REVIEW

Double Burden of Underweight and Overweight among Women in South and Southeast Asia: A Systematic Review and Meta-analysis

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ABSTRACT

The double burden of malnutrition (DBM) is characterized by the coexistence of underweight and overweight individuals in a population. The objective of this study was to assess the level of DBM, as well as its main determinants, in women in South and Southeast Asia. We searched scientific literature databases, including PubMed, EMBASE, CINAHL, and Google Scholar; gray literature; and reference lists from primary research published between 1969 and September 30, 2017. In total, 128 studies met our inclusion criteria, representing data of ∼5 million women >15 y of age from South and Southeast Asia. The findings show that prevalence rates of underweight and overweight varied by study from 7.0% to 61.0% and 1.0% to 64.0%, respectively. For the total study period, the pooled prevalence of underweight and overweight was 28% (95% CI: 25%, 31%) and 17% (95% CI: 15%, 19%) in South Asia, respectively, and 20% (95% CI: 15%, 26%) and 20% (95% CI: 15%, 24%) in Southeast Asia, respectively. In both regions, underweight was more prevalent in rural areas, among women of the youngest age group (15–19 y), and among those in the poorest wealth quintile. In contrast, overweight was higher in urban areas, among women of older age, and among those in the wealthiest households. This study also found that prevalence of overweight has recently exceeded that for underweight in this population. *Adv Nutr* 2020;11:128–143.

Keywords: underweight, overweight, double burden, Southeast Asia, trends

Introduction

While overweight and obesity have been recognized as major public health problems in most developed countries, until recently, the focus in many low- to middle-income countries (LMICs) has been on undernutrition. However, current evidence points to a double burden of malnutrition in LMICs resulting from the coexistence of underweight and overweight individuals in a given population (1–6). This double burden is thought to have arisen due to the nutritional transition experienced by these countries, along with a rapid change in food production, dietary habits, and physical activity (7).

Both underweight and overweight have multifaceted consequences for individuals in terms of longevity and disability as well as placing an economic burden on societies and health-care systems (8, 9). A continued focus on undernutrition, at the expense of tackling overweight and obesity, or the development of public health approaches to counter just one of them could be damaging.

Recent evidence shows that countries in South Asia, such as India, Bangladesh, and Nepal, are currently suffering such a double burden of malnutrition (10–14). India alone is home to one-third of the global population of malnourished children, while at the same time almost 50% of adults living in urban areas are overweight or obese (15). With other countries in the region experiencing in recent decades rapid nutritional, demographic, and socioeconomic transitions, this burden is set to rise (16–18), resulting in significant impacts on social and economic development.

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Abbreviations used: DBM, double burden of malnutrition; DHS, Demography and Health Survey; LMIC, low- to middle-income country; MOOSE, Meta-analyses Of Observational Studies in Epidemiology; PP, pooled prevalence; SES, socioeconomic status.

TABLE 1 PICOS criteria for inclusion and exclusion of studies

Parameter	Inclusion criteria	Exclusion criteria
Population	Women who were age ≥15 y	Males
Intervention/exposure	Collection of data on weight and sociodemographic factors	Lack of data on weight and/or sociodemographic factors
Comparator	Nutritional status of women	Lack of data on nutritional status
Outcome	Prevalence of nutritional status	No reported prevalence measure
Study design	Observational study	Editorial
	Cross-sectional study	Methodological article
	Cohort study	

A study in the Asia-Pacific region estimated that the economic burden of underweight ranged from 2.5% to 3.8% of a country's gross domestic product, while overweight accounted for as much as 9.9% of a country's total health-care expenditure (19).

Although in recent times, underweight in women has been one of the most prominent public health issues in South and Southeast Asia, overweight remains a relatively low priority. While it is known that undernutrition in women is associated with adverse pregnancy outcomes, including maternal mortality, delivery complications, preterm birth, and intrauterine growth retardation (20), maternal overweight/obesity is also known to lead to several adverse maternal and fetal complications during pregnancy, delivery, and postpartum (21). This is alarming as studies suggest that both undernutrition and overnutrition are significant public health concerns in this region with women a high-risk population for both (22–26).

Although many studies have reported on country-specific prevalence of underweight and overweight among women in South and South East Asia, none have systematically analyzed data to understand which demographic groups are at greater risk. Understanding the within-country burden of malnutrition, along with associated determinants, is important to inform the development of interventions to meet the Sustainable Development Goals target of improving women's nutrition by 2030. To develop and implement effective policies and interventions to counter this double burden, we must understand the patterning of underweight and overweight within these countries and throughout the region.

In this study, we aimed to systematically review estimates of the double burden of malnutrition among women living in South and Southeast Asia, as well as identifying the major determinants of both conditions in this population.

Methods

We followed the Meta-analyses Of Observational Studies in Epidemiology (MOOSE) guidelines to identify studies reporting estimates on the prevalence of underweight and overweight in women according to BMI, conducted in countries of South Asia (Afganistan, Bangladesh, Bhutan, India, Nepal, and Pakistan) and Southeast Asia (Cambodia, Indonesia, Laos, Malaysia, Maldives, Mayanmar, Philippines, Sri Lanka, Thailand, Timor-leste, and Vietnam). Underweight and overweight in individual studies were defined according to WHO and Asia-specific cutoff points.

Search strategy

We used the PICOS criteria to define the research question (**Table 1**) (7). Studies eligible for inclusion met the folowing criteria: primary or secondary data, published in the English language, conducted in humans, and studies that provide an estimate of prevalence of underweight and/or overweight for women. Editorial and methodological articles or studies with no reported prevalence of either were excluded. Country-specific national survey reports were also eligible for inclusion.

Our search included studies published from January 1, 1969, to December 31, 2017. We used a number of different search engines: PubMed, EMBASE, CINAHL, Google Scholar, and Google. We also searched the gray literature in the Demography and Health Survey (DHS) database, WHO regional databases, and Global Burden of Diseases database. The keywords used in the search were *women, female, mother, underweight, chronic energy deficiency, overweight, obesity, body mass index, BMI, South Asia, South East Asia*, and the names of each of the individual countries.

Data extraction and quality assessment

Data extraction was carried out by 2 independent reviewers following a piloted version of the Cochrane Effective Practice and Organization of Care Group guidelines (27). They completed a standard data extraction form, summarizing the study design and other relevant data for each article, including country name, sample size, survey year, and geographic location (**Supplemental Table 1**). Where articles did not report survey year, publication year was listed. The main outcomes were prevalence of underweight, overweight/obese, and mean BMI score.

We adapted the modified Newcastle Ottawa Scale for assessing the quality of the study, as recommended by the Cochrane Collaboration (28). Four criteria were used to score studies as high quality (4 points), moderate quality (2–3 points), and poor quality (0–1 points). Criteria included target population a close representation of the national population (yes = 1, no = 0), sufficient sample size (yes = 1, no = 0), random sampling (yes = 1, no = 0), and ascertainment of BMI measure (yes = 1, no = 0). The cutoff

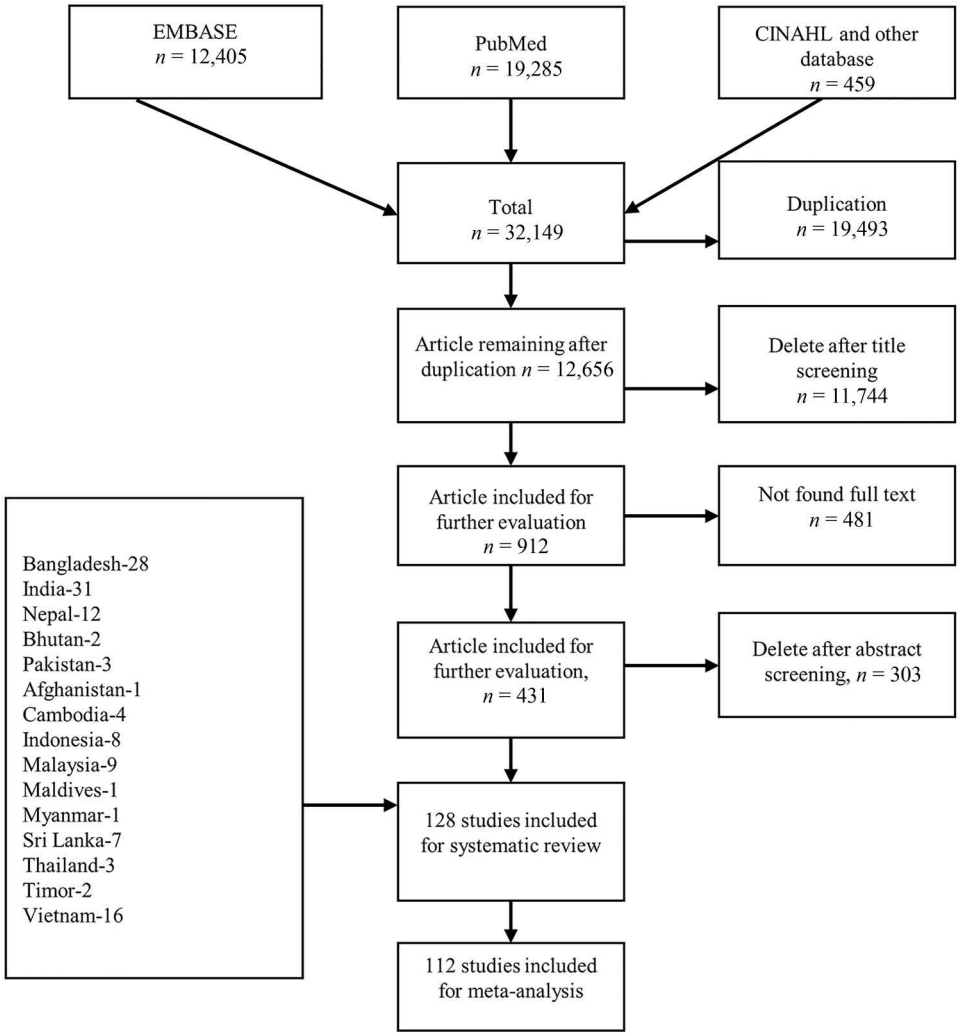

FIGURE 1 Flow diagram showing data extraction process of the study.

for a sufficient sample size was set at 500 participants (29) (**Supplemental Table 2**).

Data analysis

All meta-analyses were performed using MetaXL version 1.4 (EpiGear International Pty Ltd). We calculated pooled prevalence of underweight and overweight for 4-y intervals: 2000 and earlier, 2001–2005, 2006–2010, and 2011–2017 for South Asia and Southeast Asia separately. In addition, using nationally representative survey data, we assessed pooled prevalence of underweight and overweight by age, education, place of residence (urban/rural), and wealth index for separate countries. Analyses for these factors used country-specific DHS data only, as these are sampled to be representative of the national population.

Results

Study characteristics and quality

Our literature search yielded 32,149 records. After exclusion of duplicates and review of titles and abstracts, 912 articles were included for further evaluation; of these, full texts could not be found for 481 articles. The full text of the remaining 431 articles was examined and a total of 303 articles were excluded after abstract screening. We included 128 articles (6, 14, 15, 17, 30–152) in the final synthesis (**Figure 1**). These articles covered 18 countries from South Asia and Southeast Asia, presenting data for 4,974,717 individuals. Of these 128 articles, 52 reported prevalence of both underweight and overweight among women, 60 studies reported prevalence of just 1 condition, and 16 articles reported mean BMI only. Ninety-two percent of studies were community based and 8% institute based (Supplemental Table 1). Most studies were cross-sectional in nature, with 3 cohort studies. In total, 112 articles were included in the meta-analysis (Figure 1). Seventy-one of the 112 (64%) studies included in the meta-analysis were graded as high quality, with 6 (5%) graded as low quality (Supplemental Table 2).

Estimation of prevalence rates.

Prevalence rates varied widely across studies, from 7.0% to 61.0% for underweight and 1.0% to 64.0% for overweight. The pooled prevalence of underweight and overweight in

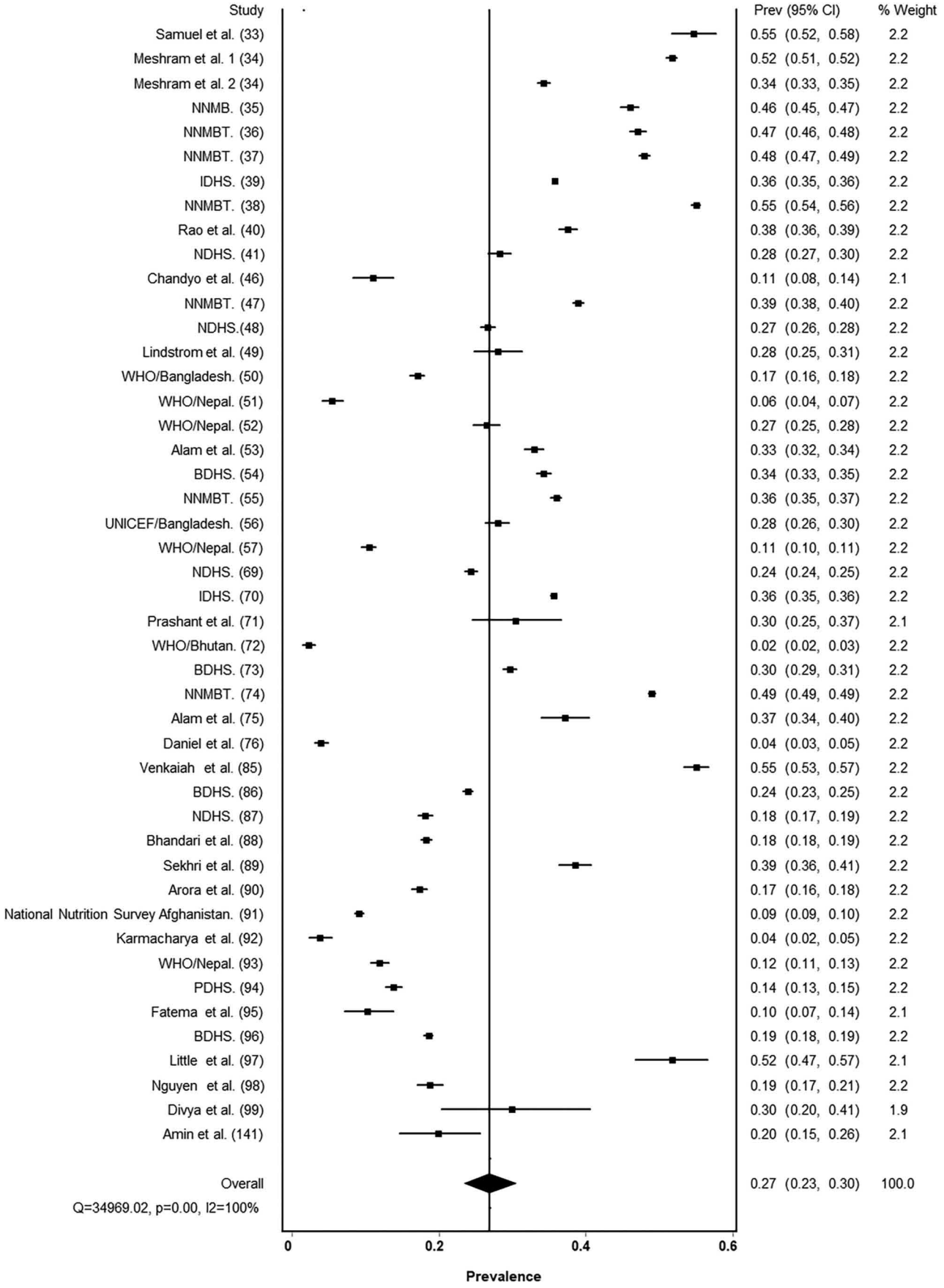

FIGURE 2 Pooled prevalence of underweight among women in South Asia.

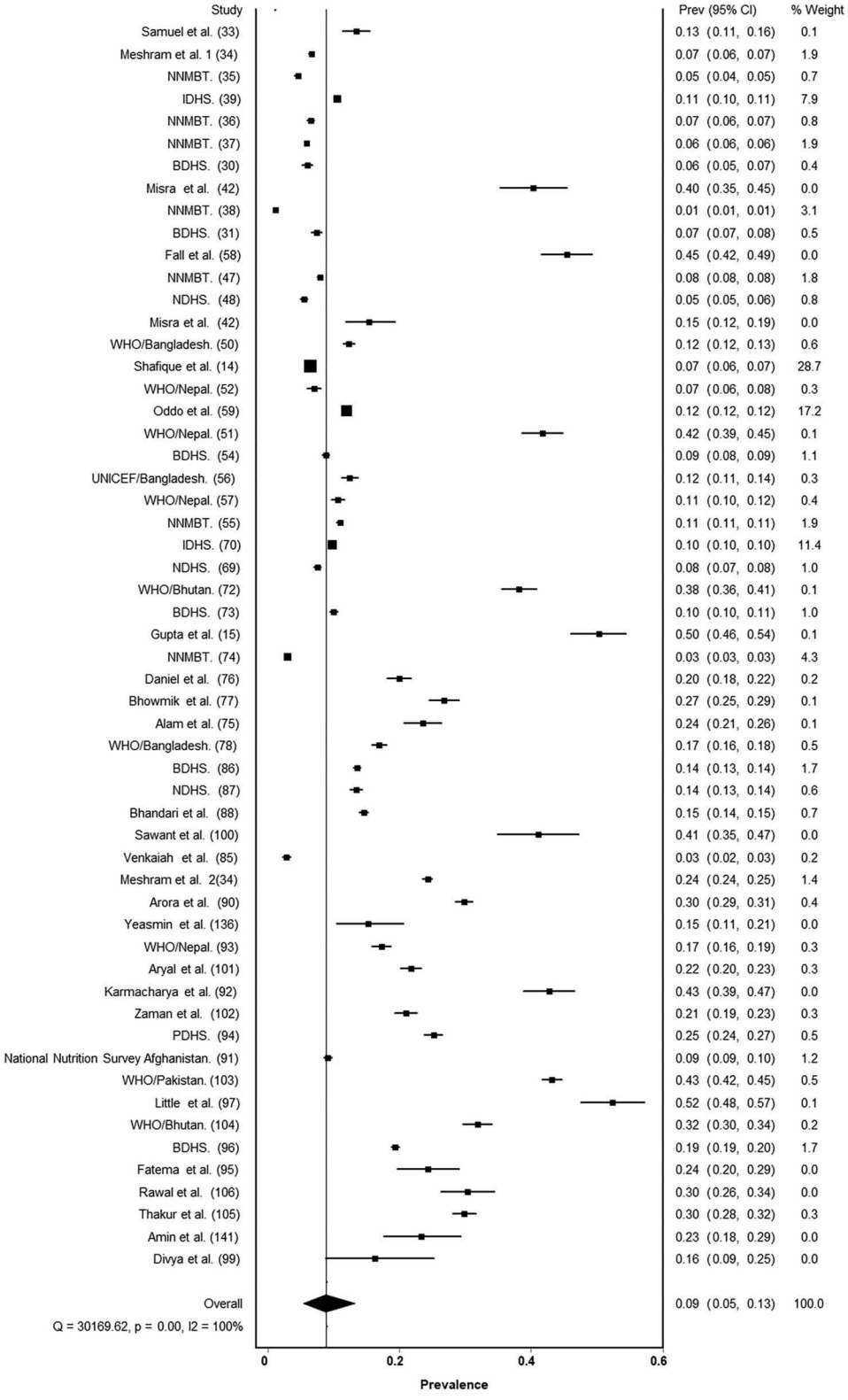

FIGURE 3 Pooled prevalence of overweight among women in South Asia.

South Asia for all studies was 28% (95% CI: 25%, 31%) and 17% (95% CI: 15%, 19%) respectively (**Figures 2** and **3**). In Southeast Asia, pooled prevalence was 20% (95% CI: 15%, 26%) for underweight and 20% (95% CI: 15%, 24%) for overweight (**Figures 4** and **5**).

Prevalence rates by year of study.

To investigate underweight and overweight prevalence over time, we arranged outcomes by time of study in 4 aggregated intervals: *1*) 2000 and earlier, *2*) 2001–2005, *3*) 2006–2010, and *4*) 2011–2017.

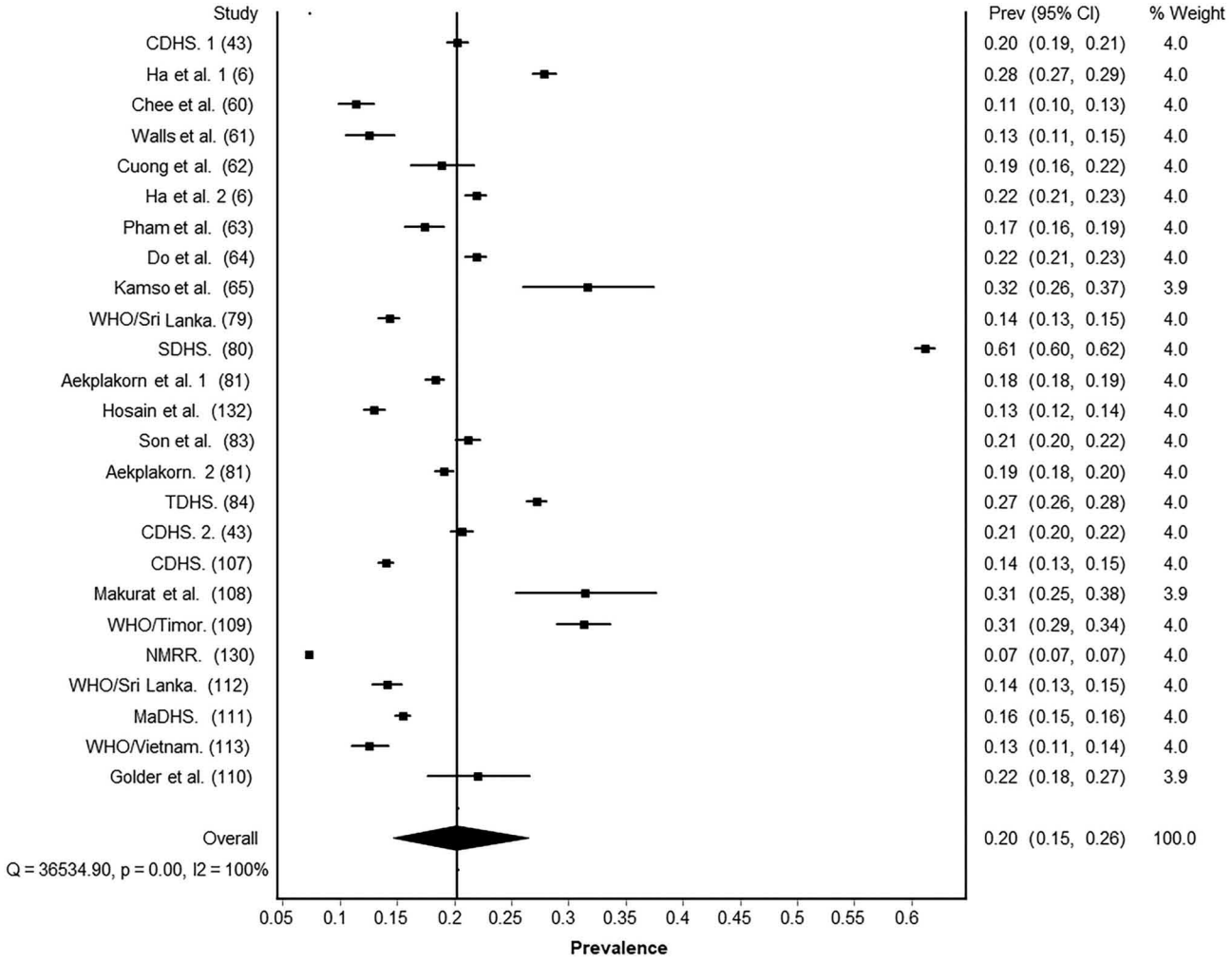

FIGURE 4 Pooled prevalence of underweight among women in Southeast Asia.

2000 and earlier.

We included 22 studies from South Asia from 2000 and earlier in our analysis, with 12 of these studies presenting findings for underweight (30–41) and 10 for overweight (30, 31, 33–39, 42). The pooled estimate of underweight was 43% (95% CI: 37%, 48%), whereas for overweight it was 9% (95% CI: 5%, 12%) (**Supplemental Figures 1–16**). Of the 12 studies presenting underweight prevalence, 8 studies came from India, 3 from Bangladesh, and 1 from Nepal. Of the 10 studies presenting overweight prevalence, 8 were from India and 2 from Bangladesh.

We identified 2 studies (6, 43) reporting underweight from 2000 and earlier in Southeast Asia, resulting in a pooled estimate of 24% (95% CI: 17%, 32%). Five studies (6, 43–45) reported overweight prevalence in the region, with a pooled estimate of 4% (95% CI: 1%, 8%). These five studies came from 3 countries, with Vietnam providing 55.5% of the sample population for meta-analysis, Indonesia 32%, and Cambodia 17.5%.

2001–2005.

Ten studies from between 2001 and 2005 presented both prevalence of underweight and overweight in South Asia, and 3 studies presented prevalence of underweight only and 3 overweight only. Pooled estimates were 24% (95% CI: 21%, 28%) for underweight and 14% (95% CI: 11%, 16%) for overweight. Of the 13 studies (14, 46–57) that presented underweight prevalence, 6 came from Bangladesh, 5 from Nepal, and 2 from India. Of the 13 studies (14, 42, 47, 48, 50–52, 54–59) that presented overweight prevalence, 6 came from Bangladesh, 5 from Nepal, and 2 from India (Supplemental Figures 1–16).

Seven studies presented prevalence on underweight (6, 60–65) for Southeast Asia over the same period and 12 on overweight (6, 44, 59–68). Pooled estimates were 19% (95% CI: 16%, 22%) and 25% (95% CI: 13%, 39%) for underweight and overweight, respectively. Studies from Vietnam provided 92.3% of the sample population for underweight meta-analysis and Indonesia 75% of the sample for overweight.

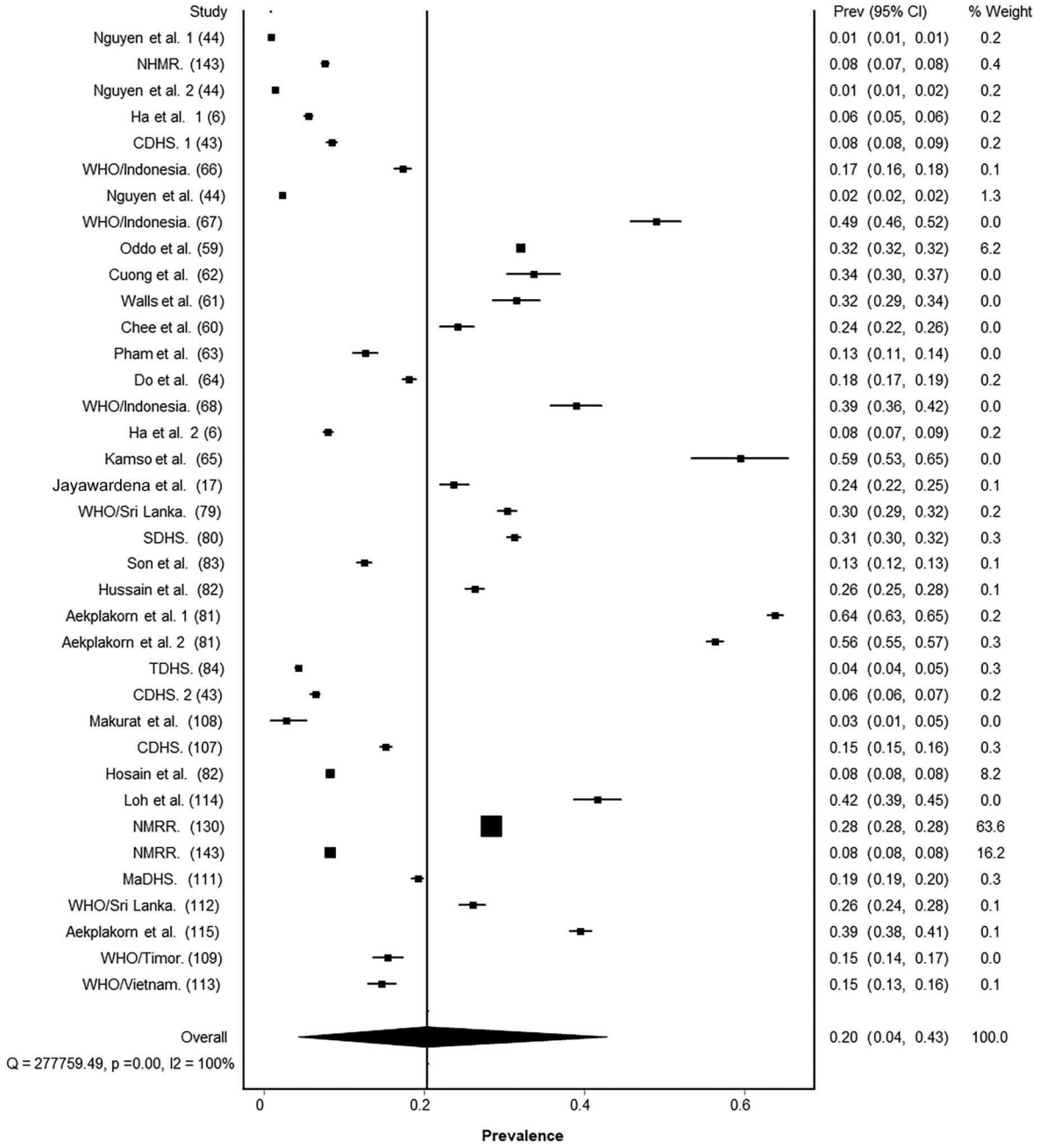

FIGURE 5 Pooled prevalence of overweight among women in Southeast Asia.

2006–2010.

We identified 8 studies from South Asia that presented findings for underweight between 2006 and 2010 (69–76). These resulted in a pooled estimate of 24% (95% CI: 17%, 32%). The studies came from 4 countries, with India providing 86% of the sample population. We identified 10 studies for the same period in this region that presented findings for overweight (15, 69, 70, 72–78), resulting in a pooled estimate of 19% (95% CI: 14%, 24%). Of these 10 studies, 4 came from India, 4 from Bangladesh, and 1 each from Nepal and Bhutan (Supplemental Figures 1–16).

Over the same time period, we identified 8 studies (43, 79–84) for underweight and 9 studies (17, 43, 79–84) for overweight in Southeast Asia. Polled estimates of underweight and overweight were 23% (95% CI: 13%, 35%) and 25% (95% CI: 11%, 42%), respectively.

2011–2017.

For the most recent interval, we identified 17 studies (34, 85–99, 141) for underweight in South Asia with a pooled estimate of 22% (95% CI: 17%, 27%). These studies came from 5 countries, with Bangladesh providing 35.7%, India 25.1%, Nepal 23.1%, Afghanistan 11.4%, and Pakistan 4.5% of the sample population. We also identified 23 studies (34, 85–88, 90–97, 99–106, 136, 141) for overweight in the region with a pooled estimate of 23% (95% CI: 19%, 28%). Of these

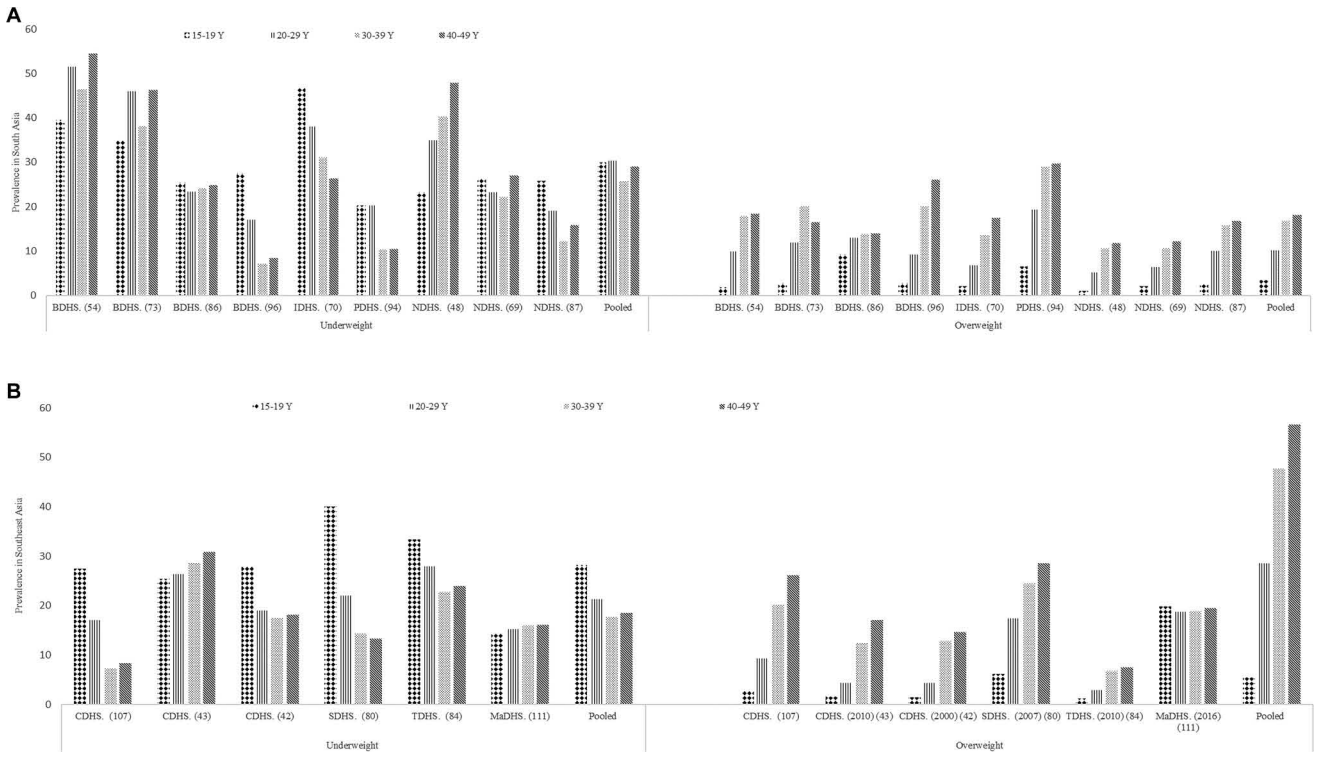

FIGURE 6 Age-specific prevalence of underweight among women in selected countries of South Asia (A) and Southeast Asia (B).

23 studies, 7 were from Bangladesh (sample n = 36,204), 6 from India (n = 27,631), 5 from Nepal (n = 22,789), 3 from Pakistan (n = 8592), and 1 each from Bhutan (n = 1748) and Afghanistan (n = 11,124).

Eight studies were identified for a pooled estimate of underweight 17% (95% CI: 12%, 23%) in Southeast Asia (107–113, 143). These studies came from 7 countries: Cambodia, Timor, Malaysia, Sri Lanka, Myanmar, Vietnam, and Maldives. We also identified 11 studies (82, 107–109, 111–115) for overweight, with a pooled estimate of 18% (95% CI: 10%, 27%). These studies came from 9 countries, with Malaysia alone providing 89.8% of the sample for meta-analysis (Supplemental Figures 1–16).

Age-specific prevalence.

We identified 9 nationally representative DHS studies in South Asia (47, 49, 70, 71, 91, 99, 101, 106, 122) and 6 for Southeast Asia (42, 80, 81, 86, 114, 116) for use in age-specific prevalence analysis.

Of these 9 studies in South Asia, 3 were conducted between 2001 and 2005, 2 from 2006 to 2010, and 4 from 2011 to 2017. These studies came from Bangladesh (n = 4), Nepal (n = 3), India (n = 1), and Pakistan (n = 1). Age-stratified pooled prevalence (PP) of overweight in South Asia in the older age groups (40–49 y) was almost 6 times higher than in younger ones (15–19 y) (3.5% compared with 18.1%). For underweight, there was little difference by age group (PP 15–19 y = 30%; PP 40–49 y = 29.1%) (Figure 2). Of the 6 studies for Southeast Asia, 1 was conducted during 2000 or earlier, 1 between 2001 and 2005, 2 from 2006 to 2010, and 2 from 2011 to 2017. Age-specific pooled prevalence of overweight was 10 times higher in the older age groups than the younger ones (15–19 y = 5.5%; 40–49 y = 56.7%), and underweight was higher in the younger age groups (PP 15–19 y = 28.1%; PP 40–49 y = 18.5%) (**Figure 6**).

Urban-rural differences.

In South Asia, pooled estimates for underweight, from the 12 nationally representative studies that included measures or urbanicity (34–36, 47, 49, 70, 71, 91, 99, 101, 106, 122), were 16.4% (95% CI: 12%, 25%) for urban areas and 26.7% (95% CI: 22%, 30%) for rural areas (Figure 4). Of these 12 studies, 3 were conducted during 2000 or earlier, 3 between 2001 and 2005, 2 from 2006 to 2010, 4 between 2011 and 2017. Pooled estimates from the 9 studies reporting overweight found overweight prevalence was more than twice as high in urban (24.1%; 95% CI: 19%, 27%) compared with rural areas (10.1%; 95% CI: 7%, 19%).

In Southeast Asia, pooled estimates by urban and rural classifications came from 7 studies (80, 81, 86, 114, 116, 123, 124), with 1 between 2001 and 2005, 2 from 2006 to 2010, and 2 from 2011 to 2017. The pooled prevalence of underweight was higher in rural areas (18.1%; 95% CI: 16%, 22%) than in urban areas (14.1%; 95% CI: 11%, 17%) in Southeast Asia, with overweight higher in urban areas (20.1%; 95% CI: 17%, 25%) than in rural areas (14.6%; 95% CI: 12%, 19%) (**Figure 7**).

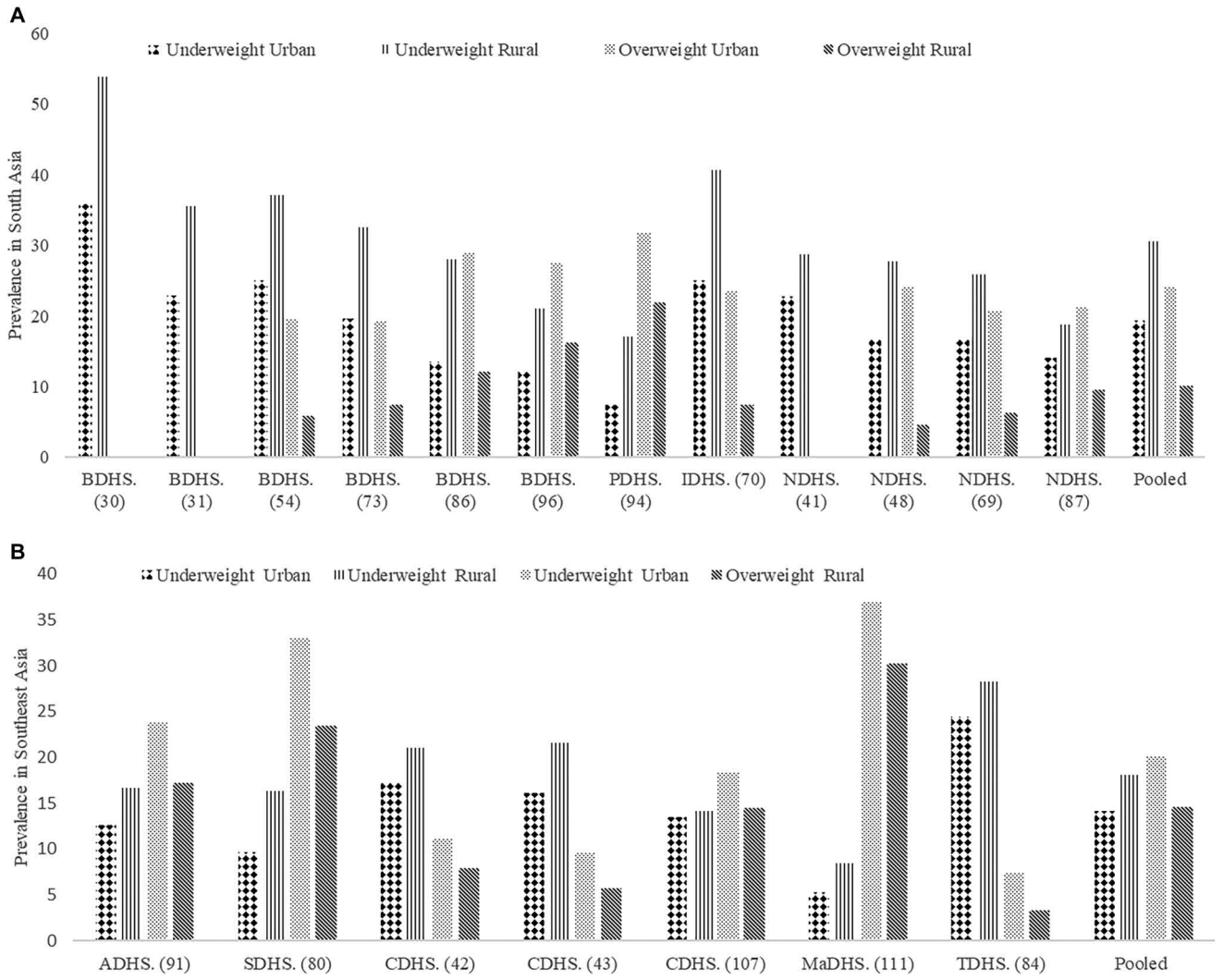

FIGURE 7 Urban- and rural-specific prevalence of overweight among women in selected countries of South Asia (A) and Southeast Asia (B).

Education and double burden of malnutrition.

We identified 10 nationally representative studies that included measures of educational level from South Asia (35, 36, 49, 70, 71, 91, 99, 101, 106, 122) and 7 from Southeast Asia (80, 81, 86, 114, 116, 123, 124). The pooled prevalence of underweight was almost 2 times higher for South Asians with no education (35.2%; 95% CI: 25%, 39%) compared with those who had secondary and higher education (20.8%; 95% CI: 15%, 28%). For overweight, a higher pooled prevalence was found in those who had secondary and higher education (19.2%; 95% CI: 15%, 26%) than those with no education (9.7%; 95% CI: 7%, 17%).

In Southeast Asia, a similar pooled prevalence of underweight was found in those with no education (17.9%; 95% CI: 11%, 29%) and those who had secondary and higher education (17.4%; 95% CI: 19%, 28%). A higher prevalence of overweight was observed among those who had secondary and higher education compared with those with no education in Southeast Asia (**Figure 8**).

Socioeconomic differences.

Eight nationally representative studies from South Asia (47, 49, 70, 71, 91, 99, 101, 122) and 6 studies from Southeast Asia (81, 86, 114, 116, 123, 124) included prevalence of underweight and/or overweight according to socioeconomic status (SES). Of these 8 studies from South Asia, 2 were conducted between 2001 and 2005, 2 from 2006 to 2010, and 4 from 2011 to 2017. Of the 6 studies from Southeast Asia, 1 was conducted between 2001 and 2005, 1 from 2006 to 2010, and 4 from 2011 to 2017. Pooled prevalence of underweight in South Asia was more than 3 times higher in the poorest households (36.0%; 95% CI: 29%, 42%) than the richest households (11.7%; 95% CI: 8%, 21%). Those living in poorer households in Southeast Asia also had a higher pooled prevalence of overweight (17.3%; 95% CI: 15%, 25%) than those living in richer households (9.7%; 95% CI: 7%, 11%). Pooled prevalence of overweight was 6 times higher among the richest households (27.0%; 95% CI: 25%, 30%) than the poorest households (4.5%; 95% CI: 3%, 9%) in South Asia and

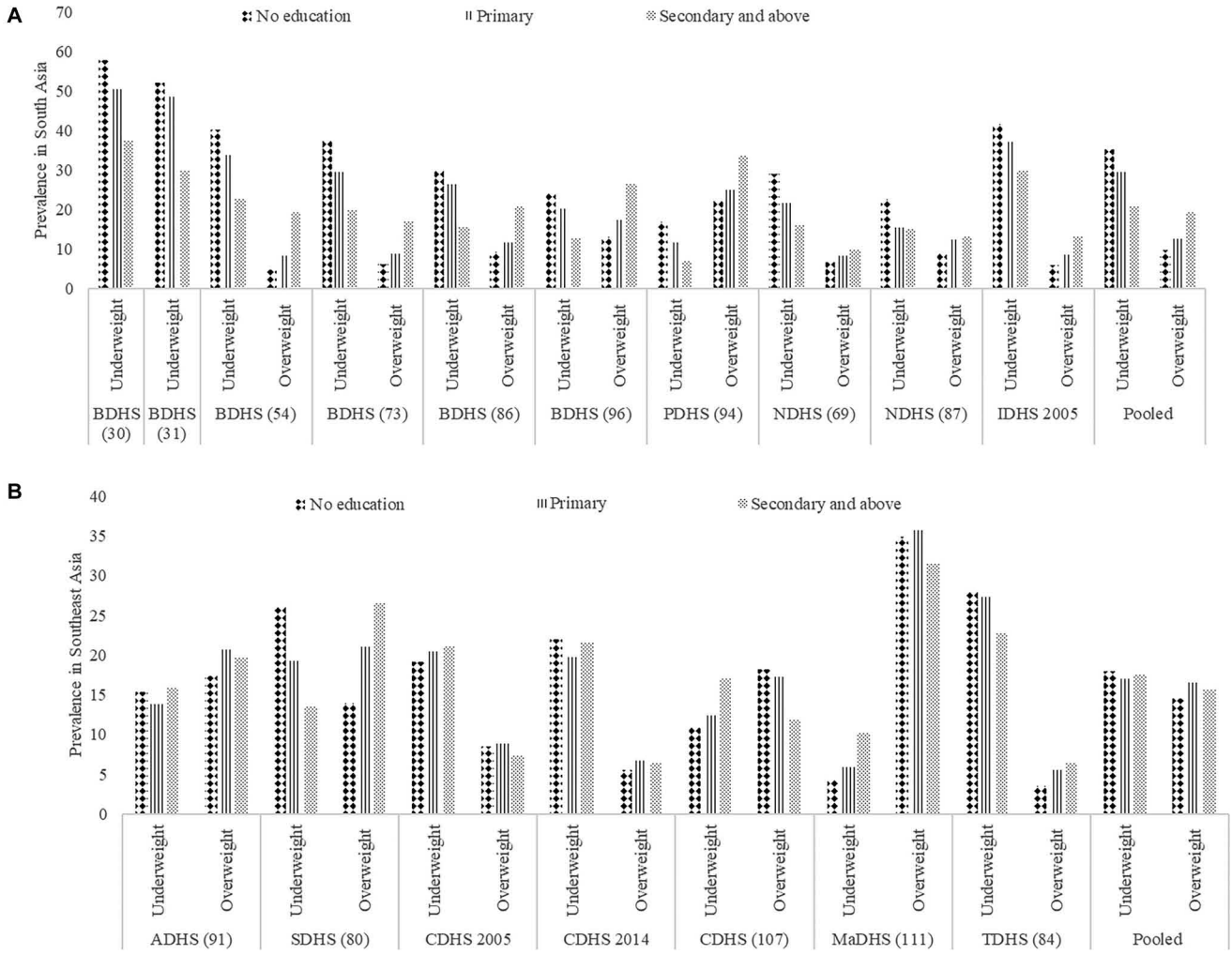

FIGURE 8 Prevalence of underweight and overweight among women in South Asia (A) and Southeast Asia (B) by educational status.

2 times higher in Southeast Asia (20.3%; 95% CI: 27%, 26% compared with 10.9%; 95% CI: 8%, 13%) (**Figure 9**).

Discussion

To our knowledge, this is the first systematic evaluation of the scientific literature on the double burden of underweight and overweight among women in South and Southeast Asia. In this study, we followed a systematic and comprehensive approach to identify studies on both underweight and overweight following MOOSE guidelines and a registered protocol (CRD42017079694). Within the study, we also investigated associations in prevalence with important determinants, including age, urbanicity, and SES. The pooled analysis from this study found that the prevalence of overweight has increased dramatically in both regions since before 2000. Despite the observed decreases in the prevalence of underweight over the same period, current prevalence of underweight in both regions remains worryingly high. However, findings from this study suggest that the prevalence of overweight among women in these regions now exceeds underweight, with this shift occurring in 2011–2017 (i.e., the most recent time period examined). We also found that while overweight was associated with older age groups, underweight is more prevalent among younger women. Those living in urban areas were more likely to be overweight, while those from rural areas had a greater risk of underweight. Lower SES was also associated with a greater prevalence of underweight and a lower prevalence of overweight.

In agreement with previous studies (107, 110, 116, 117), the present study demonstrates a higher prevalence of overweight or obesity in older women. Some have suggested that this finding can partially be explained by weight gain during pregnancy, with women often unable to get back to their prepregnancy weight (118). Studies have also reported that women living in urban areas, or those from wealthier households, are at a lower risk of underweight but at a greater risk of becoming overweight (119, 120). These reports are supported by the present study, with work also suggesting that urbanization is associated with a more sedentary lifestyle, resulting from decreased use of active

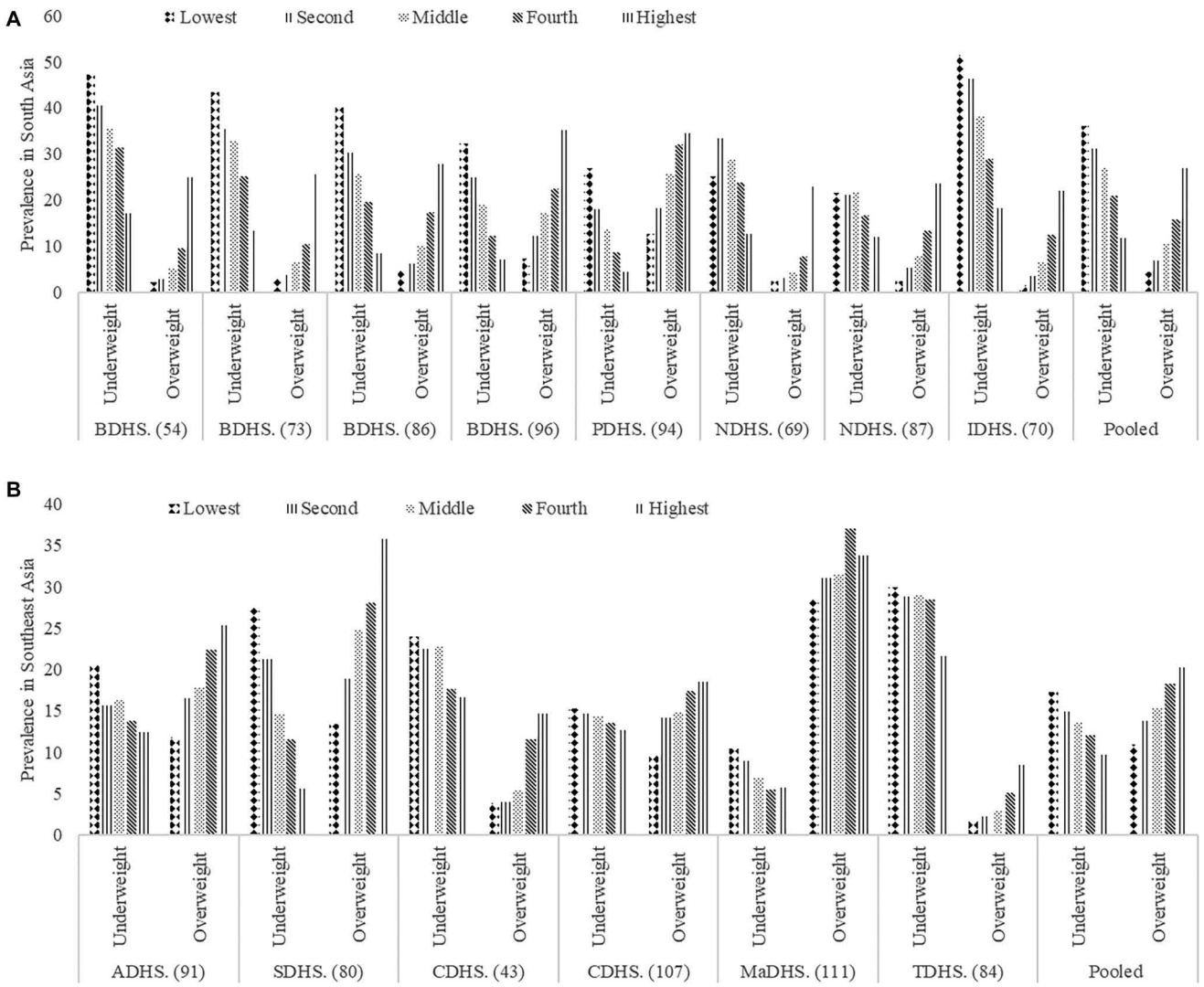

FIGURE 9 Prevalence of underweight and overweight among women in South Asia (A) and Southeast Asia (B) by wealth index.

transport and less physical active supporting environments (121–123). The associations of underweight and overweight with socioeconomic factors also agree with earlier work (119, 120), including a study using DHS data from 36 countries that demonstrated that wealth is a key determinant of overweight in LMICs (125). The findings presented here agree with other studies that older women (117, 127), those of a higher SES (128), and those living in urban areas (12, 14, 125, 126) are more likely to be obese. Similarly, younger women of lower SES and those living in rural areas are more likely to be underweight (119, 120, 124).

Our finding that, over time, there has been some decrease in underweight in these regions, along with corresponding increases in overweight, may have occurred due to substantial socioeconomic development within these countries. A recent study using DHS in 36 LMICs reported similar findings (131), with a number of others linking economic development to increases in the intake of processed food (126); the consumption of energy-dense foods, including fats and high-calorie drinks; and concurrent reductions in physical activity (132). Despite these decreases, this study also found that underweight remains a significant problem in South and Southeast Asia, with inequalities in both conditions between population subgroups.

Although policy makers and national development agencies working in these regions must recognize that overweight is now an increasing trend, the persistence of underweight means that policies and public health approaches must be developed and implemented that consider the double duty of underweight and overweight together. The determinants of these conditions should be explored further such that interventions could be targeted that consider the distribution of these conditions within countries. In addition, heterogeneity between studies, including a scarcity of data from rural regions, should encourage countries to develop extensive national surveillance programs using measured BMI and consistent underweight and overweight reference standards.

While in this study we assessed risk of publication bias using well-established criteria, the results presented need to be interpreted in light of some limitations. First, although most of the studies included in this review were graded as moderate to high quality, many were cross-sectional in nature and followed a survey-based approach. In addition, findings of this study were extremely heterogeneous in nature, not only in study design and data collection but also in outcome. As with all systematic reviews, there is the potential for publication bias in the identified studies, with some not initially designed to report on the prevalence of underweight and overweight. The reference standards for determining underweight and overweight were not consistent between all studies. In addition, although we attempted to estimate prevalence by determinants such as age, urbanicity, and SES, not all studies presented prevalence stratified by these factors. Moreover, information on certain groups, such as ethnicity, was not available in enough studies to be included in subgroup analysis.

Conclusions

We found a decline in the prevalence of underweight and an increase in the prevalence of overweight among women in South Asia and Southeast Asia over the study period. We also identified a number of determinants of both conditions that included age, urbanicity, education, and wealth. Future research should investigate within-country driving forces behind the increasing rates of overweight and explain the inequalities in both conditions. Policy approaches should be developed to counter the double burden of malnutrition, with integrated interventions to combat both overweight and undernutrition.

Acknowledgments

The authors' responsibilities were as follows—TB and AM: developed the study concept and undertook reviews of published studies; RJSM and NT: contributed to study design; TB: wrote the first draft; RJSM, NT, SKD, AM: critically reviewed the drafts; and all authors: participated in the data analysis and discussion, and read and approved the final manuscript.

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