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Original article

PREVALENCE AND RISK FACTORS OF MALNUTRITION AMONG PRIMARY SCHOOL CHILDREN FROM 1998-2017: A SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT

Obesity and overweight of school going children have become worldwide epidemics. Additionally, under nutrition is a major health problem for children especially in developing countries. Comparative, up-to-date information on levels is essential to both quantify school going children malnutrition and prompt decision-makers to prioritize action. Prevalence rates of underweight**,** overweight and obesity varied across the world and high in certain regions, a fact which may be attributed to climatic, racial and temporal characteristics. This paper aimed to determine the prevalence and risk factors of malnutrition among school-aged children using systematic review and meta-analysis.The key terms child, underweight, overweight and obesity had been used to search for collecting published papers from 1998-2017 on malnutrition of school going children. Non-repetitive papers had been collected using search engine Pub Med, Endnote, Elsevier, Eric, MEDLINE, Cochrane Library and EMBASE. A total number of 906 English papers were found by Endnote software and 43 papers were reviewed using Pub Med. In this study, Q, I^2 statistics and Forest plot has been used. The overall prevalence of obesity among school going children in the published literatures varied considerably from 0.3% in Nigeria to 36.8% in Vietnam, and the prevalence rate of overweight from 2.8% in Nigeria to 40% in UK. On the other hand the overall prevalence rate of underweight of school going children in the published literatures varied noticeably from 2.11% in Brazil to 64.4% in India. The pooled risk ratios ranged from 0.46 to 1.59 and 0.73 to 1.04 for underweight and overweight children respectively. This study revealed that parental overweight was the most important predicator for overweight of children. It was also found that low birth weight and child hunger were influential risk factors for underweight of children.

Keywords : Malnutrition, Primary School, Children, Meta analysis

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INTRODUCTION

Religion has always fascinated sociologists and anthropologists since the beginning of these disciplines. It was a common perception that Anthropologists were interested only on studying tribe and ethnic groups. But it is not true in contemporary times although they initially focused mainly on the so-called

In *Primitive Culture* (1871), Tyloradopted a unilinear evolutionary theory of societies where he suggested that societies, through the Now a day's malnutrition, both under nutrition and over nutrition, has a major health problem of children for most of the countries in the world. Malnutrition has been shown to be a risk factor for disease, over nourished children are more likely to become over nourished adults and it is associated with a number of serious health conditions including heart disease, diabetes, and some cancers (Roger, 2011). On the other hand, undernourished children are more likely to develop gastro esophageal reflux disease, inflammatory bowel disease, chronic vomiting or diarrhea (Zidorio, 2015). The study on prevalence of under-nutrition and over-nutrition provides useful information about child health, and reflect the general living environment of a given population. It was found that overweight and obesity for school-aged children in the year 2010 is 20% in urban China, 46% in the America, 41% in the Eastern Mediterranean region, 38% in the European region, 27% in Western Pacific region and 22% in South-East Asia (38^{th} General Internal Medicine meeting, 2015). The prevalence of obesity had increased 54% among 6-11 years old children in India (Xiao, 2015). In Ghana, malnutrition among primary school children had been surveyed and found the prevalence of overweight was 7% in urban and 1% in rural areas (Manyanga, 2014). In Bangladesh, the malnourished children are less likely to enroll in school on time and achieve an age-appropriate grade by 26 percentage and 31 percentage, respectively (Khanam, 2011). Another study in Bangladesh investigated the malnutrition among primary school children and reported the prevalence of stunting and wasting were 55.9%, and 25.9% respectively (Rahman, 2015). It is noted that that child obesity has been dramatically increasing throughout the world both in developed and developing countries and also it is observed that the prevalence of undernourished children have been increasing specially in poor countries (Goh, 2013). This current epidemic of obesity among children is largely rapid changes due to socio-economic and nutrition transition to globalization (Slaney,

2012). Due to economic insolvency and, to some extents, lack of awareness malnutrition travels from generation to generation because the malnourished mothers give birth to malnourished babies. Special attention should be paid to school going children considering their potential influence on the nation's workforce for future. Due to their unique role in the nation for future, it is important to investigate the prevalence and determine the risk factors for malnutrition among children.

The aim of the study is to determine the prevalence of malnutrition among school going children aged 6-10 years and to investigate the risk factors for malnutrition using a systematic review and meta-analysis.

METHODS

The systematic review of Meta analysis was used in the present study to determine the prevalence of underweight, overweight and obesity among school-age children from 1998-2017. The databases PubMed, Endnote, Elsevier, Eric, MEDLINE, Cochrane Library and EMBASE were searched using combinations of the various search terms to identify eligible observational studies published between 1980 and 2017 in English. The key terms "child", "underweight" "obesity", "overweight", were used for in Endnote, PubMed, and Ovid, ProQuest, and Elsevier databases. Non-repetitive papers conducted from 1998-2017 holding the key terms in their abstracts, keywords, or main body were extracted and reviewed. Different search strategies were applied in different databases as they provided different search tools. To search the papers, "underweight" "obesity" and "overweight" were looked up separately in the databases for papers published during the same time span. Overall, 906 English papers (547 in Pub Med and 359 in Elsevier) were found at the first stage of investigation. At the next stage, papers that focused on underweight, overweight and obesity in school-age children in worldwide during the specified time span and that had their full paper available were selected. Repetitive papers as well as case-control and clinical trial papers were eliminated. A graduate in informatics and a specialist performed the search and analysis separately. A checklist covering papertitles, authors, time and setting of study,

sample size, age of subjects, sex, and percentages of overweight and obesity was prepared for final assessment. Finally, 43 papers were included in the current study.

Statistical methods: Statistical analysis was carried out using the statistical software package Stata version 11. The effect size of the meta-analysis was the prevalence of underweight, overweight and obesity. The pooled prevalence of underweight, overweight and obesity was estimated by fixed effects. We examined risk factors for over nutrition and under nutrition that met the meta-analysis eligibility criteria, by looking at the 95% CIs reported in each study. A fixed effects model was utilized to pool the effect sizes of the individual effect size taking into account both the sampling error and heterogeneity by the generic inverse variance method.Effect size was pooled from all eligible studies using the inverse variance fixed effects method (IVFEM) for meta-analysis.This model was preferred to a fixed effect model, since it was based on the assumption that a distribution of effects exists, resulting in heterogeneity among study results. Additionally, the heterogeneity was separately estimated using by $\chi 2$ test, Q statistics with corresponding I^2 statistics. In analyses where $I^2 > 60\%$ was observed, we explored possible sources of heterogeneity based on the definition used for the nutritional status of children. For space economy, results were presented in tables and forest plots where prevalence rates, ES and 95% confidence intervals (CI) are figured out for every study inserted in the model along with an overall estimate.

RESULTS AND DISCUSSION

Prevalence of malnutrition

In this study, 43 papers were reviewed using Pub Med and those were investigated in terms of place of study, year of publication, sample size, and prevalence rates of overweight, obesity and underweight. Table 1 and Table2 summarize the information from the papers. It was found that the overall prevalence rate of obesity in primary-school children in the published literature varied considerably from 0.3% in Nigeria to 36.8% in Vietnam. On the other hand, the prevalence rate of overweight was varied from 2.8% in Nigeria to 40% in UK. The overall prevalence rate of underweight in primary-school children in the published

literature varied noticeably from 2.11% in Brazil to 64.4% in India. The statistics also differed considerably in terms of sex.

Twenty-eight studies were included for the analysis to determine the prevalence of overweight and obesity. Meta-analysis demonstrated thatthe overall pooled prevalence of overweight estimate was 3.33% (95% CI: 2.78, 3.91), however, I^2 statistics showed that the heterogeneity of the prevalence estimates among the twenty-eight studies on overweight was very high (I^2 = 70.9 % and p=0.000) (Fig.1).

It was observed that the overall pooled prevalence of obesity estimate was 6.45% (95% CI: 2.58, 10.34) but the heterogeneity of the prevalence estimates among the twenty-eight studies on obesity was very low (I^2 = 0.00 % and p=0.767) (Fig.2).

Fifteen studies were included for the analysis to determine the prevalence of underweight and it was found that the overall pooled prevalence of underweight estimate was 30.34% (95% CI: 17.43, 43.24), the heterogeneity of the prevalence estimates among the 15 studies on underweight was very low (I^2 = 0.00 % and p=0.970) (Fig.3).

In our systematic analysis of global data on the prevalence of obesity and overweight, we found that the prevalence of overweight and obesity was raised significantly over the past three decades, with marked variations across countries in the levels. In developed countries, there is some indication that the increases in obesity that began in the 1980s have attenuated over the last eight years or so. Our findings suggest that there are likely to be continued increases in the developing world, where almost two in three of the world's obese live. Island nations in the Pacific and the Caribbean, and countries in the Middle-East and Central America, have already reached particularly high rates of overweight and obesity. In the current study, the prevalence of obesity in the world was found to be remarkably varied according to the published papers. Higher rates for obesity and overweight were respectively recorded for UK (10% and 40%) (Ahrens 2014), in Kuwait (16.8% and 20.2%) (Al-Isa 2010), Austria (15.8% and 28.17%) (Amigo 2013), Italy (24.2% and 13.2%) (Celi 2003), Vietnam (36.8% and 21.4%) (Dieu 2009), and Swiss (16.1% and 34.2%) (Zimmermann, 2000). The lowest prevalence rate belonged to Nigeria (0.3% and 2.8%) (Adegoke, 2009). The higher rate for underweight was recorded in India 64.4% (Bose, 2008) and the lowest prevalence rate belonged to Brazilil 2.11% (Flores, 2013).

Risk factor for malnutrition

Seventeen studies were included for the analysis of risk factors for under weight. Accordingly, six risk factors were used in the quantitative meta-analysis. The pooled risk ratios ranged from 0.46 to 1.59, which corresponds to child hunger and low birth weight was found in this study. Greater heterogeneity was observed among studies evaluating child hunger, number of children, dietary energy intake, protein intake, vitamin A intake, and low birth weight as risk factors for underweight (Fig 4). On the other hand, thirty four studies were included for the analysis of risk factor for overweight, and five risk factors were used in the quantitative meta-analysis. The pooled risk ratios ranged from 0.73 to 1.04, which corresponds to parental overweight and low educational level. Greater heterogeneity was also observed among studies evaluating parental overweight, preschool overweight history, large size for gestational age, maternal obesity and low educational level as risk factors for overweight (Fig 5).

Table1. A Summary of Results from Papers Published on Overweight and Obesity in School-Age Children

Author(s)	Year	Country/ Region	Age	Sample Size	Sex	% Overweight	%Obesity
Abril, et al	2013	Ecuador	6-9	743	both	26	10.6
Achat, et al	2014	Sydney	9-12	2341	both	19	6
Adegoke, et al	2009	Nigeria	6-8	720	both	2.8*	0.3*
Ahmetasevic, et al	2015	Bosnia	3-12	162	both	21	11
Ahrens, et al	2014	UK	2-10	18745	both	40*	10
Albertini, et al	2008	Italy	6-9	2955	both	16.5	8.6
Al-Isa, et al	2010	Kuwait	6-10	662	male	20.2	16.8
Al-Raees, et al	2009	Bahrain	2-5	698	both	12.3	8.4
Alvarez-Villasenor et al	2014	Mexico	0-4	368	both	17.3	30

Amigo, et al	2013	Austria	9-10	291	both	28.17	15.80
Amin, et al	2008	Saudi	10-14	1139	male	14.2	9.7
Andegiorgish, et al	2012	China	7-18	3140	both	12.5	15.7
Anderson, et al	2014		0-2		both	12.5	8.5
Andre, et al	2016	Lisbon	6-12		both	9.8	33
Apfelbacher, et al	2011	German	5-7	35434	both	17.5	5.7
Balaban, et al	2001	Recife		762	both	26.2	8.5
Bartle, et al	2013	London	7-11	400	both	13.5	5.3
Berg, et al	2001	Sweden	12	7011	both	12.3	7.9
Celi, et al	2003	Italy	3-17	12143	male	13.2	24.2
Cerrillo, et al	2012	Spain	8-9	990	both	11	22
del Rio-Navarro, et al	2004	Mexico	10-17	7862	male	10.8	9.2
Dieu, et al	2009	Vietnam	4-5	1162	both	21.4	36.8*
El Mouzan,et al	2010	Saudi	5-18	19317	both	23.1	9.3
Emandi, et al	2013	Roman	7-18	3626	both	18.2	7.2
Georgiadis, et al	2007	Greek	6-17	6448	both	17.3	3.6
Gijon-Nogueron, et al	2017	Spain	10	27	both	7.8	2.7
Hajian-Tilaki, et al	2011	Iran	7-12	1000	both	12.3	5.8
Zimmermann, et al	2000	Swiss	6-12	595	both	34.2	16.1

Table2. A Summary of results from papers published on underweight in school-age children

Author(s)	**Year**	**Country/ Region**	**Age**	**Sample Size**	**Sex**	**%Underweight**
Elizondo-Montemayor, et al	2017	Mexico	6-11	40	both	25
Akombi, et al	2017	Nigeria	< 5	24,529	both	29
Ambroszkiewicz, et al	2015	sklerostyna	5-10	60	both	50
Batte,. et al	2017	Uganda	0-10	194	both	45.4
Bloss, et al	2004	Kenya	5	296	both	30
Bose, et al	2008	India	1-12	1206	boys	64.4*
Catalani, et al	2016	Argentina	13	711	boys	37.4
Chen, et al	2012	Asian	6-10	705	both	21.0
Chirita-Emandi, et al	2016	Romania	6-19	25060	both	5
Flores, et al	2013	Brazilian	7-10		both	2.11*
Gaeini, et al	2011	Iran	3-6	378	boys	4.77
Gardner, et al	2011	Saint Lucia	5	425	both	4.7
Hasnain, et al	2009	Sindh	<5	1100000	both	54.3
Jeemon, et al	2009	India	10-19	3750	both	53.2
Khatri, et al	2015	Nepal	<5	280	both	41.4

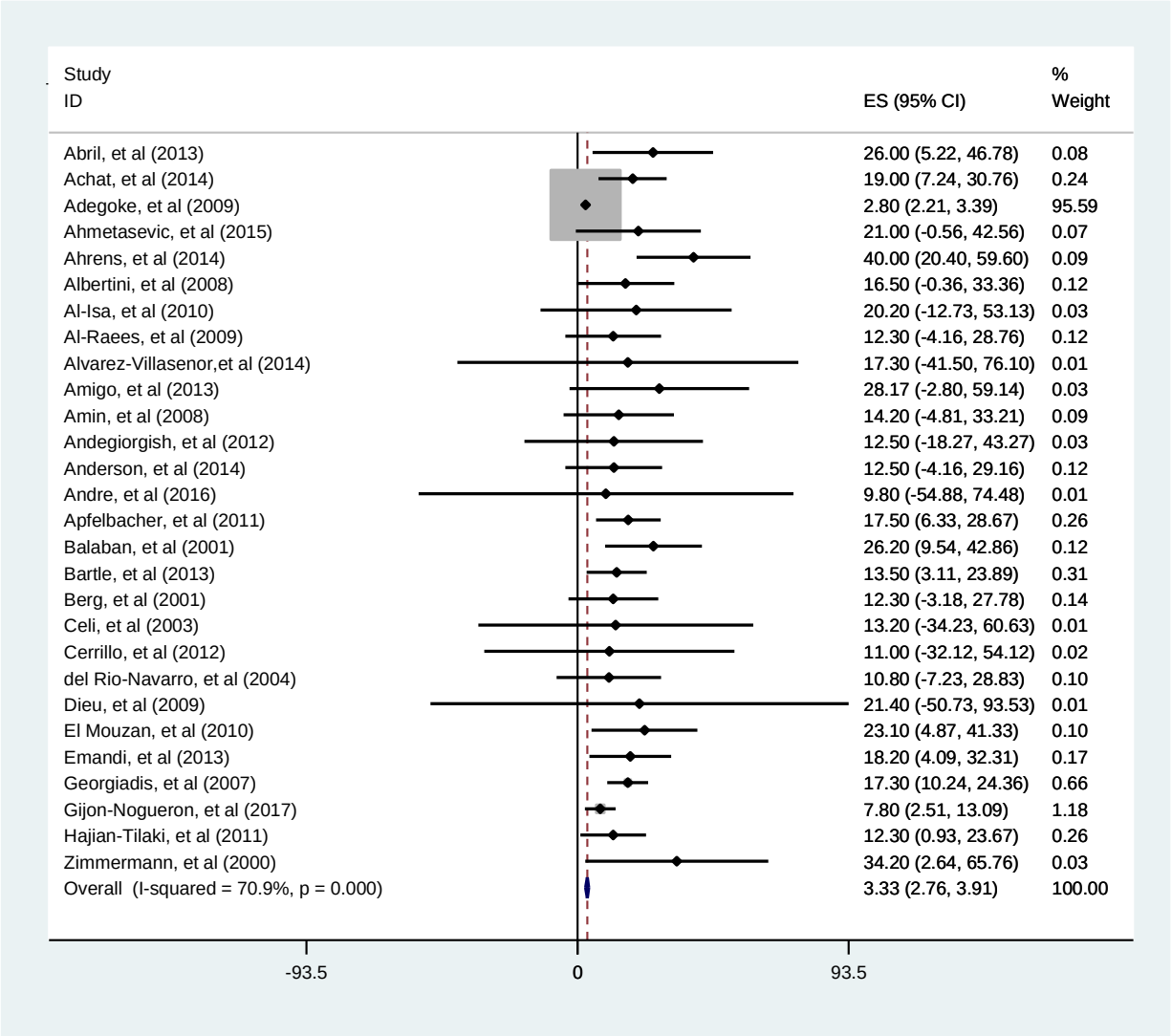


Fig. 1: Prevalence of effect size and 95% CI of overweight

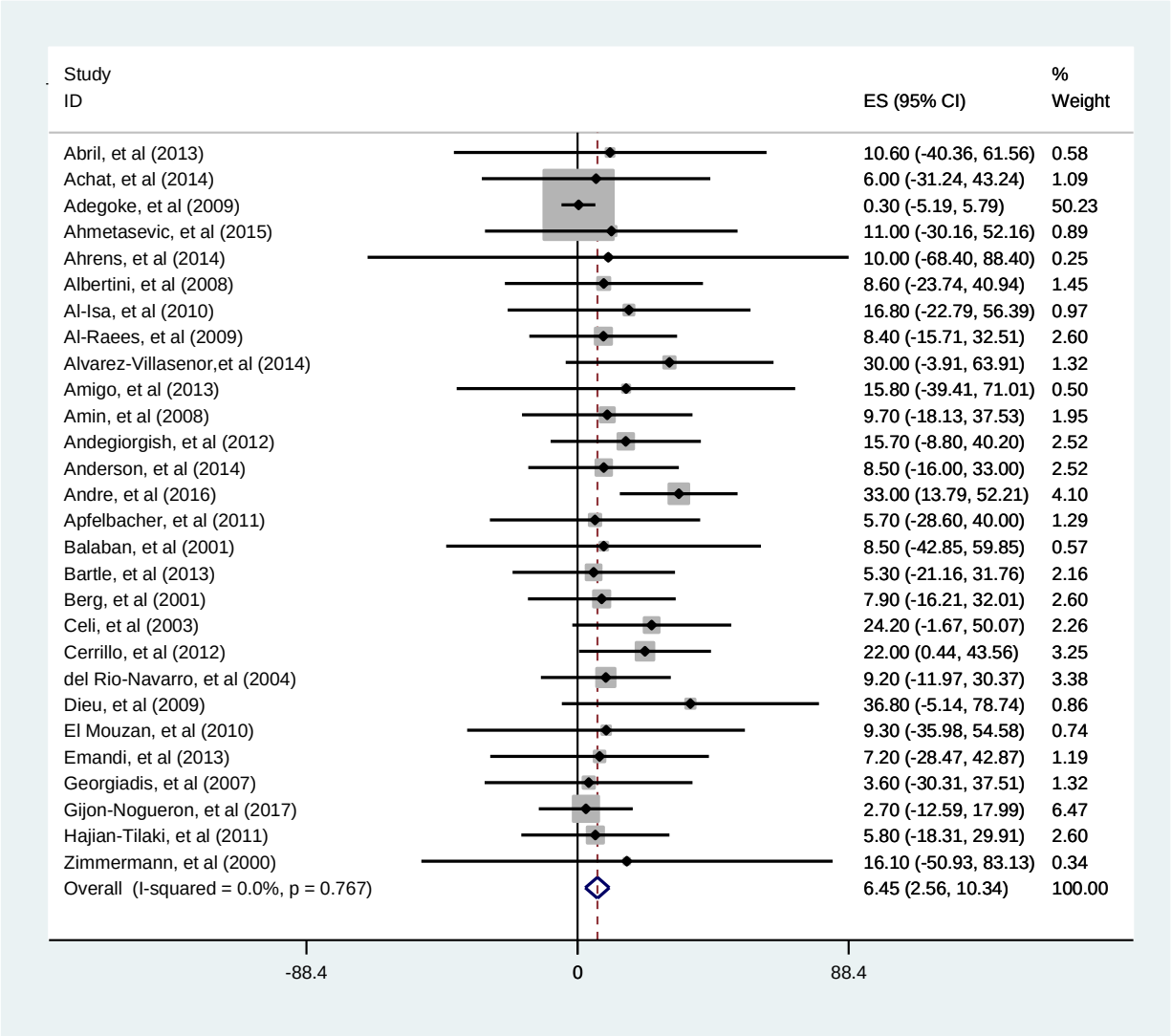


Fig. 2: Prevalence of effect size and 95% CI of obesity

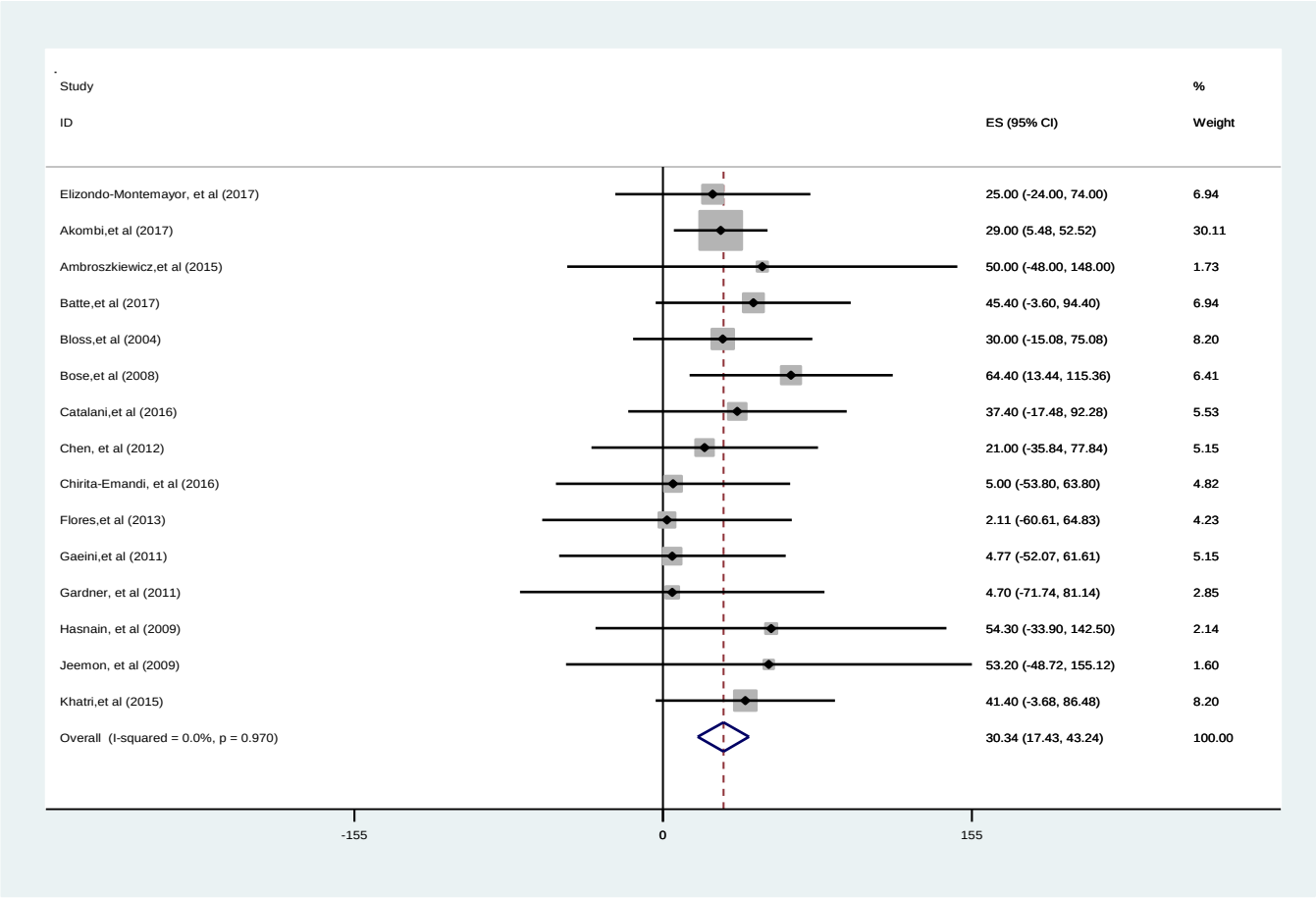
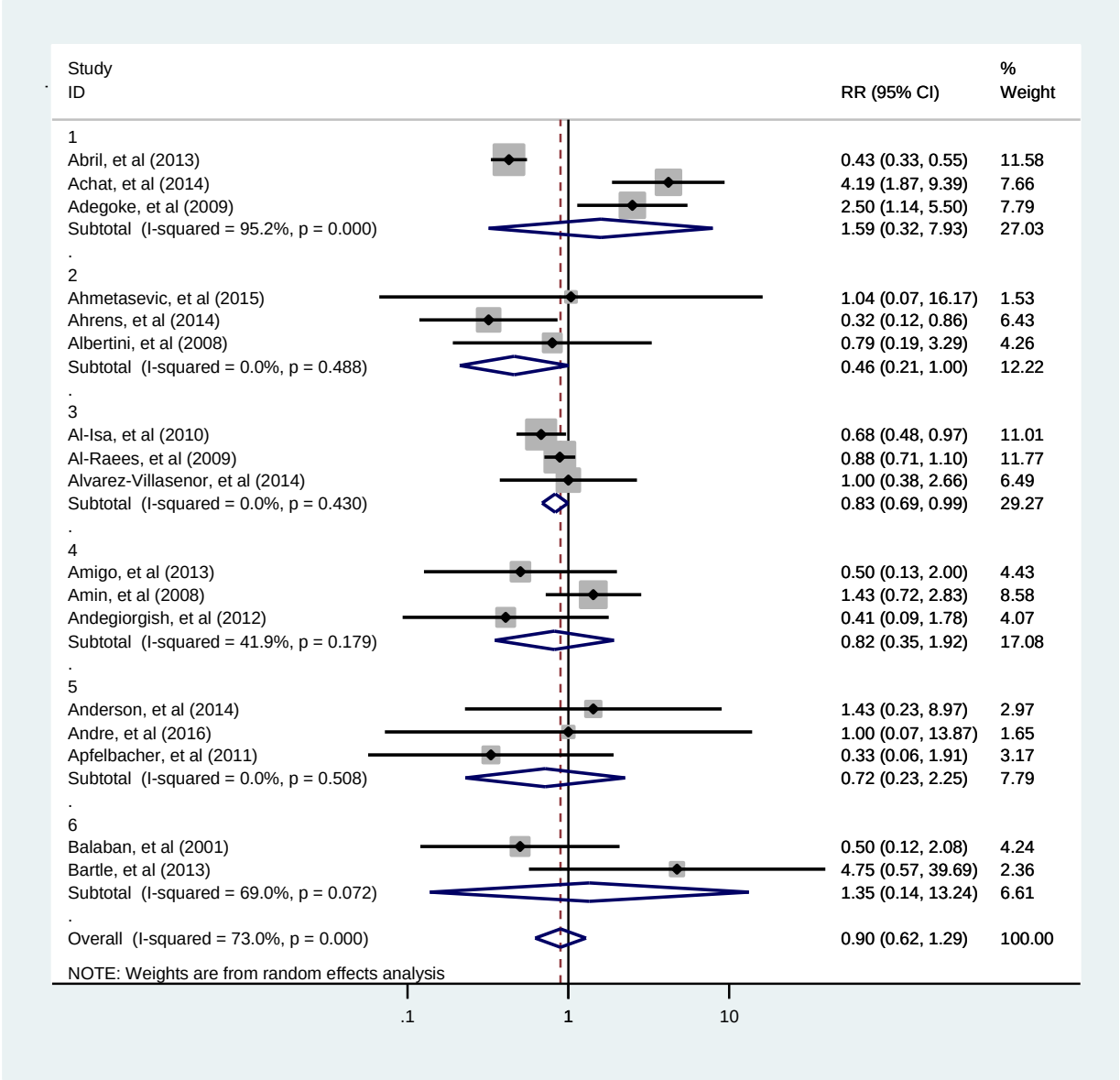
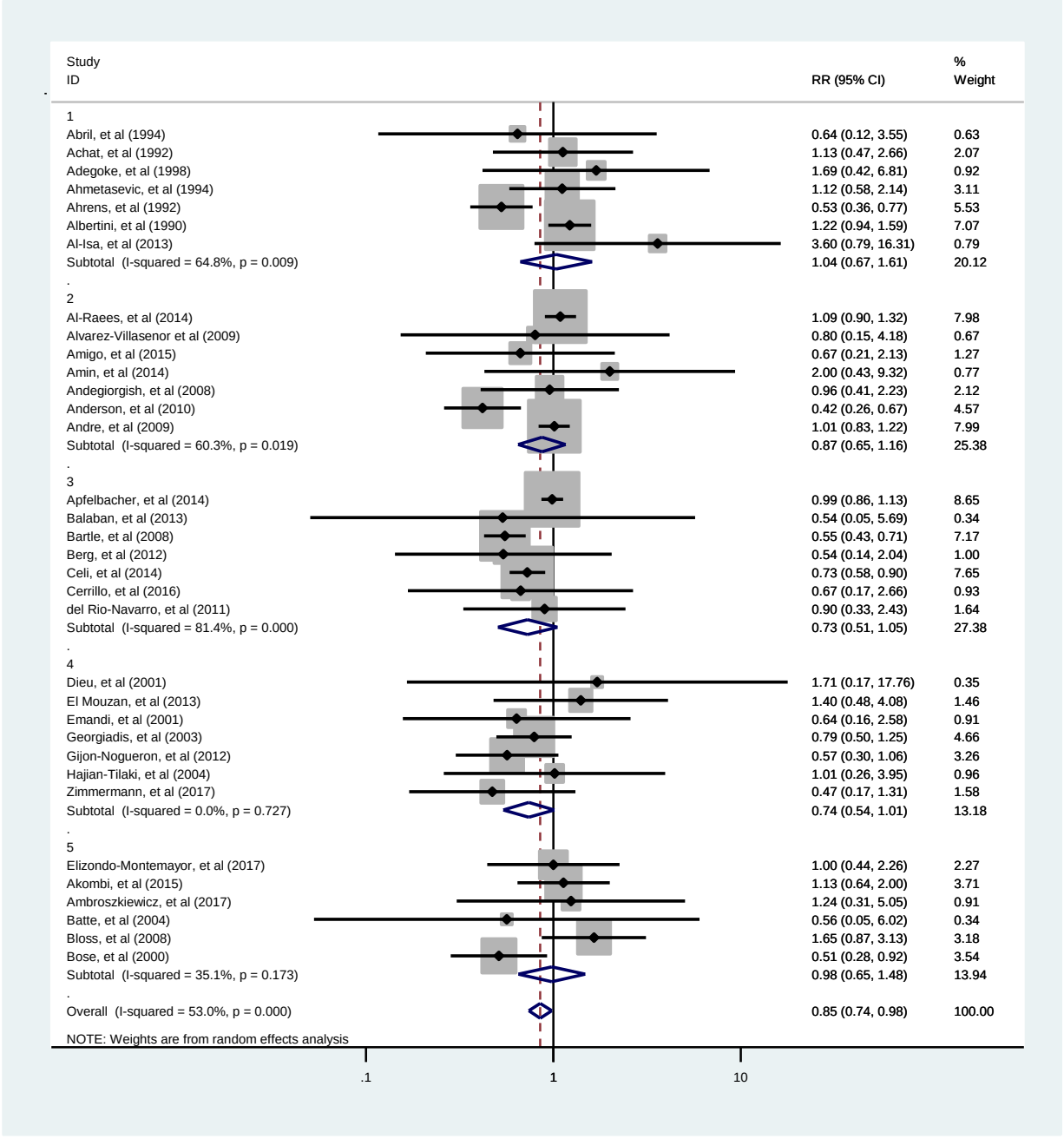


Fig. 3: Prevalence of effect size and 95% CI of underweight



N.B: 1 = child hunger, 2 = number of children, 3 = dietary energy intake, 4 = protein intake, 5 = vitamin A intake, 6 = low birth weight.

Fig. 4: Risk factors for under nutrition



N.B: 1 = parental overweight, 2 = preschool overweight history, 3 = large size for gestational age, 4 = maternal obesity, 5 = low educational level.

Fig. 5: Risk factors for over nutrition

CONCLUSSION

In this study, we determined the prevalence and risk factors for separately underweight, overweight and obesity among school going children from 1998-2017 in worldwide from using systematic review and meta-analysis. Q and I^2 statistics were used to check heterogeneity among the collected published papers and Forest plot was applied to find the prevalence and risk factors for malnutrition of school going children. The overall prevalence of obesity among school going children was varied from 0.3% in Nigeria to 36.8% in Vietnam and the prevalence rate of overweight from 2.8% in Nigeria to 40% in UK. On the other hand, the overall prevalence of underweight among school going children were varied from 2.11% in Brazil to 64.4% in India. The pooled risk ratios ranged of overweight from 0.73 to 1.04, which corresponds to parental overweight and low educational level. Greater heterogeneity was also observed among studies evaluating parental overweight, preschool overweight history, large size for gestational age, maternal obesity and low educational level as risk factors for overweight. The pooled risk ratios ranged of underweight from 0.46 to 1.59, which corresponds to child hunger and low birth weight was found in this study. Greater heterogeneity was observed among studies evaluating child hunger, number of children, dietary energy intake, protein intake, vitamin A intake, and low birth weight as risk factors for underweight.

This study suggests that this target is extremely ambitious and unlikely to be attained without concerted action and further research to evaluate the impact of population wide interventions, and how to effectively translate that knowledge into national obesity control programs. To counter the impending health effects on populations, particularly in the developing world, urgent global leadership is required to assist countries to more effective intervene against major determinants such as excessive caloric intake, physical inactivity and active promotion of food consumption by industry, all of which exacerbate an already problematic obesogenic environment. It is noticed that, overweight and obesity prevalence rates are varied across worldwide and high in certain country. It is essential to devise health policies in this regard including appropriate interventional measures; familiarization of families and children with obesity-inducing factors, consequences, short- and long-term risks, and its morbidity and mortality; corporation of suitable educational programs in school curricula; and modification of lifestyles.

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