Is Second Hand Smoke associated with Child's Nutritional Status? A Meta-Analysis

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Systematic Review

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Abstract

Introduction The strong relation between parental smoking, children exposure to Second Hand Smoke (SHS) through parents and child growth has been proven. However, the effect is not well defined. Through this meta-analysis, we sought to determine the relationship between SHS exposure and child nutritional status

Methods A meta-analysis has been performed which included articles between 2005-2019, related to SHS exposure and child nutritional status which is accessed through child growth outcomes (Stunting, Wasting, Underweight and Obesity). Relevant studies were searched through Medline, PubMed, JStor and Cochrane Library.

Results 17 articles were identified which comprised of different growth outcomes such as overweight, obese, stunting, severe stunting, underweight, severe underweight, wasting and severe wasting. 10 studies showed SHS exposure was highly related to overweight with the pooled risk of 0.26 with 95% CI 0.22-0.29 (I^2 = 73.6%). Few studies reported other growth outcomes such as stunting, underweight and obese. Subgroup analysis was done to see the risk associated with different growth outcomes.

Conclusion: The current review identified that exposure to SHS may be associated with adverse growth outcomes in children. It is crucial that active smokers, specifically those who live with children or with a pregnant partner, are made aware of the potential effects of SHS exposure on non-smokers. Further studies are needed to see the impact of SHS exposure with different measures of child nutritional status.

Introduction

Tobacco consumption is the single largest preventable reason behind death, killing over 7 million people annually, of which 6 million and more are users or ex-users of tobacco, and around 890,000 are non-smokers exposed to second-hand smoke. Over 80% of those deaths occur in low- and middle-income countries (1). India is the third-largest producer of tobacco products and also the second-largest consumer of tobacco products (2). 37% of the total male population and 12.4% of the female population are daily tobacco users. The prevalence of smokeless tobacco (SLT) consumption is highest in India for about 33% in male and 18% in female (3). A similar trend was also seen in the youth age between 13-15 years, 19% of the males and 6.3% of the females were current tobacco users. Among them 8.1% of the youth were smokers and 9.0% were smokeless tobacco consumers. The exposure to second-hand smoke at home was 21.9% among the youth aged 13-15 years (4). As per the India Report of Global Youth Tobacco Survey 2006 the prevalence of smoking initiation before age 10 years among ever cigarette smokers was 36.9% which was alarming in the Eastern, Northern, and Southern parts of India (5). A Lancet study did a retrospective analysis of data from 192 countries in which 40% of children, 33% of male non-smokers, and 35% of female non-smokers were exposed to second-hand smoke in 2004 (6). An analogous study in 68 low-middle income countries showed a prevalence of second-hand smoke as 55.9% among children aged 12-15 years (7).

India is additionally home to one-third of the world's undernourished children, with rates of a child under-nutrition remaining obstinately high for decades. Consistent with the fourth National Family Health Survey (NFHS-4), one-third of children are born with low birth weight (LBW), 38% of children below five years of age

are stunted, 21% are wasted, and 36% are underweight. The nutritional status of a child, as with every individual, is assessed through dietary, anthropometric, biochemical, and physical observation (8).

Second-Hand Smoke (SHS) significantly contributes to morbidity and mortality in children. Children, are the foremost susceptible population to the harmful effects of SHS. Children are exposed to tobacco smoke not solely in their homes but also in schools, restaurants, child-care settings, cars, buses, and other public places. The home is the greatest single source of SHS for children. Parental smoking inside the home affects both foetal health and maternal health. SHS has been associated with adverse effects on paediatric health; including preterm birth, intrauterine growth retardation, perinatal mortality, respiratory illness, neurobehavioral problems, and decreased performance in school (9–14).

There are multiple studies showing factors which affects the nutritional status of children such as food insecurity, low socioeconomic status, maternal health, pre-natal and post-natal care, and child health within two years after birth which affects the overall nutritional status of children in one way or another (15–17). As per the WHO growth standards, a child's nutritional status can be assessed using anthropometric measures such as Stunting, Wasting, Underweight, LBW, waist-hip ratio, head circumference, body mass index (BMI) arm circumference, and subscapular skinfold (18). The study aims to conduct a meta-analysis to evaluate SHS as one of the main confounding factors associated with child nutritional status.

Methodology

In this meta-analysis we used international PEO (Population, Exposure and, Outcome) Format (19): P: Population consists of the children who are exposed to smoke; E: Mother, Father or Either of the parents has a habit of smoking; and O: To explore whether parental smoke affects child nutritional status (Underweight, Wasting, Stunting, Overweight, Obese).

Literature Inclusion Criteria

1) Research methods include case-control, cross-sectional and longitudinal study; 2) child anthropometric measurements were taken; 3) studies published between 2005 to 2019; 4) studies had confounding factors such as parental smoking behavior, smoking habits, and frequency; 5) studies published in English language literature.

Literature exclusion Criteria

1) Studies with reporting of only LBW as a measurement for child nutrition; 2) child growth measurement had been done after the age of 10 years; 3) studies with no reporting of odds ratios.

Literature retrieval studies

We searched Medline, PubMed, JStor and Cochrane Library with keywords: “Second Hand Smoke and Child Nutrition”, “Maternal Smoke and Child Nutrition”, “Maternal Smoke and Child Obesity”, “Maternal Smoke and Child Stunting”, “Parental Smoke and Child Obesity or Child Stunting”, “Second Hand Smoke and Child

Stunting or Child Obesity", "Parental Smoke and child Wasting", "Parental Smoke and Child Underweight", "Second Hand Smoke and Child underweight or Child wasting", "Maternal Smoke and Child Underweight or Child Wasting" [Figure 1].

Extracting information, excel spreadsheet, and fetching information

1) General information was extracted author, publishing year and journal name; 2) study population, study area; 3) study results stating odds ratio (OR) with 95% confidence interval associated with parental smoking behaviour or habits with child nutritional status.

Statistical Analysis

ORs obtained from each study were merged. Subgroup analysis was conducted to see the contribution of parental smoking behaviour or habits on child nutritional status (Underweight, Wasting, Stunting, Overweight, Obese) using pooled estimates of OR. Weighting for each study had been done by considering sample size. The forest plots were used to present study-wise variation with OR. Data included: 1) parental smoking behaviour or habits and child nutritional status; 2) heterogeneity test and pooled estimates of OR, and; 3) bias analysis. OR value was used to measure the effect quantity. To ensure the accuracy of the results and because of the high heterogeneity of the studies, we used the random-effects model. To access heterogeneity, Higgins I^2 was calculated, which allowed a determination of the proportion of the observed variance. I^2 above 50% or 75% suggests the presence of a moderate or high heterogeneity, respectively (20). Publication bias was examined by visual examination of asymmetry of the funnel plot which was statistically tested through Egger's Test (21). The statistical analysis was performed using Stata 14 software (22).

Results

Of the total selection criteria, 17 studies were used for the meta-analysis. Of the total studies, the nutritional status of children was mostly assessed through overweight followed by obese which was calculated using BMI of the children at their respective ages. Very few studies had reported stunting, severe stunting, underweight, severe underweight, wasting, severe wasting as the outcome for the nutritional status of children. Since the different authors had captured the smoking behaviour or habits of parents differently. Hence, subgroup analysis of all the studies had been done by different child anthropometric measurements.

Subgroup analysis of child nutritional status with smoking pattern

10 studies had reported overweight with factors such as maternal smoking during pregnancy, family smoking in the house, prenatal and postnatal smoking, parental smoking. The risk for overweight was high in family

smoking in the house. The pooled estimated risk for overweight was 1.29 with 95% CI 1.25-1.33 (I^2 = 73.6%) (Figure 2). Similarly, 5 Studies had reported obese with pooled estimated risk of 1.50 with 95% CI 1.36- 1.65 (I^2 = 46.2%) (Figure 3). Unlike the overweight risk for obese was highest in family smoking in the house. Furthermore, for stunting 5 studies reported pooled estimated risk of 1.12 with 95% CI 1.10 - 1.13 (I^2 = 39.2%) (Figure 4). Later, 4 studies reported severe stunting and underweight with risk of 1.14 (95% CI 1.11 - 1.18) (I^2 = 73.7%) and 1.05 (95% CI 1.04 - 1.07) (I^2= 92.7%) respectively (Figure 5). For other anthropometric measures, few studies reported risk for severe underweight (3 studies), wasting (2 studies), severe wasting (2 studies), and rapid weight gain (1 study) (Table 1). Severe underweight had pooled risk of 1.11 with 95% CI 1.07 – 1.14. Wasting, severe wasting and rapid weight gain had been seen in only one to two studies only. Table 1, shows heterogeneity and publication bias. Publication bias was assessed using asymmetrical nature of the funnel plot which was tested using Egger's test. For the studies included to estimate the pooled risk of overweight, stunting, severe stunting, underweight and severe underweight for parents having smoking behaviour or habits were a little bit asymmetrical but the Egger test was not significant (p-value > 0.05). Studies with obese (p value 0.023) as outcome variable for child nutritional status contains publication bias as its sample size was small. Analysis of two studies on severe wasting did not yield any statistically significant estimates.

Discussion

This meta-analysis provides evidence from 17 studies about the association between parents smoking behaviour and child nutritional status. The child's nutritional status has been assessed in multiple ways. As per our study, multiple studies have reported overweight and obese (calculated using BMI) as an outcome for child nutritional status. Very few studies have reported other anthropometric measures such as stunting, wasting, and underweight. A study by Quelhas et al. in 2018 did the review and have stated that maternal smoking during the time of pregnancy results in a shorter length and smaller head circumference (23). Another similar study by Qureshi et al. in 2018 also showed us that parental smoking is associated with childhood obesity from birth to 18 years (24). Our results also showed similar results among children with a risk of overweight below the age of 10 years. Riedel et al. in 2014 conducted a review in which she has compared maternal smoking during pregnancy, anytime household smoking, and its association with overweight and obesity. In this study maternal smoking during pregnancy and family smoking in the house has a greater impact on childhood overweight and obesity compared to parental smoking at any time (25). Also, a study by McConnell et.al. in 2015 has shown that childhood obesity is associated with exposure to second-hand smoke, maternal smoking during pregnancy, and vehicular air pollution. (26).

Review articles have also shown that maternal smoking during pregnancy and small for gestational age leads to children with shorter length i.e. stunted and smaller head circumference at time of birth which was found to be consistent with our study for stunting (23). Also our study shows that father smoking is associated with stunting. A study by Kyu et.al. in 2009 also showed that exposure to maternal smoking and biofuel smoke has been associated with child stunting (27). Results from this study show there is an impact on other anthropometric measures such as stunting, underweight, wasting, and LBW.

In India, there is a high prevalence of SLT consumption than smoking tobacco and to see the impact of parental smoking on child nutritional status is a difficult task. Only one study by Berger E.K. et.al. in 2016 (28)

showed the risk for LBW due to SLT consumption (Betel Nut and Tobacco) among Palauan women. A study by Khader Y.et.al. in 2011 has shown that women exposed to smoking are at 1.5 times higher risk for delivering a LBW baby as compared to women not exposed to smoking. Also, exposure to smoking leads to preterm delivery (29).

A large number adolescents of the aged 12-15 years are in the lure to smoke which is a matter of great concern. So there is a dire need to see the current picture of parents who are smoking and their impact on children. Only one study in India by Shenoy et al. in 2020 has looked into the bidi smoking women and their outcome on children in rural areas of Mangalore, Karnataka, India. The study has shown that there has been a high risk of LBW and small head circumference in children for mothers who smoke bidi during pregnancy (30).

This meta-analysis provides us the promising research that needs to be carried out to see the effects of parental smoking on children's nutritional status within a country like India where there is a large difference in socio-economic factors and the health status. A study by Gehrman and Hovell in 2003 reviewed multiple interventional methods to reduce the impact of SHS over children which includes behaviour interventions, counselling, paediatrician counselling (31). Hence, there is a dire need for intervention methods that need to be incorporated to reduce the impact of SHS over children. Also, we need to see the impact of SHS over child growth measurements.

This study contains multiple strengths and limitations. The strengths include wide selection of search strategy, systematic data extraction and thorough review of previous studies. However, there have been some limitations which include less number of studies with underweight, wasting as the outcome for child nutritional status. Low birth weight as outcome for child growth was also not considered in this study. Most of studies were from European, Western Asian and South East Asian countries. At the same time this study reveals that there is dire need for further investigation on the association of SHS over other child nutritional outcomes such as head circumference, wasting, subscapular skin fold index, arm circumference, and waist hip ratio. Furthermore, similar studies are required in several developing countries.

This review emphasizes that child nutritional status is also plagued by SHS and thus be considered a modifiable risk factor for various child growth outcomes (Stunting, Wasting, Underweight, LBW, waist-hip ratio, head circumference, body mass index (BMI), arm circumference, and subscapular skinfold), specifically in low-income and lower middle-income countries. This review implies that it is crucial that people who currently are active smokers, specifically those that abide children or a pregnant partner, are made conscious of the potential effect of tobacco smoke exposure on non-smokers. By encouraging household members to prevent smoking (and/or by declining smoking prevalence rates within the population as a whole), the burden of children's growth problem would even be reduced at the population level. Furthermore, it is also important to encourage families to keep up a smoke-free home environment, and hence education on the health risks of SHS exposure may protect non-smoking women and their children from SHS exposure and its potential negative effects on growth outcomes.

Declarations

Compliance with Ethical Standards -

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Ethical Approval: None

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Table

Table 1: Summary of Meta-analysis for Child Nutritional status associated with Second Hand Smoke

Child Nutritional Status	No. of Studies	Pooled Relative Risk 95% CI	Heterogeneity	Egger's Test p-value
Overweight	10	1.29 (1.25 - 1.33)	73.60%	0.399
Obese	5	1.50 (1.36 - 1.65)	46.20%	0.023
Stunting	5	1.12 (1.10 - 1.13)	39.20%	0.839
Severe Stunting	4	1.14 (1.11 - 1.18)	73.70%	0.249
Underweight	4	1.05 (1.04 - 1.07)	92.70%	0.852
Severe Underweight	3	1.11 (1.07 – 1.14)	81.70%	0.360
Wasting*	2	1.07 (1.02 – 1.13)	35.50%	
Severe Wasting*	2	1.10 (1.00 – 1.21)	0.00%	
Rapid Weight Gain*	1	1.28 (1.17 – 1.40)	78.20%	
***Number of study reported is very less, hence publication bias cannot be reported**				

Figures

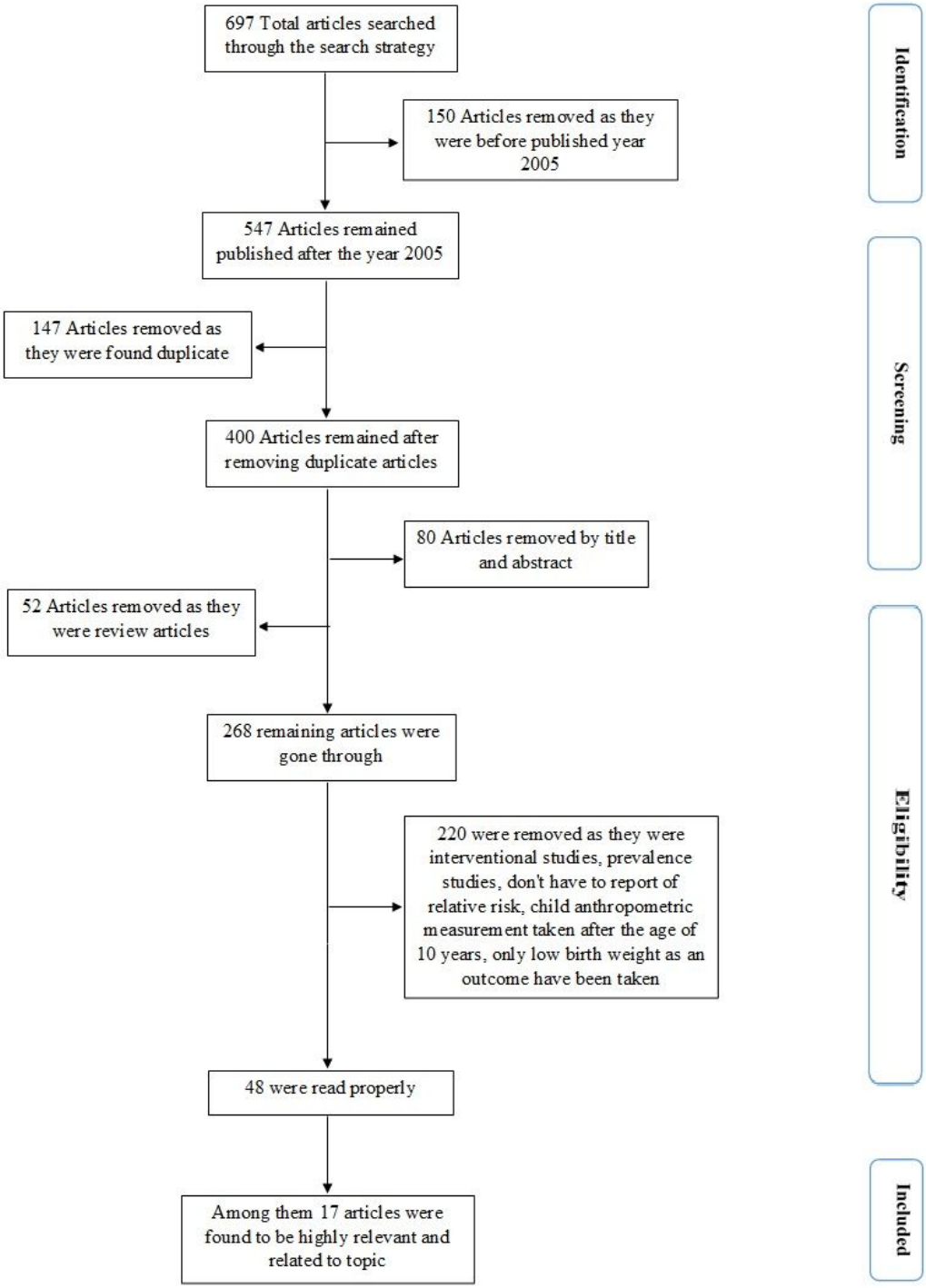


Figure 1

Selection Criteria

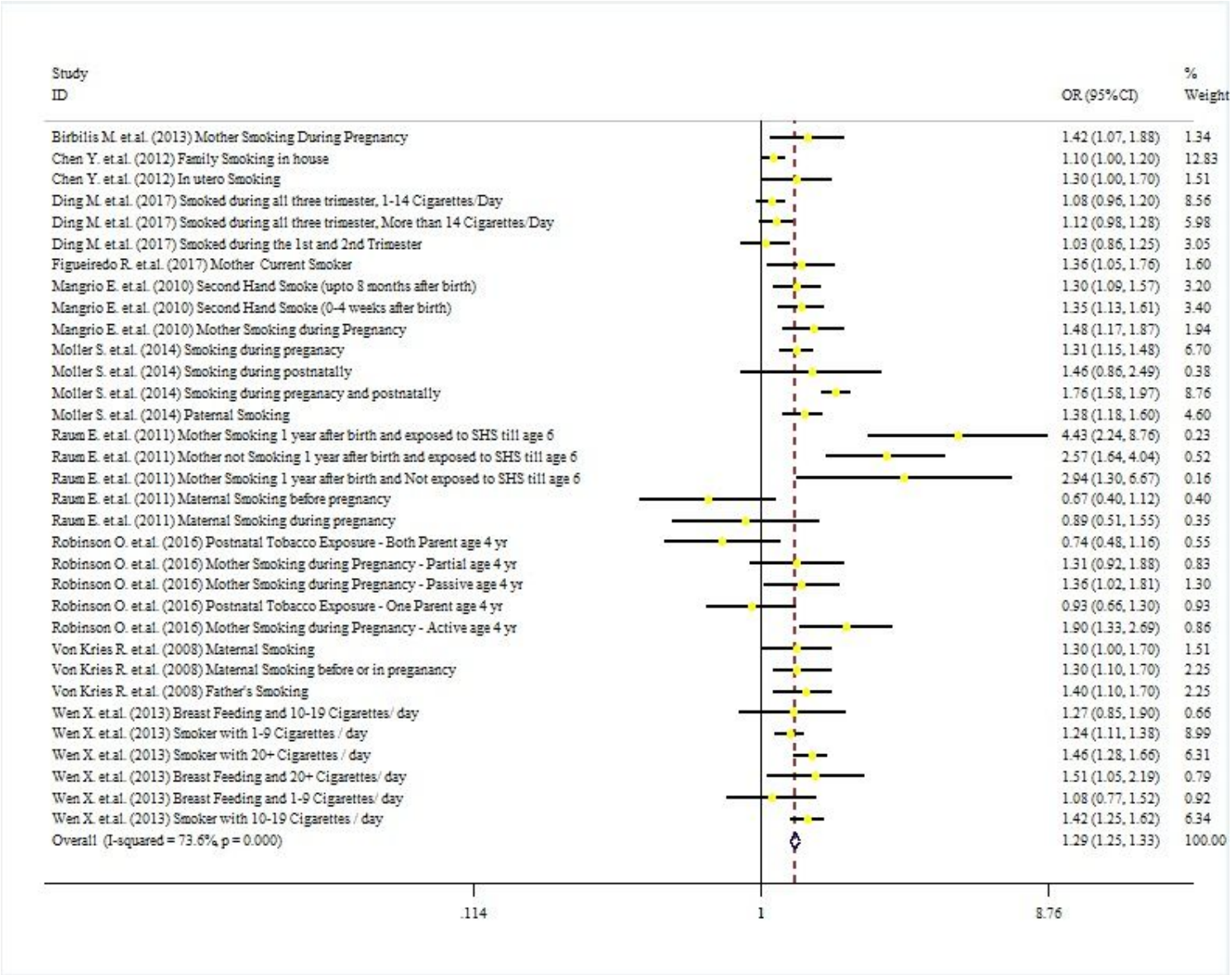


Figure 2

Forrest Plot for Overweight

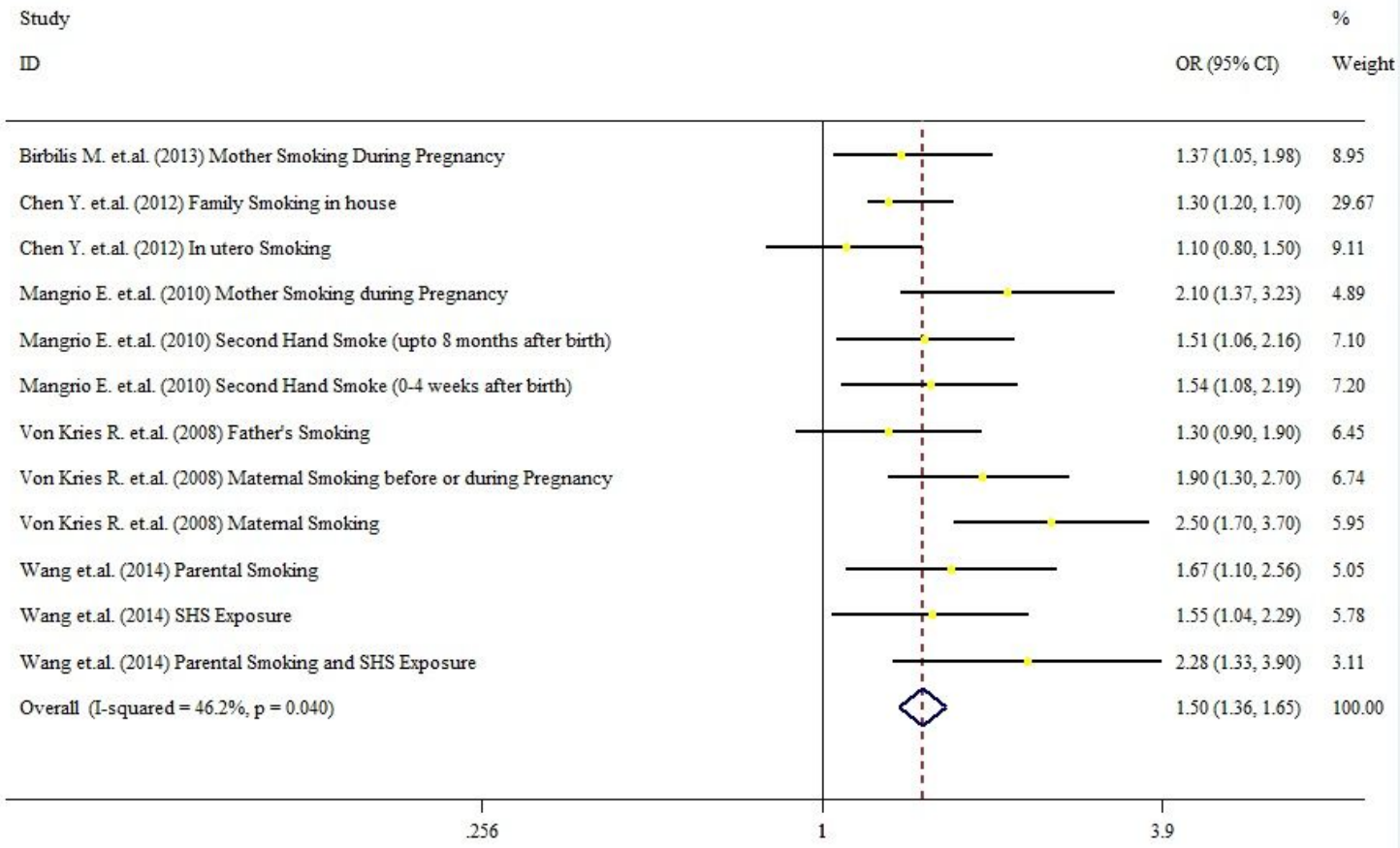


Figure 3

Forrest Plot for Obese

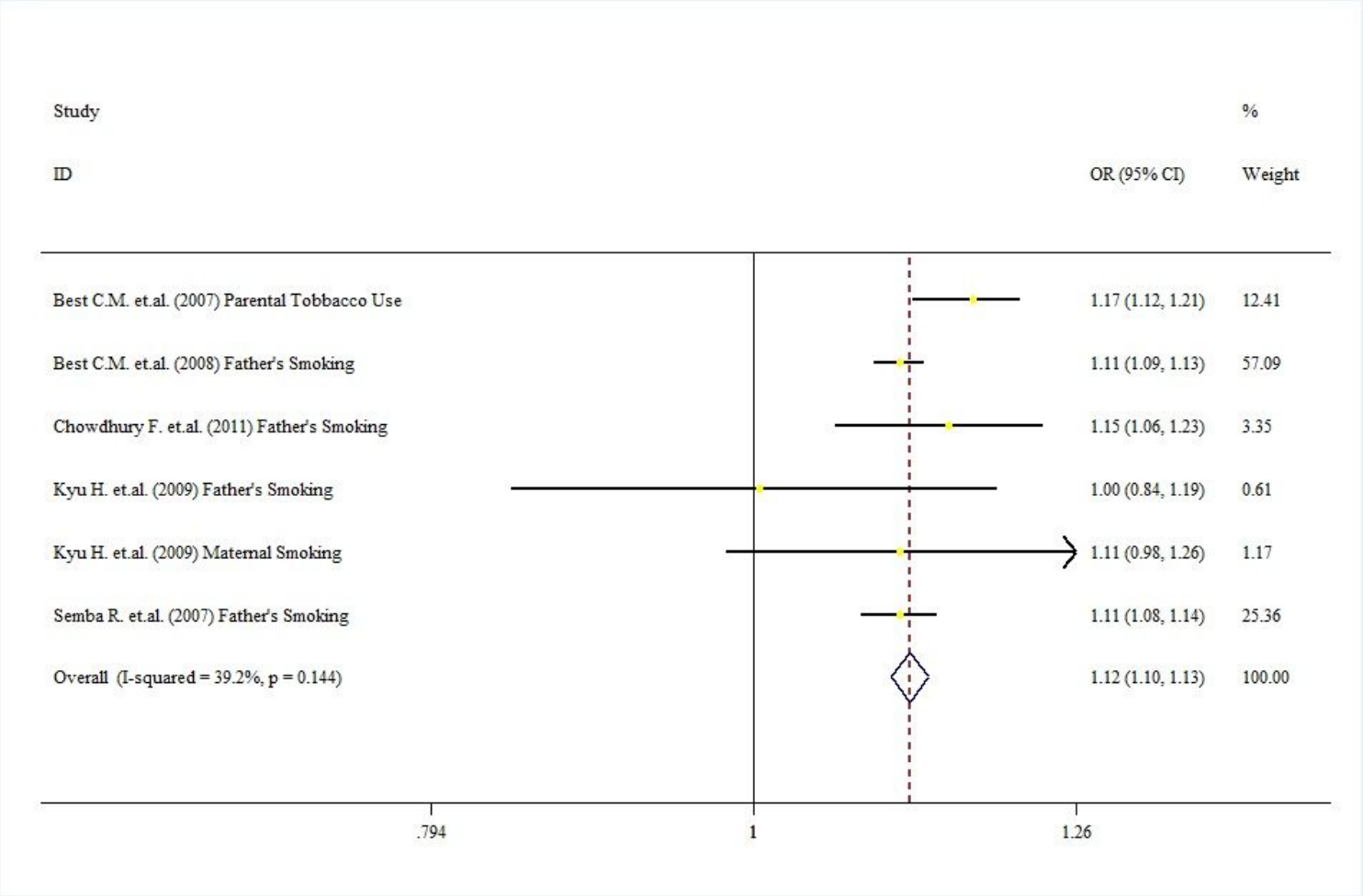
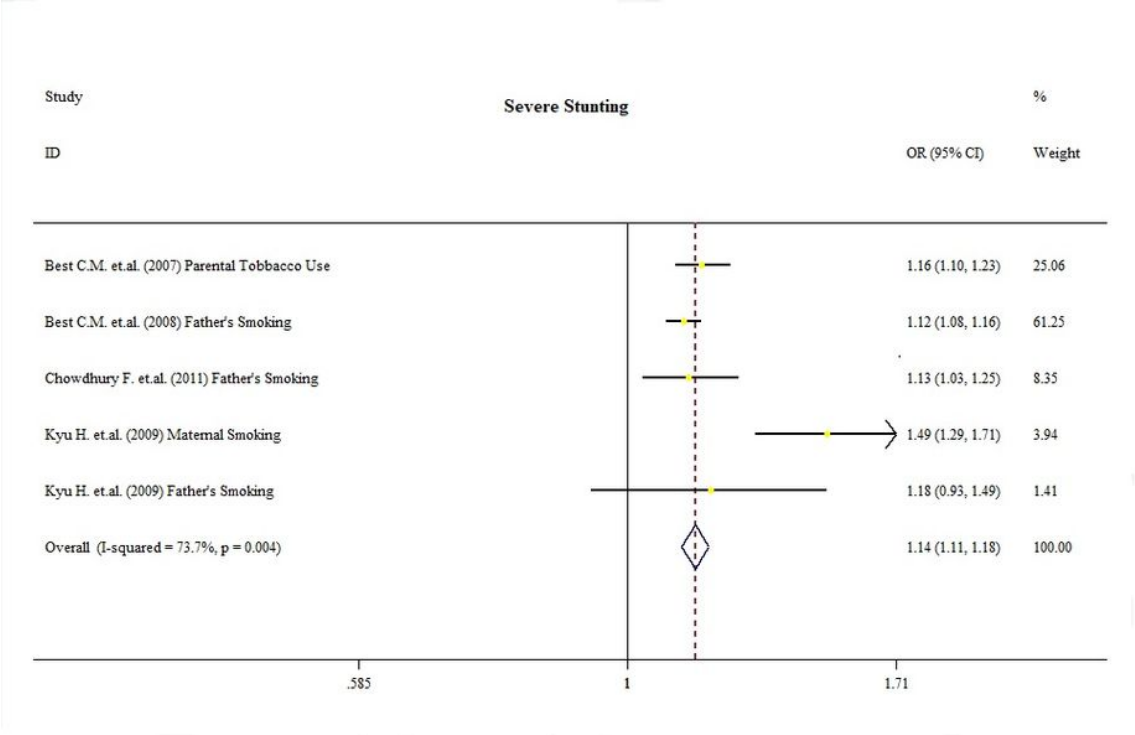


Figure 4

Forrest Plot for Stunting



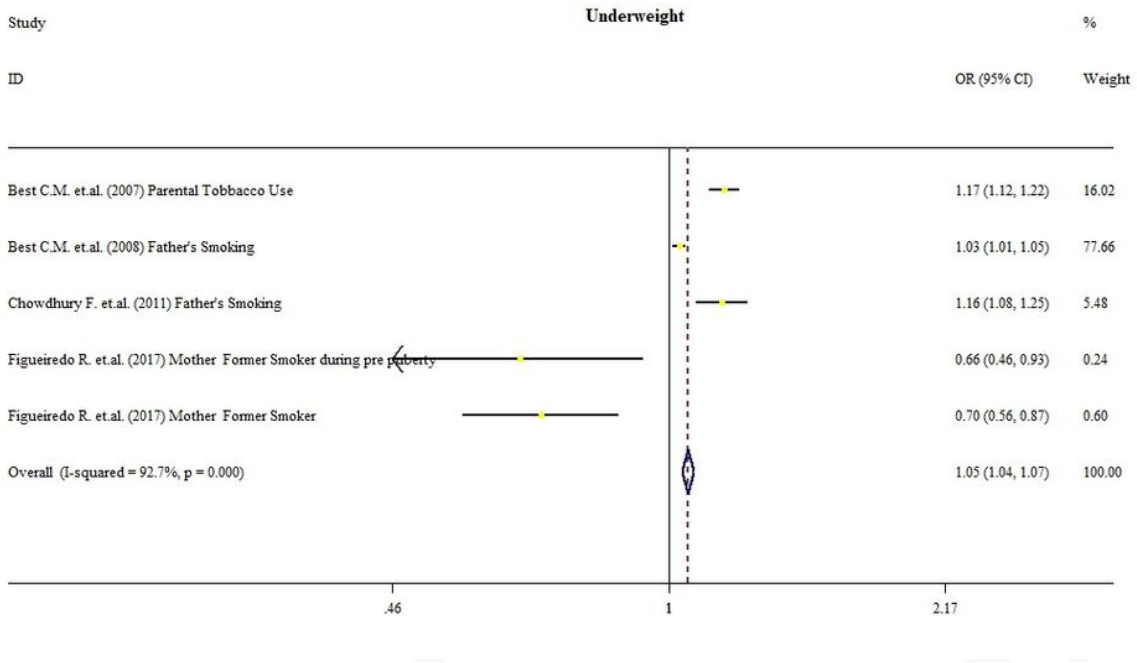


Figure 5

Forrest Plot for Stunting and Underweight

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- AppendixTable.docx