweight which is contributed by obesity leading to chronic diseases such as diabetes, coronary disease, cancer and kidney among others. Malnutrition is one of the most common causes of morbidity and mortality world-wide and it is an epidemic among adolescents in both developing and developed countries (WHO, 1017, UNCEF, 2017, Abbas et al., 2019).

Adolescents' population is normally higher in regions with higher burden of health conditions which include and not limited to poverty, violence, injury, undernutrition, over nutrition and sedentary lifestyle (Christian et al, 2018). Every year children die of diseases that can be prevented and treated and at least half of these deaths world-wide are caused by malnutrition and regions with much advanced effects are from Sub-Saharan Africa (Abbas et al., 2019, WHO, 2017, Amitava et al., 2017). As per the WHO nutritional status can be assessed through nutritional indicator based on anthropometric measurements; height, weight and age, due to its sensitivity to the full spectrum of

malnutrition. The indicators includes; stunting which was defined as (HAZ) Height- for- age Z- scores $< -2SD$. Weight-for-age z-score (WAZ), (age range; 5-10 years) to assess if the child is underweight up to 10 years old (WHO, 2017, UNICEF, 2017). After 10 years of age, weight-for-age is not a good indicator where the children grow faster during the period of puberty and can be falsely categorized as excess weight. Underweight is defined as (WAZ) $< -2SD$. BMI-for-age z-score (BAZ) (age range 5-19 years); BMI measures weight in kilogram divided by height in meter square. It is a preferred indicator for assessing thinness, overweight and obesity in children 10-19 years. (WHO, 2016). Wasting is defined as BAZ) $< -2SD$ while BAZ $> +2SD$ was defined as obese for age- and sex-specific z-score respectively of National Center for Health Statistics (NCHS) (WHO, 2016, WHO UNICEF, 2009).

Adolescents are nutritionally vulnerable due to their high requirements for growth and development and sex maturation. Inadequate nutrition also puts them at high risk of chronic diseases and their detrimental effects appear after a long time during adulthood (WHO, 2016, Brain et al., 2013). Indicators of over nutrition such as overweight and obesity and those of underweight such as stunting, wasting and underweight now occur simultaneously in both young children and adolescents (WHO and UNICEF, 2009). This is what is referred to as double burden of malnutrition world-wide (Delisle et al., 2015, Blossner et al., 2017).

Double burden of malnutrition usually refers to co-occurrences of underweight; stunting or micronutrient deficiencies plus overweight or obesity the denominator for this constellation frequently varies. At the country level the double burden of malnutrition can be said to exist when childhood stunting amounts to 27%, and maternal overweight equals to 29% (Ergo et al., 2009). At household level double burden of malnutrition would be defined when a family has at least one underweight, stunted or micronutrient deficit member and at least one overweight or obese person (Marriott et al., 2012, Wells, 2012).

At individual level the double burden of malnutrition usually addresses macro and micro-nutrient deficiencies as comorbidities of adiposity in one person (Melaku et al., 2019, Wells, 2012). Evidence suggests that poor dietary habits and sedentary lifestyle are ubiquitous among school-aged children and adolescents in general (Derese et al., 2019, Melaku et al., 2019). Adolescence is a period within which dietary habits, food preferences and physical activity are developed. These acquired behaviors are carried out throughout the lifetime of an individual and depending on whether they are positive or negative can contribute to development of Non-Communicable Diseases (NCDs) in adulthood (WHO and UNICEF, 2009). The nutritional status of adolescents shapes the ability to develop and perform to their full potential and in turn adversely affects the National trajectory (Kidanemaryama et al., 2019, Maria et al., 2019).

There is need to combine efforts which are currently being in the first 1000 days of life to prevent undernutrition and stunting in children so that adolescents are also included in this category. A lot of interventions are done to improve nutrition status of children 0-59 months, pregnant and lactating mothers. Yet not much attention has been paid to adolescents' nutrition in developing countries. Improving nutritional status of adolescents will help achieve optimal skill, talents, and energies leading to achievement of responsible citizens of tomorrow and also break intergenerational malnutrition in the life cycle (WHO and UNICEF, 2009).

II.METHODS

Study design and search strategy

This was a systematic review of eligible articles using preferred reporting items as per provided guidelines for systematic review. This was used in conducting this review (Kidanemaryam et al., 2018). The review engaged a comprehensive search of articles published between 2016 January to February 2020. The search was made from Google Scholar, OPub Med, Scopus and Cochrane Library. In addition reference lists of the included studies were scanned to find potential articles. For this review search to be complete key words such as adolescents, prevalence, risk factors, nutritional status, obesity, sedentary lifestyle, undernutrition, over nutrition and malnutrition were used to

find appropriate articles to this review. The review did not specify itself to any region or continent. The search was made by the author independently who reviewed 45 articles.

Study selection and eligibility criteria.

This review included studies conducted in the world on prevalence of malnutrition in adolescents. The main objective of this review was to determine the prevalence of adolescents' malnutrition and the associated risk factors. The review articles inclusion criteria was those articles published in English and at both facility and community levels. The exclusion criteria were all studies conducted on adolescents with chronic diseases and those undergoing any form of treatment. The publications with maximum information as per this review objective were included in the review.

Out-come measure

The primary out-come of this review was prevalence and associated factors of malnutrition on adolescents (11-19 years). According to WHO adolescents height-for-age and Body Mass Index (BMI) for age below -2 Standard Deviation (SD) is stunting and underweight respectively (Moher et al., 2019) while adolescents weight-for-age and Body Mass Index (BMI) for age above -3 Standard Deviation (SD) is obese and overweight respectively.

The second out-come of this review was the associated factors for adolescents malnutrition. If one factor was identified as an associated risk factor for adolescents' malnutrition in two or more articles then that was included in this review. If it was only identified in only one article it was not included in this review. The review was able to identify risk factors such as food insecurity, poverty, family size, residence, sex, water protection, Dietary Diversity Score (DDS), head of household education level and presence of latrine in the households and facilities.

Table 1 Summary of included studies evaluating the prevalence of adolescents' malnutrition and the associated risk factors in the articles reviewed.

Author Name	Year	Study design	Place of study	Country	Sex	Sample size	Prevalence of stunting	Prevalence of underweight	Prevalence of overweight	DDS	Age
Melaku	2019	Cross-sectional	Somali refugee camp	Somali region state	Girls	423	%13.20	10.80%	0.13		
Bekele	2020	Cross-sectional	Street children	Ethiopia	Girls	312	%84.50	29.20%	Low 86.1%	1.78%	
Abay	2017	Cross-sectional	TehuLedere district	''	Both	535	%29.00				98% safe
Christian	2018	Cross-sectional	Global	Global	Both	240,000	%40.00	50%	Boys 8% Girls 5%	Low 97%	76% unsafe
Abbas	2019	Cross-sectional	Dodoma	Tanzania	Both	385	%18.00	14%	Boys 9.23% Girls 5.23%	Low 58.3%	89%
Takele	2016	Cross-sectional	Adawa town	Ethiopia	Girls	Girls	%81400.00	21.40%		Low	
Marie	2017	cross	Agogo	Ghana	Both	201	%15.00	7%	0.15		
Richi	2018	cross	Global		Both	129,276	%45.20	31.50%	0.214		
Severine	2017	cross	Plateau Central	Burkinafaso	Both	455	%36.50	52%	0.351		
Masumi	2019	cross	Kletan Disstrict	Indonesia	Both	1080	Boys 25% Girls %2.1	39.00%	0.25		
Sigma	2019	cross	Dang District	Nepal	Both	310	Boys %34.5 Girls 24%	21.80%	0.311	15%	
Abay	2017	Cross	TahuLedere District	Ethiopia	Oth	535	%15.80	Low	0.553		
Rishi	2018	cross	Global LMIS	Global	Both	129,276	%38.00			40.60%	
Masumi	2019	Cross-sectional	Klata District	Indonesia	Both	1080	%36.00	31.50%		27.20%	
Severine	2017	Cross sectional	Plateau Center	Burkina Faso	Both	455	Boys 25% Girls %21	29.40%	0.351	56.70%	

Characteristics of most of the reviewed papers were that majority was cross-sectional studies and the age of adolescents in most of the reviewed papers was ranging from 11-19 years. Regional and global papers were reviewed making a total of 45 papers that were reviewed a sample of the reviewed papers is presented above.

Stunting and underweight

Stunting (height-for-age below 2 SD of the World Health Organization (WHO)/CDC reference standards) is one of the outcomes the review was seeking to find out and the prevalence of stunting was high at 57.8% (Mariam et al 2017) and lowest at 13.2% (Bekele et al, 2017). The difference could have been contributed to by the study setting which included urban and rural adolescents. Adolescents in early and middle age had a higher likelihood of getting stunted than their counterparts at the late stage (Christian et al, 2018), Richi et al, 2018) 8. This could have been contributed to by increased growth spurt during early and middle adolescent stage. The type of school the adolescents attended also contributed such that those who attended government schools had higher stunting rate than those who attended private schools 57.8% (Richi et al, 2018) 84.5% (Christian et al, 2018).

This could be due to the fact that households which take their children to government schools are likely to be of low social-economic status and thus food insecurity could be present in such households. This could be contributed to by lack of economic power to access food. Most of these schools have environments that are less likely to be hygienic thus predisposing adolescents to infections that lead to poor nutritional status. Stunting in adolescents reflects poor nutrition, environmental stress and infection accumulated from the fetal period through to young adulthood. In 2016, the mean BMI estimates for youths aged 10-19 in South Asia, Southeast Asia, East Africa, West Africa and Central Africa were <20 for both male and female adolescents. Prevalence of underweight (<1 to -2 SD BMI), moderate and severe underweight (<-2 SD BMI), overweight (>1 to 2 SD BMI) and obesity (>2 SD BMI) – stratified by sex and geographic region.

The highest reported underweight was at 41.4% for boys (Richi et al, 2018), and lowest 2.0% for girls. Underweight is a factor of malnutrition and when adolescents suffer from underweight they more likely to perform poorly in school due to affected cognitive domain by poor dietary intake. These households with such individuals were food insecure and had no latrines leading to intestinal infections caused by parasites.

Diet

Diet is an important aspect of adolescents' nutrition and need to be given undivided attention. Adolescents who consumed less than 3 meals per day were more likely to be stunted than those consuming 3 meals per day (Tekele et al, 2016, Marie et al 2017). Adolescents Dietary Diversity Score was low 27.2% (Bekele et al, 2020). This was likely

to contribute to adolescents stunting. Adolescents' period is a period where catch-up growth can be achieved and is the period with fastest growth spurt and nutritional requirements are high in order to fasten and improve growth and development. If balanced nutrition is not provided to the body at this stage then stunting, thinness and underweight are likely to be witnessed and this is irreversible since the body may not get another window of opportunity for catch-up growth. Majority of adolescents are reported to have consumed sorghum with most (40.6%) foods from own production for adolescents from the rural areas, while in others dietary habits revealed they consumed white roots, and tubers (56.7%), (Abay and Woody, 2017), Abbas Ismail, 2019). Less than a third of adolescents reported having consumed fruits and vegetables daily. A review of 25 articles concur with this review since it found out that most adolescents had inadequate intake of fruits and vegetables (Bekele et al, 2020, Takele et al, 2016, Christian and Smith, 2017). Consumption of fruits and vegetables translates to adequate of minerals and vitamins. Adequate intake of fruits is an excellent source of vitamin C, vitamin A, folate and other essential micronutrients. They also provide bioactive compounds such as phytochemicals, vitamins, minerals and fiber.

Adolescents intake of macronutrients was inadequate in this review with highest intake of protein at 14.2%, carbohydrates 72.4% and fats at 15% (Richi et al, 2018, Christian and Woody, 2017). This disagrees with a review of 63 studies on macronutrient intake indicated that most adolescent girls had adequate global protein adequacy except for older adolescent girls living in Africa (Christian and Woody, 2017, Keats et al, 2017). Sub-optimal protein utilization and poor quality protein intake results to protein inadequacy especially due to high infection burden globally. Carbohydrates and fats were found to be adequate among younger adolescents than older adolescents. Intake of carbohydrates, protein and fats were higher in adolescents' living in urban area than in rural areas Keats et al, 2017, Mariam et al 2017, Adin-ma et al, 2017).

This could have been necessitated by the fact that their higher economic power for the urban dwellers than their counterparts residing in rural area where there is rampant unemployment and seasonality which dictates the availability of food in such areas. Moreover food distribution is not even and at times rural adolescents consume only those foods which are on season at any given time. Adequate energy is important for supporting appropriate growth during adolescence and they require a total of 4% to support growth as compared to the younger children who require 3% caloric intake. Caloric requirements in adolescents are determined by physical growth, and lean tissue accretion.

Overweight

The review reported highest prevalence of overweight at 24.2% (Tekele et al, 2016) and lowest at 10.8% (Bekele et al, 2020). The highest reviewed overweight was lower than

that got in Egypt at 31.4% (Maiti et al, 2011). An adolescent overweight exposes them to double burden of malnutrition which poses a challenge for government and Low-Medium Income Countries (LMICs). Double burden of malnutrition usually refers to the co-occurrence of under-weight, stunting or micronutrients deficiencies plus overweight or obesity the denominator for this constellation frequently varies. At the country level the double burden can be said to exist when childhood stunting amounts to 27% and maternal overweight equals to 29% in a population (Marie et al 2017),.

At household level double burden of malnutrition would be defined when a family has at least one overweight or obese person. At individual level the double burden of malnutrition usually addresses macro and micro-nutrient deficiencies as commodities of adiposity in one person (Marie et al, 2017). This review showed that adolescents who came from households with head who had attained higher education level tended to have overweight and obesity (Christian and Woody, 2017, Newcastle, Newcastle-Ottawa, 2000, Abbas et al., 2019, Bain et al., 2013). The type of school the adolescent attended and residence also tended to contribute to overweight, for instance Marie et al, 2020 reported that students who attended private schools tended to be overweight and those residing in urban area as well (Moher et al., 2009, Patton et al., 2016, Mengistu et al., 2013, Mayanga et al., 2013).

This could be contributed to by the fact that these households have high economic power and can not only access food but also afford a set of television which adolescents spend time watching leading to reduced physical activity. These households also tend to have small family size >5 members and their dietary intake is more on refined carbohydrates with high glycemic index leading to over weight (Bekele et al., 2016, Christian and Woody, 2017, Delisle, 2005, WHO, 2017).

Sanitation

Basic sanitation was characterized by use of clean portable water and using wells which are fenced and also use of latrines facilities which are within each adolescent's compound. The source of water supply had an association with adolescents stunting which ranged between 15.7% to 90.9% (Abbas & Anne, 2019) (AbayWoday et al., 2018). Adolescents from households with unsafe water supply as main source of water were almost four times more likely to be at risk of malnutrition due to intestinal infections such as diarrhea, vomiting, parasitic infestation and water borne diseases caused by unsafe drinking water at household level. Washing hands after visiting the toilet and before eating ranged between 20.4% to 83.3% (Melaku&Alemayehu, 2019, Abay et al, 2018) (Delisle, 2005, Keats et al, 2017). Adolescents who did not wash their hands after visiting the toilet and before eating were found to be stunted and underweight making these two traits significant predictors for malnutrition directly or indirectly

since this will lead to illnesses such as diarrhea and intestinal infestations.

IV. CONCLUSION

According to the review adolescents risk for malnutrition are unhealthy and polished foods, sugar added diets, lack of physical activity, obesity, use of unsafe water and poor sanitation. These have led to underweight and having adolescents who are overweight. Living areas had highly significant association with the BMI of adolescents. Consumption of soft drinks, coffee, milk and milk products, red meat, vegetables and fruits had significant association with their existing BMI. Adolescents should be engaged into regular nutrition education, concentrating on their dietary habits and intake especially inclusion of fruits and vegetables in their regular meals and snacks. This should be a joint venture between the governments, Non-governmental organizations and faith based organization all targeting adolescents.

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