

## Pediatric Obesity

# Prevalence of overweight and obesity among children and adolescents with intellectual disabilities: a systematic review and meta-analysis

C. Maïano,<sup>1,2,3</sup> O. Hue,<sup>4</sup> A. J. S. Morin<sup>2</sup> and G. Moullec<sup>3,5</sup>

<sup>1</sup>Cyberpsychology Laboratory, Department of Psychoeducation and Psychology, Université du Québec en Outaouais (UQO), Gatineau, Canada, <sup>2</sup>Institute for Positive Psychology and Education, Australian Catholic University, Strathfield, Australia, <sup>3</sup>Department of Psychoeducation and Psychology, Université du Québec en Outaouais (UQO), Gatineau, Canada, <sup>4</sup>Department of Physical Activity Sciences, Université du Québec à Trois-Rivières, Trois-Rivières, Canada, and <sup>5</sup>Research Center, Hôpital du Sacré-Coeur de Montréal, Affiliated Hospital of Université de Montréal, Montréal, Canada

Received 26 October 2015; revised 30 January 2016; accepted 23 February 2016

Address for correspondence: C Maïano, Université du Québec en Outaouais, Campus de Saint-Jérôme, Département de Psychoéducation et de Psychologie, 5 rue Saint-Joseph, Saint-Jérôme, Québec J7Z 0B7. E-mail: christophe.maiano@uqo.ca

### Summary

Although there have been numerous studies examining the prevalence of overweight and obesity among children and adolescents with intellectual disabilities, they have not yet been integrated and synthesized through a systematic quantitative review process. The purpose of this systematic review and meta-analysis was to determine: (i) the prevalence of overweight/obesity among children and adolescents with intellectual disabilities; (ii) the sources of heterogeneity in studies reporting the prevalence of overweight/obesity in this population; and (iii) the risk of overweight/obesity in this population compared with their typically developing peers. A systematic literature search was performed and 16 studies, published between 1985 and 2015, met the inclusion criteria. The resulting pooled prevalence estimates for overweight, overweight–obesity and obesity were respectively: (i) 15%, 30%, and 13%, in children; and (ii) 18%, 33%, and 15% in adolescents. Subgroup analyses showed significant variations in the pooled prevalence estimates as a function of geographical region, recruitment setting, additional diagnoses, and norms used to define overweight or obesity. The findings also showed adolescents with intellectual disabilities to be respectively 1.54 and 1.80 times more at risk of overweight–obesity and obesity than typically developing adolescents. Unfortunately, no such comparison is available for children. © 2016 World Obesity

**Keywords:** Age, additional diagnosis, geographical regions, ID levels.

**Abbreviations:** B-M Begg and Mazumdar, DD developmental disabilities, ID intellectual disabilities, IOTF International Obesity Task Force, PRISMA Preferred Reporting Items for Systematic reviews and Meta-Analyses, STROBE STrengthening the Reporting of OBServational studies in Epidemiology statement, TD typically developing, USA United States of America.

**obesity reviews** (2016) **17**, 599–611

## Introduction

Over the past three decades, a considerable amount of research regarding the prevalence of overweight and obesity among youth presenting various disabilities or special needs has been conducted and synthesized (1–6). However,

the prevalence of overweight/obesity among children and adolescents with intellectual disabilities (ID; i.e. characterized by a deficit in intellectual functioning accompanied by a deficit in adaptive functioning and an onset during the developmental period) (7) has not been so closely examined. The first narrative review on this topic, published

in 2011 (8), reported a prevalence of overweight excluding obesity ranging from 11% to 25%, and a prevalence of obesity from 7% to 36% in children and adolescents with ID.

Since then, five additional reviews have summarized the research examining the prevalence of overweight and/or obesity among children and/or adolescents with ID (9) or developmental disabilities (DD). The DD categorization is broader than ID and encompasses Fragile X syndrome, Down syndrome, pervasive developmental disorders, fetal alcohol spectrum disorders, cerebral palsy and ID (10–13). However, only a limited number of studies focussing specifically on children and/or adolescents with ID were included in these reviews.

Moreover, these reviews suffer from important limitations. Firstly, five of these reviews (8–11,13) were non-systematic, and the sole systematic review (12) was restricted to the relationship between parental/parenting factors and obesity among children and/or adolescents with DD. Therefore, numerous studies on children and/or adolescents with ID could have been missed. Secondly, only two reviews have included studies comparing the prevalence of overweight or obesity among children and/or adolescents with ID and their typically developing (TD) peers (8,11). Furthermore, both of these reviews included very few such comparative studies, and most of them overlapped between the two reviews. Finally, no reviews have yet quantitatively examined whether the heterogeneity observed in the overweight/obesity prevalence of children and/or adolescents with ID could be attributed to the participants' characteristics (e.g. age, sex, ID severity, genetic syndromes, geographical region, or recruitment setting) or to the assessment methods (e.g. norms used to define overweight and obesity and measurement of height and weight).

Consequently, the prevalence of overweight and obesity among children and adolescents with an ID remains an underexplored area and there still remain gaps and inconsistencies in the knowledge. Still unknown is: (i) the extent to which children and adolescents with ID are at high risk for overweight, overweight–obesity or obesity; (ii) whether the observed prevalence estimates reported in the literature varied when different sources of heterogeneity were considered; and (iii) whether children and adolescents with ID are at greater risk for overweight, overweight–obesity or obesity than their TD peers.

In this context, a systematic review and meta-analysis of the prevalence rates of overweight/obesity among children and adolescents with ID appears to be of substantial importance. Indeed, a better estimation of this critical public health problem in children and adolescents with ID would encourage scholars, practitioners and policy makers to further develop lifestyle intervention programmes (i.e. healthy diet, physical activity, health promotion-education and

behavioural modification) designed for tackling or managing weight problems in this population. Therefore, following the Meta-Analysis of Observational Studies in Epidemiology Statement (14), the aims of the current review were to determine among children and adolescents with ID: (i) the prevalence of overweight, overweight–obesity, and obesity; (ii) the sources of heterogeneity in studies reporting the prevalence of overweight, overweight–obesity, and obesity; and (iii) the risk of overweight, overweight–obesity and obesity, compared with their TD peers.

## Method

### Sources of information and search strategy

A systematic electronic search was conducted in nine databases without imposing any year restriction (Academic Search Complete, Medline, PsycARTICLES, Psychology and Behavioral Sciences Collection, Scopus, CINAHL, Education Sources, ERIC and SocINDEX). Studies were identified using all possible combinations of the following three groups of search terms: (i) intellectual\* disab\* OR learning disab\* OR learning difficult\* OR mental\* retard\* OR developmental dis\* OR developmental del\* OR cogniti\* dis\* OR mental dis\*; (ii) obes\* OR overweight\* OR fat\* OR weight\* OR body mass index OR nutritional status OR adiposit\*; and (iii) child\* OR adolescen\* OR student\* OR youth\* OR paediatric\* OR pediatric\*. In addition, a hand search was carried out in reference lists of relevant articles and previous literature reviews on children and adolescents with disabilities (1–6), with ID (8,9) or with DD (11–13). Finally, an additional search was also performed in content pages of specific peer-reviewed journals devoted to ID or DD (e.g. *American Journal on Intellectual and Developmental Disabilities*, *Journal of Intellectual Disabilities Research*, *Intellectual and Developmental Disabilities*, *Journal of Applied Research in Intellectual Disabilities*, *Journal of Intellectual and Developmental Disability* and *Research in Developmental Disabilities*). This literature was last updated by hand-search on 5 December 2015.

### Inclusion criteria

Only studies meeting four specific inclusion criteria were considered eligible for this review. First, study participants had to present an ID. Studies based on mixed samples of participants presenting multiple disabilities were also considered eligible if specific data regarding the prevalence of overweight, overweight–obesity, or obesity were available for children and/or adolescents with ID.

Second, study participants had to be composed of children (age range  $\geq 4$ –11 years) and/or adolescents (age range  $\geq 11$ –18 years). Studies including mixed samples of children and adolescents were considered eligible if specific data

on the relevant outcomes were available for children and/or adolescents subgroups separately. Studies or samples in a study were not included when the age range of the participants overlapped multiple age categories: infants and children (e.g. 2–10 years), children and adolescents (e.g. 7–12 years and 10–13 years) and adolescents and adults (e.g. 12–19 years and 17–20 years), etc.

Third, studies were retained if the prevalence estimates of overweight, overweight–obesity or obesity were the primary outcome of the study and if they were assessed by means of height/weight measurement indicators, such as the body mass index (BMI; Cole, 15) and the weight-for-length index (WLI; DuRant and Linder, 16). Here, children/adolescents with ID are categorized as overweight (excluding obesity) when their value of BMI or WLI is greater than cut-off values for normal weight and less than cut-off values for obesity. Additionally, children/adolescents with ID are categorized as obese when their value of BMI or WLI is greater than or equal to cut-off values for obesity. Finally, children/adolescents with ID are categorized as overweight–obese (a combined category including overweight and obesity) when their value of BMI or WLI is greater than or equal to cut-off values for overweight. This last combined category was considered to permit the consideration of studies in which no distinction was made between overweight and obesity.

The indicators based on height and weight measurement were preferred to other measures of adiposity (e.g. skinfold thickness, waist circumference and bioelectrical impedance analysis) for two reasons. First, previous reviews (8–13) showed that they were the most largely used in overweight/obesity prevalence studies among children and adolescents with ID. Second, a recent scoping review (17) showed that the validity, reliability and/or sensitivity of other methods (i.e. skinfold thickness and bioelectrical impedance analysis) for measuring adiposity in individuals with ID were limited and questionable. Additionally, the use of alternative fatness measurements can be limited or unfeasible in certain occasions (e.g. heterogeneous samples including various subtypes of ID, individuals with additional diagnoses and lack of national norms), and they can introduce a high level of non-compliance in this population (e.g. reluctance to undress). Consequently, we considered that the use and comparison of other body composition measures with the BMI or WLI were premature. When some participants' characteristics (e.g. sex ratio and age) and key information on ID subgroups used to calculate the overweight/obesity rate (e.g. sample size) were not reported in the manuscript, authors were contacted directly to provide the information.

Fourth, when the same dataset was used in various studies, only one study was included. Fifth, only original cohort, cross-sectional and case-control studies were included. Reviews, reports, theoretical papers or single-case studies were excluded. However, a hand search was

carried out in reference lists of all previous published reviews on the topic. Sixth, studies were retained if they were written in English and published in a peer-reviewed journal.

### Study selection and data extraction

The studies were selected following the Preferred Reporting Items for Systematic reviews and Meta-Analyses Statement (18). Two authors examined the eligibility of relevant studies separately, based on the consecutive examination of the titles, abstracts and full texts. The results were then discussed in committee, and disagreements were resolved by discussion. The following information was extracted from the selected studies (Table 1): country, geographical region, design, recruitment setting, ID characteristics (i.e. sample size, sex ratio, age groups [children and/or adolescents] and ID levels), TD comparison sample (i.e. yes-no, sample size), height and body-weight measurement method (i.e. direct [by the research team or collected via measures taken by clinicians or teachers] or indirect) and type of norm used to define overweight and obesity (e.g. International Obesity Task Force [IOTF], national norms and non-national norms).

### Quality assessment of the reviewed studies

The quality of the reviewed studies was rated using criteria developed based on the recommendations of the STrengthening the Reporting of OBServational studies in Epidemiology statement (STROBE; Vandembroucke et al., 19). These criteria covered four potential sources of bias in each study. The first criterion assessed the study population biases and more specifically whether the reviewed study: (i) was population-based; (ii) reported the main demographic characteristics of the children and adolescents with ID (i.e. age, sex, and ID level); and (iii) reported additional diagnoses of the children and adolescents with ID (e.g. Down syndrome, autism). The second criterion assessed outcome biases, more specifically whether the outcomes (weight and height) were measured directly (i.e. by the research team, clinicians or teachers). The third criterion assessed analysis biases, more specifically whether the reviewed studies reported subgroup (e.g. age, sex, ID levels, additional diagnoses) and/or interaction analyses. Finally, the last criterion assessed data presentation biases, more precisely whether the reviewed studies reported the frequency and prevalence estimates of overweight/obesity.

### Statistical analysis

Analyses were performed with the Comprehensive Meta-Analysis (20) software (version 2.2.064). Pooled estimates of overweight, overweight–obesity and obesity prevalence

**Table 1** Main characteristics of the studies included in the meta-analysis

Study	Country	Geographical region	Design	Recruitment setting	Sample size (N)	Sex (% of boys)	Age group (age range in years)	ID level	Yes-No	Sample size (N) method	Norms used to define OW or OB	Outcome	TD	
													ID	TD
Abdallah et al. (28)	Egypt	Eastern Mediterranean	CS	Regular and special schools	574	NA	Children (9-10) & Adolescents (11-14)	NA	o	Direct	NA	OB		
Batista et al. (29)	Brazil	South America	CS	ID association	54	NA	Children (5-11)	NA	o	Direct	Non-national	OW, OW-OB, OB		
Bégarie et al. (30)	France	Europe	CS	Special school	865	NA	Children (5-10) & Adolescents (11-18)	Mild to severe	o	Direct	IOTF	OW, OW-OB, OB		
Choi et al. (31)	South Korea	Western Pacific	CS	Special school	2,404	71	Children (7-10) & Adolescents (11-18)	NA	o	Direct	National	OW, OW-OB, OB		
Foley et al. (32)	USA	North America	Cohort	Special Olympics	1,122	61	Children (8-11) & Adolescents (12-18)	NA	o	Direct	National	OW, OW-OB, OB		
Fox et al. (33)	USA	North America	CS	Regular school	118	53	Children (5.5-10.4)	Mild to profound	o	Direct	National	OW, OW-OB, OB		
Krause et al. (34)	Australia	Western Pacific	CS	Regular and special schools	261	56	Adolescents (13-18)	NA	o	Direct	IOTF	OW, OW-OB, OB		
Lin et al. (35)	Taiwan	Western Pacific	CS	National survey	187	64	Children (4-6) & Adolescents (13-18)	Mild to profound	o	Indirect	National	OB		
Lloyd et al. (22)	Worldwide	North America, Africa-Eastern Mediterranean, South America, Europe, South-East Asia, Asia-Western Pacific	CS	Special Olympics	9,678	63	Children (8-11) & Adolescents (12-18)	NA	o	Direct	IOTF	OW, OW-OB, OB		
Mikulovic et al. (36)	France	Europe	CS	Regular and special schools	183	NA	Adolescents (11-14)	NA	o	Direct	IOTF	OW, OW-OB, OB		
Nogay (37)	Turkey	Europe	CS	Regular and special schools	25	60	Adolescents (14-18)	Mild to severe	o	Direct	National	OB		
Phillips et al. (38)	USA	North America	CC	National survey	60	59	Adolescents (12-17)	NA	•	Indirect	National	OW, OW-OB, OB		
Rimmer et al. (39)	USA	North America	CC	ID association	163	68	Adolescents (12-18)	NA	•	Indirect	National	OW, OW-OB, OB		
Salaun & Berthouze-Aranda (40)	France	Europe	CS	Special school	192	56	Children (6-11) & Adolescents (12-18)	Mild	o	Direct	IOTF	OW-OB		
Takeuchi (41)	Japan	Western Pacific	CS	Special school	20,031	65	Children (6-11) & Adolescents (12-17)	NA	o	Indirect	National	OB		
Tamin et al. (42)	Indonesia	South-East Asia	CS	Special school	428	NA	Adolescents (14-16)	NA	o	Direct	NA	OB		

CC, case control; CS, cross-sectional; ID, intellectual disability; OB, obesity; OW, overweight; OW-OB, overweight including obesity; USA, United States of America; IOTF, International Obesity Task Force; •, Yes; o, No; NA, not available; TD, typically developing.

were generated using a random effects model, because the studies differed greatly regarding the participants' characteristics and the assessment methods. Forest plots for prevalence were generated using spreadsheets developed by Neyeloff, Fuchs and Moreira (21). To compare the risk of being overweight, overweight–obese or obese between children and adolescents with ID and their TD peers, odds ratios (OR) and 95% confidence intervals were calculated.

Potential sources of heterogeneity in prevalence estimates of overweight, overweight–obesity and obesity were examined by performing a series of pre-specified subgroup (using a mixed effect model) analyses for the following variables: (i) sex; (ii) geographical regions as defined by the World Health Organization (e.g. Europe, North America, South America, Western Pacific), except for the worldwide study of Lloyd et al. (22), in which geographical regions of specific subsamples were already defined; (iii) recruitment settings (e.g. regular school, special school, Special Olympics); (iv) ID levels (e.g. mild, mild to moderate, mild to profound, moderate to severe-profound); (v) type of norms used to define overweight or obesity (IOTF, national and non-national); (vi) method used for measuring body height and weight (direct

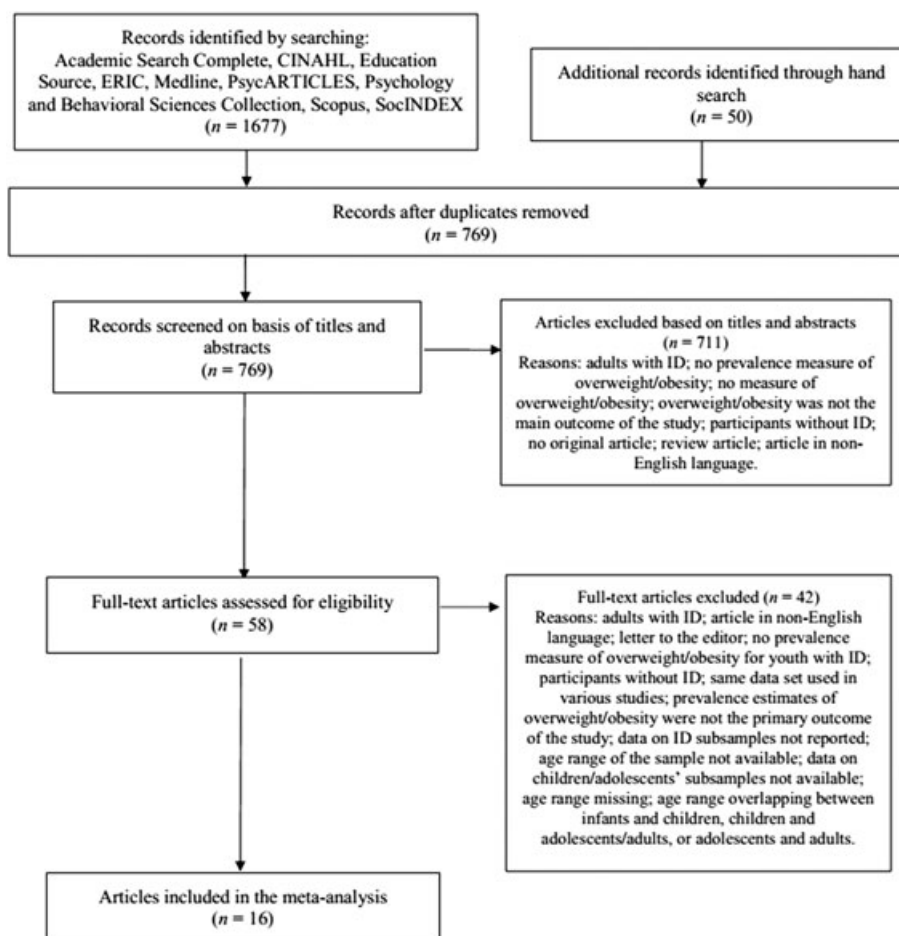
versus indirect); and (vii) additional diagnoses (e.g. Down syndrome). No moderation analysis was performed when only one study was available in a pre-specified subgroup.

Heterogeneity of prevalence estimates within and between subgroups was assessed using the  $Q$  test (23) and the  $I^2$  statistic (24). Finally, potential publication bias was assessed by examining the funnel plots [including results from the Duval and Tweedie's (25) 'trim and fill' test], Begg and Mazumdar's (B-M) rank correlation test (26) and Egger's test of intercept (27).

## Results

### Study selection

The search identified a total of 1,727 possibly eligible articles (Fig. 1). This number fell to 769 after duplicates were removed. Based on titles and abstracts, 711 studies were excluded for reasons detailed in Fig. 1. The full text of the remaining 58 articles was screened, and 16 studies (22,28–42) published between 1985 and 2015 met the inclusion criteria and were included in this meta-analysis (Table 1).



**Figure 1** Results of search based on the PRISMA Statement (18).



## Study characteristics

Participant characteristics, study design and recruitment settings for the 16 retained studies are reported in Table 1. Studies were conducted mainly in Western Pacific ( $n=4$ ), Europe ( $n=4$ ) and North America ( $n=4$ ). Two of the 16 studies (13%) included a TD sample that could be used for comparative analyses. Overall, a total of 36,345 participants with ID were involved in these studies ( $M=2,272$ ; range=25 to 20,031) and nearly half of the studies recruited their participants in regular and/or special schools (10/16 studies, 63%). Additionally, 10 of the 16 studies (63%) focussed on children ( $\geq 4$ –11 years) and 14 of the 16 (88%) on adolescents ( $\geq 11$ –18 years). Additionally, participants were mostly boys ( $M=61\%$ ,  $SD=5\%$ , range=53% to 71%).

In the vast majority of the studies, height and body weight were measured directly either by the research team or collected via measures taken by clinicians (e.g. nurses, doctors and dieticians) or teachers ( $n=12$ ; 75%). In the other studies, height and weight were reported by parents, career or schools without information on the method of measurement. Overweight, overweight–obesity and obesity status were determined using BMI in all studies, except for two (33,41) using the WLI. The vast majority of the norms used in the reviewed studies were national ( $n=8$ ; 50%) or from the IOTF ( $n=5$ ; 31%). Only one used non-national norms, and two do not mention the norms used.

In the reviewed studies using national and non-national norms, participants were considered as being: (i) overweight if their age- and sex-specific BMI was  $\geq 85$ th percentile and

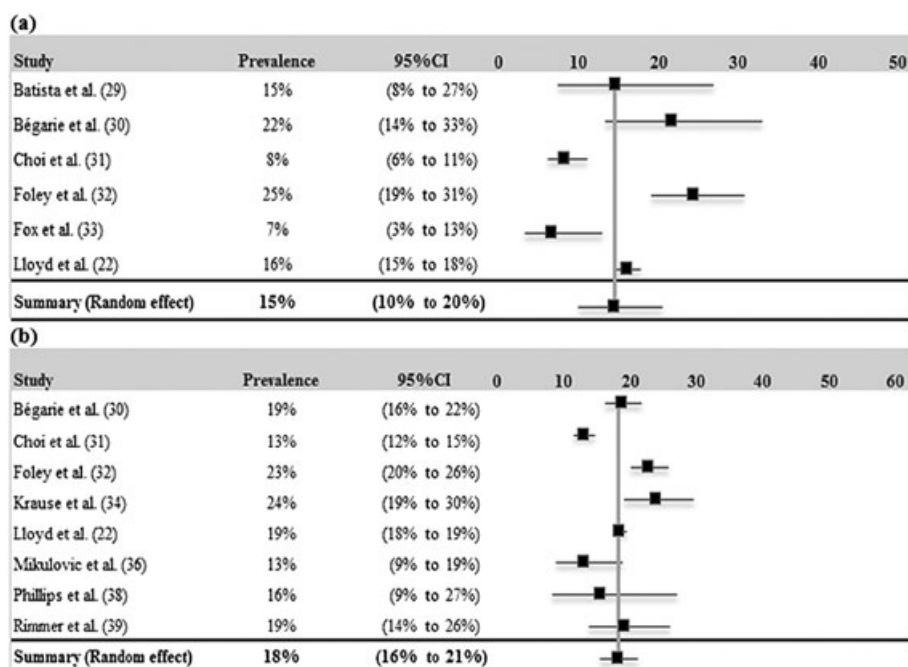
<95th percentile or if their WLI was  $\geq 110\%$  and  $\leq 119$ ; (ii) overweight–obese if their age- and sex-specific BMI was  $\geq 85$ th percentile or if their WLI was  $\geq 110\%$ ; and (iii) obese if their age- and sex-specific BMI was  $\geq 95$ th percentile or if their WLI was  $\geq 120\%$ .

In the studies using the IOTF norms (43), participants were considered as being: (i) overweight if their age- and sex-specific BMI was equivalent to an adult BMI  $\geq 25$  and  $< 30$  kg/m<sup>2</sup>; (ii) overweight–obese if their age- and sex-specific BMI was equivalent to an adult BMI  $\geq 25$  kg/m<sup>2</sup>; and (iii) obese if their age- and sex-specific BMI was equivalent to an adult BMI  $\geq 30$  kg/m<sup>2</sup>.

## Prevalence estimates of overweight, overweight–obesity, and obesity

**Children.** *Overweight* (Fig. 2a) prevalence estimates were reported in six studies from several countries (Brazil, France, South Korea, United States of America [USA] and Worldwide). The pooled prevalence estimate was 15% (95%CI=10%–20%), with a high level of heterogeneity ( $Q_{(5)}=42$ ,  $p<0.001$ ;  $I^2=88$ ). The highest estimate was observed in the USA (25%) by Foley et al. (32), and the lowest in the USA (7%) and South Korea (8%) by Fox et al. (33) and Choi et al. (31), respectively. Finally, no evidence of publication bias was noted (Fig. S1a in the Supporting Information; B-M's test,  $p=0.50$ ; Egger's test,  $p=0.36$ ).

Prevalence estimates of *overweight–obesity* (Fig. 3a) were reported in seven studies from several countries (Brazil, France,



**Figure 2** Forest plot of random-effects pooled prevalence estimates of overweight among (a) children and (b) adolescents.

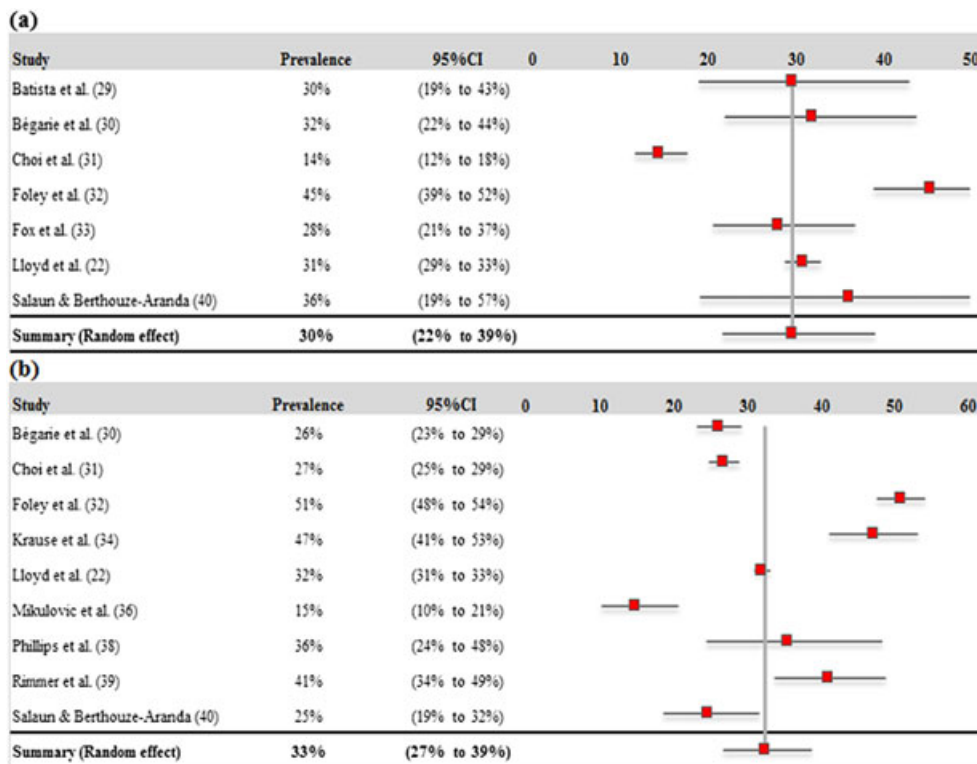
South Korea, USA and Worldwide). The pooled prevalence estimate was 30% (95%CI=22%–39%), with a high level of heterogeneity ( $Q_{(6)} = 82, p < 0.001; I^2 = 93$ ). The highest estimate was observed in the USA (45%) by Foley et al. (32) and the lowest in South Korea (14%) by Choi et al. (31). Finally, no evidence of publication bias was noted by the B-M rank correlation test ( $p = 0.50$ ) and Egger’s test of intercept ( $p = 0.46$ ). The Duvall and Tweedie’s trim and fill revealed that two studies were missing on the left of the funnel plot (Fig. S1b in the Supporting Information). When these two studies are imputed to obtain a symmetrical funnel plot, the pooled prevalence estimate becomes 27% (95%CI=20%–35%).

**Obesity** prevalence estimates (Fig. 4a) were reported in nine studies from several countries (Egypt, Brazil, France, Japan, South Korea, Taiwan, USA and Worldwide). The pooled prevalence estimate was 13% (95%CI=10%–16%), with a high level of heterogeneity ( $Q_{(8)} = 61, p < 0.001; I^2 = 87$ ). The highest estimate was observed in the USA (21%) by Foley et al. (32) and Fox et al. (33), and the lowest in South Korea (6%) by Choi et al. (31). Finally, no evidence of publication bias was noted by the B-M rank correlation test ( $p = 0.38$ ) and Egger’s test of intercept ( $p = 0.30$ ). The Duvall and Tweedie’s trim and fill revealed that two studies were missing on the left of the funnel plot (Fig. S1c in the Supporting Information). When these two studies are imputed to obtain a symmetrical funnel plot, the pooled prevalence estimate becomes 11% (95%CI=9%–14%).

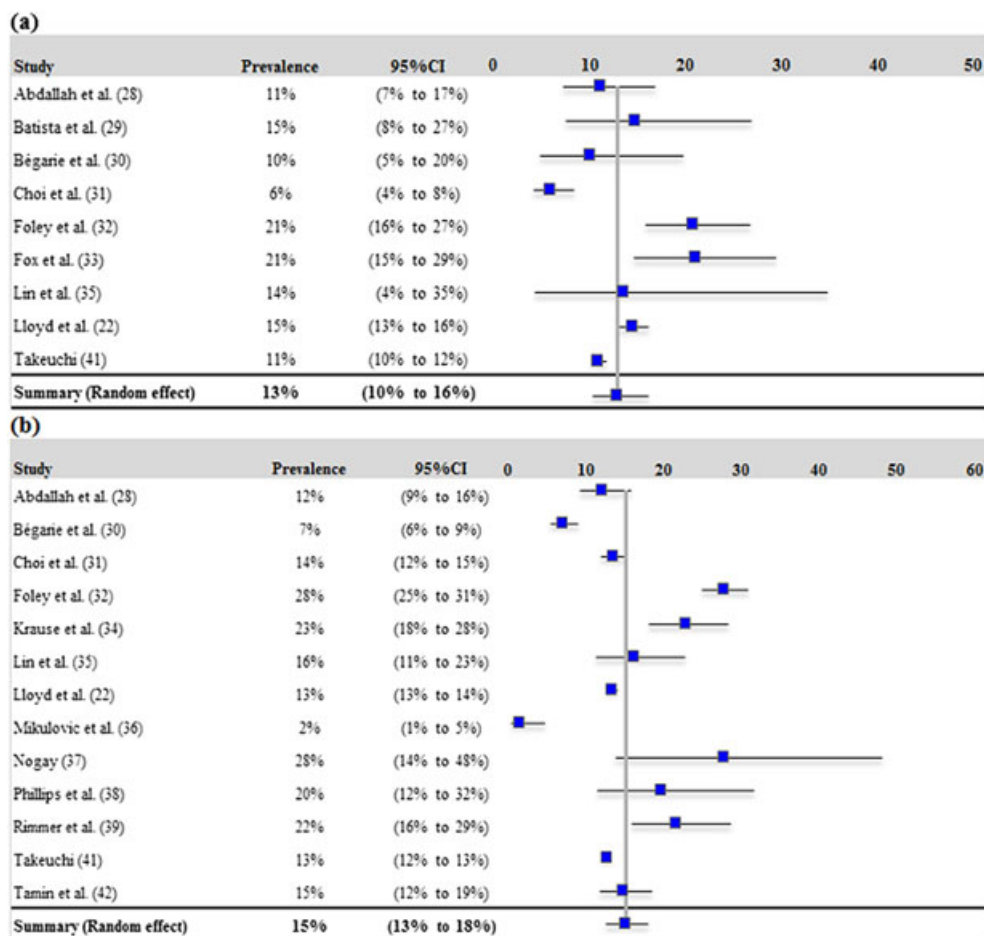
**Adolescents. Overweight** (Fig. 2b) prevalence estimates were reported in eight studies from several countries (Australia, France, South Korea, USA, Worldwide). The pooled prevalence estimate was 18% (95%CI=16%–21%), with a high level of heterogeneity ( $Q_{(7)} = 55, p < 0.001; I^2 = 87$ ). The highest prevalence estimate was observed in Australia (24%) and the USA (23%) by Krause et al. (34) and Foley et al. (32), respectively. Conversely, the lowest prevalence estimates were observed in France (13%) and South Korea (13%) by Mikulovic et al. (36) and Choi et al. (31), respectively. Finally, no evidence of publication bias was noted (Fig. S2a in the Supporting Information; B-M’s test,  $p = 0.19$ ; Egger’s test,  $p = 0.47$ ).

Prevalence estimates of **overweight-obesity** (Fig. 3b) were reported in nine studies from several countries (Australia, France, South Korea, USA and Worldwide). The pooled prevalence estimate was 33% (95%CI=27%–39%), with a high level of heterogeneity ( $Q_{(8)} = 235, p < 0.001; I^2 = 97$ ). The highest prevalence estimate was observed in the USA (51%) by Foley et al. (32) and the lowest in France (15%) by Mikulovic et al. (36). Finally, no evidence of publication bias was noted (Fig. S2b in the Supporting Information; B-M’s test,  $p = 0.46$ ; Egger’s test,  $p = 0.44$ ).

**Obesity** prevalence estimates (Fig. 4b) were reported in 13 studies from several countries (Egypt, France, Indonesia, Japan, South Korea, Taiwan, USA and Worldwide). The pooled prevalence estimate was 15% (95%CI=13%–18%) with a high



**Figure 3** Forest plot of random-effects pooled prevalence estimates of overweight–obesity among (a) children and (b) adolescents.



**Figure 4** Forest plot of random-effects pooled prevalence estimates of obesity among (a) children and (b) adolescents.

level of heterogeneity ( $Q_{(12)}=230$ ,  $p < 0.001$ ;  $I^2=95$ ). The highest prevalence estimate was observed in Turkey (28%) and in the USA (28%) by Nogay (37) and Foley et al. (32), respectively. Inversely, the lowest prevalence estimate was observed in France (2%) by Mikulovic et al. (36). Finally, no evidence of publication bias was noted by the B-M rank correlation test ( $p=0.21$ ) and Egger's test of intercept ( $p=0.23$ ). The Duvall and Tweedie's trim and fill revealed that three studies were missing on the left of the funnel plot (Fig. S2c in the Supporting Information). When these three studies are imputed to obtain a symmetrical funnel plot, the pooled prevalence estimate was 13% (95%CI = 11%–16%).

### Moderation analyses

Results from the moderation analyses, as well as the references of the studies used for these analyses, are detailed in Tables S1–S6 in the Supporting Information.

**Children.** Findings showed significant disparities in overweight–obesity and obesity pooled prevalence estimates by geographical region (Tables S4–S6). Pairwise comparisons (available upon request from the first author) showed that

the risk of being overweight–obese was greater in children with ID from North America (39%) than from South America (25%). North American children with ID were also more likely to be obese (23%) than those from Europe (9%), South America (11%) and Western Pacific (9%). Results also showed significant variations in the pooled prevalence of obesity by recruitment setting (Tables S5 and S6 in the Supporting Information). The pooled prevalence of obesity was significantly higher in children recruited via Special Olympics (17%) than via special schools (9%). No significant variations were found as a function of sex, ID level, additional diagnoses, body height and body weight measurement method or the norms used to define overweight, overweight–obesity or obesity (Tables S1–S6 in the Supporting Information).

**Adolescents.** Findings showed significant disparities in overweight, overweight–obesity and obesity pooled prevalence estimates by geographical region (Tables S1–S6 in the Supporting Information). Adolescents with ID from North America (22% and 48%) were more likely to be overweight and overweight–obese than those from Europe (17% and 23%), and more likely to be obese (27%) than those living in Europe (8%), South East Asia (10%) and Western Pacific (16%).



Results (Tables S4–S6 in the Supporting Information) also showed that pooled prevalence of overweight–obesity and obesity were significantly higher in adolescents with Down syndrome (61% and 33%) than without Down syndrome (35% and 17%). Findings also revealed higher pooled prevalence of obesity among adolescents with ID in studies using national norms (19%) rather IOTF norms (10%). No significant variations were found as a function of sex, ID level or body height and body weight measurement method (Tables S1–S6 in the Supporting Information).

### Comparison of risk with typically developing peers

**Children.** None of the studies assessed the risk of being overweight, overweight–obese or obese in children with ID compared with their TD peers.

**Adolescents.** Only two studies provided data that can be used to compare the risk of overweight/obesity in adolescents with ID and their TD peers (34,39). Random effects models showed a statistically higher risk for overweight–obesity and obesity in adolescents with ID than in their TD peers, with a pooled OR of 1.54 (95%CI=1.12–2.12,  $p=0.008$ ) and of 1.80 (95%CI=1.30–2.49,  $p<0.001$ ); with a moderate level of heterogeneity ( $Q_{(1)}=1.3$ ,  $p=0.26$ ;  $I^2=39$ ) and no observed heterogeneity ( $Q_{(1)}=0.11$ ,  $p=0.74$ ;  $I^2=0$ ), respectively. Nevertheless, no significant differences were found in the risk of being overweight (OR = 1.15; 95%CI=0.80–1.63;  $p=0.46$ ), with a very low level of heterogeneity ( $Q_{(1)}=1.1$ ,  $p=0.31$ ;  $I^2=5$ ).

### Quality rating of the reviewed studies

Table 2 provides the quality ratings of the reviewed studies based on STROBE's criteria (19). The fact that only three studies (19%) used a population-based sample raises concerns about the representativeness of the other samples and, consequently, about the generalizability of their results (Table 2), thus supporting the importance of the quantitative review process conducted here. Additionally, information regarding sample characteristics was often lacking, especially concerning sex ratios (5/16 studies, 31%), ID levels (12/16 studies, 75%) and additional diagnoses (7/16 studies, 44%). The majority of the studies (75%) have measured height and weight directly. All but one (15/16 studies) reported subgroup analyses, but only four (25%) performed interaction analyses. Finally, only three studies did not report both frequency and percentage of overweight or obese children and adolescents with ID (Table 2).

## Discussion

### Prevalence estimates of overweight, overweight-obesity, and obesity

The first objective of this meta-analysis was to determine the pooled prevalence estimates of overweight/obesity among

children and adolescents with ID. Among children, the results revealed pooled prevalence estimates of overweight, overweight–obesity and obesity of 15% (7%–25%), 30% (14%–45%) and 13% (6%–21%), respectively. These pooled prevalence estimates are higher than those found in previous studies of TD children (44,45). In addition, these findings show that the highest and lowest prevalence estimates of overweight/obesity were observed in studies from the USA (32) and South Korea (31), respectively. Interestingly, findings from a French study (30) show that children with ID were two times more likely to be overweight (22%) than obese (10%), whereas in an American study (33) the children with ID were three times more likely to be obese (21%) than overweight (7%). However, in Brazil (29) and South Korea (31) prevalence estimates were nearly similar for overweight and obesity.

Among adolescents, the results revealed pooled prevalence estimates of overweight, overweight–obesity and obesity of 18% (13%–24%), 33% (15%–51%) and 15% (2%–28%), respectively. These pooled prevalence estimates are higher than those found among TD adolescents (46). Additionally, these findings show that: (i) the highest prevalence estimates of overweight were observed in studies from Australia (34) and the USA (32), and of obesity in studies from the USA (32) and Turkey (37); (ii) the lowest prevalence estimates of overweight were observed in studies from France (36) and South Korea (31), and of obesity in studies from France (30,36). The highest prevalence estimates of overweight–obesity and obesity (>20%) were found in three studies from the USA (32,38,39). Finally, two French studies (30,36) show that adolescents with ID were nearly three (19% vs. 7%) to seven (13% vs. 2%) times more likely to be overweight than obese. Inversely, studies from the USA (32,38,39) show that adolescents with ID were slightly more likely to be obese (20–28%) than overweight (16–23%). However, similar rates of overweight and obesity were observed in Australia (34) and South Korea (31).

### Moderators

The second objective of this meta-analysis was to examine whether the heterogeneity of overweight/obesity prevalence estimates across studies could be attributed to various moderators, including the participants' characteristics (i.e. sex, geographical region, recruitment setting, ID level and additional diagnoses) or the assessment method (i.e. type of norms used to define overweight or obesity, body height and body weight measurement method).

**Participants' characteristics.** The findings suggest that the risk of overweight was higher in adolescents with ID living in North America than in Europe. Additionally, findings show that children and adolescents with ID living in North America were significantly more overweight–obese than

**Table 2** Quality assessment of studies

Study	Population bias			Outcome bias	Analysis bias	Data presentation bias	
	Population-based	Main demographic characteristics reported	Additional diagnosis reported	Direct measurement of height and weight	Subgroup analyses reported	Interaction analyses reported	Frequency and prevalence of outcomes reported
Abdallah et al. (28)	○	○ (ID level)	○	●	● (age, SES, sex)	○	●
Batista et al. (29)	○	○ (sex, ID level)	○	●	● (age)	○	●
Bégarie et al. (30)	○	●	●	●	● (age, sex, comorbidity, ID level, etc.)	●	●
Choi et al. (31)	○	○ (ID level)	●	●	● (age, sex)	●	●
Foley et al. (32)	○	○ (sex and ID level)	○	●	● (age, sex)	○	○
Fox et al. (33)	○	●	●	●	● (age, sex, ID level, comorbidity, etc.)	●	●
Krause et al. (34)	●	○ (ID level)	●	●	● (age, sex, comorbidity, behaviour problems, mobility, medication, etc.)	●	●
Lin et al. (35)	●	○ (ID level)	●	○	● (age, sex)	○	●
Lloyd et al. (22)	○	○ (ID level)	○	●	● (age, sex)	○	○
Mikulovic et al. (36)	○	○ (ID level)	○	●	● (age, sex, school type)	○	○
Nogay (37)	○	●	○	●	● (age, sex)	○	●
Phillips et al. (38)	●	○ (sex, ID level)	●	○	○	○	●
Rimmer et al. (39)	○	○ (age, sex, ID level)	●	○	● (diagnosis)	○	●
Salaun & Berthouze-Aranda (40)	○	●	●	●	● (age, sex)	○	●
Takeuchi (41)	○	○ (ID level)	●	○	● (age, sex)	○	●
Tamin et al. (42)	○	○ (sex and ID level)	○	●	● (age)	○	●

● (reported characteristics), Yes; ○ (missing characteristics), No; ID, intellectual disability; SES, socioeconomic status.

those living in South America and in Europe. Finally, children and adolescents with ID living in North America were significantly more obese than those living in Europe, South America and in the Western Pacific. This finding suggests that the North-American environment may expose youth with ID to be at greater risk for weight gain when compared with other geographical areas. These results are consistent with those from recent reviews (44–46) and cross-national studies (47,48) conducted among TD youth. However, our findings should be interpreted with caution. Indeed, even within regions, most of the participants were from the same country (e.g. USA, France). Consequently, future research examining the prevalence of overweight/obesity among youth with ID should focus on more regions, as well as countries within regions.

Surprisingly, subsequent analyses suggest that children with ID recruited via Special Olympics were significantly more obese than those recruited in special schools. Higher prevalence estimates of obesity were also observed in adolescents recruited via Special Olympics compared with special schools, or regular and special schools, but the difference was non-significant. This result might be related to the fact that athletes with ID attending Special Olympics may have been misclassified as obese by reporting increased muscular mass, associated to a higher BMI. Further studies are required to determine the actual reasons of these counter-intuitive results.

Additional findings suggest that adolescents with Down syndrome were significantly more overweight–obese and obese than those without Down syndrome. This result is consistent with findings from previous reviews (4,9,11,13) and may be explained by Must et al.'s (13) observation that adolescents with Down syndrome have 'lower fat-free mass (González-Agüero et al., 2011) and lower resting metabolic rates than TD children (Hill et al. 2013; Luke et al., 1996)' (p. 158). Additionally, according to Reinehr et al. (4, p. 270), adolescents with Down syndrome 'have a predisposition to overeat, because the cerebral regions that are responsible for weight regulation (hypothalamus) may be damaged (van Mil et al., 2001; Luke et al., 1996)'. Nevertheless, because only two studies (34,39) were included in this subgroup analysis, these differences should be interpreted with caution and require additional scientific attention. Finally, no significant variations were found in the pooled prevalence estimates for other characteristics of participants with ID, including sex and ID level.

**Assessment methods.** These findings show that the norms used to define obesity significantly influenced prevalence estimates among adolescents with ID. Indeed, findings show that studies relying on national norms provided significantly higher pooled prevalence estimates of obesity than those using the IOTF norms, which is consistent with data obtained in TD youth (49–51). It is thus important that future studies systematically provided prevalence estimates of

overweight/obesity among youth with ID using both norms (national and IOTF) in order to enable international and national comparisons. Finally, no significant variations were found in the pooled prevalence estimates for assessment methods, including body height and body weight measurement method.

### Comparison with TD peers

The last objective of this meta-analysis was to examine whether children and adolescents with ID were at greater risk of overweight/obesity than their TD peers. The findings show that the risk of being overweight was nearly identical between adolescents with ID and their TD counterparts. However, additional findings indicate that adolescents with ID were nearly two times more at risk of being overweight-obese and obese than their TD peers. This result is consistent with findings from previous reviews (11,13). It shows that obesity represents an important health threat for this population that deserves more attention from practitioners and policy makers. Nevertheless, since only two studies (38,39) from the USA were included in these analyses, these differences should be interpreted with caution and require future research.

### Limitations and directions for future studies

Although informative, the findings from this systematic review and meta-analysis should be interpreted with caution given the limitations of the reviewed studies. First, the reviewed studies were conducted mostly in Europe, North America and Western Pacific regions. Moreover, only a few considered participants' characteristics (e.g. sex, age, ID level and living arrangements) and additional diagnoses (e.g. autism spectrum disorder, Down syndrome, Fragile X, Prader-Willi syndrome, physical disabilities) in subgroup analyses. Therefore, the moderating role of these variables should be more thoroughly examined in future studies.

Second, as already illustrated in previous reviews (8–11,13), most of the risk factors commonly associated with overweight/obesity in the general population (e.g. dietary intake, physical activity, sedentary behaviour, socio-economic status) were insufficiently controlled in the reviewed studies. Consequently, the role of these factors could not be examined in the present meta-analysis and should be examined in future studies.

Third, only a few of the reviewed studies compared the risk of overweight/obesity between children and adolescents with ID and their TD peers, and more specifically while controlling for key participant characteristics, such as sex and age. Consequently, it is unknown whether boys and girls or early and late children or adolescents with ID are at greater risk of overweight/obesity than their TD

peers. Clearly, this issue should be examined in future studies.

Fourth, all the reviewed studies (except 28,34,36,37) recruited participants in a single setting, and all used only one criterion (i.e. national norms or IOTF) to define overweight or obesity. Consequently, the role of these potential moderators in the prevalence estimates of overweight and obesity should be more thoroughly investigated in future studies.

Fifth, none of the reviewed studies (except 32) relied on a longitudinal design, precluding examination of longitudinal trajectories of overweight or obesity prevalence among youth with ID. Consequently, it is still unknown: (i) whether overweight or obesity prevalence is plateauing or increasing with time and (ii) whether trajectories of overweight or obesity prevalence could differ according to the participants' characteristics (e.g. sex, age, ID level, additional diagnoses). A longitudinal design study is needed to provide clear answers to these questions.

Finally, the reviewed studies were generally poorly described and lacking in details on key variables, such as sex ratio, age or ID level. Last but not least, as regards descriptive epidemiology, only three studies were population-based, designed using a national survey database and/or a random-sampling method (34,35,38). This raises serious concerns about the representativeness of most of the samples, and thus the value of the reported prevalence rates.

### Conclusion

This meta-analysis highlights that a large proportion of children and adolescents with ID are overweight and obese, and that they are significantly more obese than their TD peers. Unfortunately, many potentially important determinants of overweight and obesity (e.g. sex, age, ID level, living arrangements, additional diagnoses, dietary intake, physical activity) are clearly understudied in this population and deserve further investigation. Additionally, such a high prevalence among children and adolescents with ID is worrisome and problematic given their known higher risk of developing secondary health problems (52). A key policy priority should thus be to develop and test specific age subgroups lifestyle intervention for tackling or managing this serious public health issue in this vulnerable population (for systematic reviews refer to 53,54).

### Conflict of interest statement

The authors declare no conflict of interest.

### Acknowledgements

The preparation of this meta-analysis was supported by grants from the Social Sciences and Humanities Research Council of Canada (430-2012-0091 and 435-2014-0909)

awarded to the first three authors and the Australian Research Council (DP140101559) awarded to the first and third authors.

## References

- Allison DB, Packer-Munter W, Pietrobelli A, Alfonso VC, Faith MS. Obesity and developmental disabilities: pathogenesis and treatment. *J Dev Phys Disabil* 1998; **10/3**: 215–255.
- Ells LJ, Lang R, Shield JPH *et al.* Obesity and disability—a short review. *Obes Rev* 2006; **7/4**: 341–345.
- Holcomb MJ, Pufpaff LA, McIntosh DE. Obesity rates in special populations of children and potential interventions. *Psychol Schools* 2009; **46/8**: 797–804.
- Reinehr T, Dobe M, Winkel K, Schaefer A, Hoffmann D. Obesity in disabled children and adolescents: an overlooked group of patients. *Dtsch Arztebl Int* 2010; **107/15**: 268.
- Minihan PM, Fitch SN, Must A. What does the epidemic of childhood obesity mean for children with special health care needs? *J Law Med Ethics* 2007; **35/1**: 61–77.
- Rimmer JH, Rowland JL, Yamaki K. Obesity and secondary conditions in adolescents with disabilities: addressing the needs of an underserved population. *J Adol Health* 2007; **41**: 224–229.
- American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, 5<sup>th</sup> ed. edn. American Psychiatric Association: Arlington, VA, 2013.
- Maïano C. Prevalence and risk factors of overweight and obesity among children and adolescents with intellectual disabilities. *Obes Rev* 2011; **12**: 189–197.
- Casey AF, Rasmussen R. Obesity. In: Matson JL, Matson ML (eds). *Comorbid Conditions in Individuals with Intellectual Disabilities* [Autism and child psychopathology series]. Springer: Cham, Switzerland, 2015, pp. 275–298.
- Bandini L, Danielson M, Esposito LE *et al.* Obesity in children with developmental and/or physical disabilities. *Disabil Health J* 2015; **8/3**: 309–316.
- Grondhuis SN, Aman MG. Overweight and obesity in youth with developmental disabilities: A call to action. *J Intellect Disabil Res* 2013; **58/9**: 787–799.
- McGillivray J, McVilly K, Skouteris H, Boganin C. Parental factors associated with obesity in children with disability: a systematic review. *Obes Rev* 2013; **14/7**: 541–554.
- Must A, Curtin C, Hubbard K, Sikich L, Bedford J, Bandini L. Obesity prevention for children with developmental disabilities. *Curr Obes Rep* 2014; **3/2**: 156–170.
- Stroup DF, Berlin JA, Morton SC *et al.* Meta-analysis of observational studies in epidemiology: a proposal for reporting. *J Am Med Assoc* 2000; **283/15**: 2008–2012.
- Cole TJ. A method for assessing age-standardized weight-for-height in children seen cross-sectionally. *Ann Hum Biol* 1979; **6**: 249–68.
- DuRant RH, Linder CW. An evaluation of five indexes of relative body weight for use with children. *J Am Diet Assoc* 1981; **78/1**: 35–41.
- Casey AF. Measuring body composition in individuals with intellectual disability: a scoping review. *J Obes* 2013.
- Liberati A, Altman DG, Tetzlaff J *et al.* The PRISMA Statement for reporting systematic reviews and meta-analysis of studies that evaluate health care interventions: explanation and elaboration. *PLoS Med* 2009; **6**: 1–6.
- Vandenbroucke JP, von Elm EV, Altman DG *et al.* Strengthening the reporting of observational studies in epidemiology (STROBE): explanation and elaboration. *PLoS Med* 2007; **4/10**: e297.
- Borenstein M, Hedges L, Higgins J, Rothstein H (eds). *Comprehensive Meta-analysis Version 2*. Biostat: Englewood, NJ, 2005.
- Neyeloff JL, Fuchs SC, Moreira LB. Meta-analyses and Forest plots using a microsoft excel spreadsheet: step-by-step guide focusing on descriptive data analysis. *BMC Res Notes* 2012; **5/1**: 52.
- Lloyd M, Temple VA, Foley JT. International BMI comparison of children and youth with intellectual disabilities participating in Special Olympics. *Res Dev Disabil* 2012; **33**: 1708–1714.
- Cochran WG. The comparison of percentages in matched samples. *Biometrika* 1950; **37**: 256–66.
- Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *Br Med J* 2003; **327/7414**: 557.
- Duval S, Tweedie R. Trim and fill: a simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. *Biometrics* 2000; **56/2**: 455–463.
- Begg CB, Mazumdar M. Operating characteristics of a rank correlation test for publication bias. *Biometrics* 1994; **50/4**: 1088–1101.
- Egger M, Smith GD, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. *Br Med J* 1997; **315/7109**: 629–634.
- AbdAllah AM, El-Sherbeny SS, Khairy S. Nutritional status of mentally disabled children in Egypt. *Egypt J Hosp Med* 2007; **29**: 604–615.
- Batista LRV, Moreira EAM, Rauen MS, Corso ACT, Fiates GMR. Oral health and nutritional status of semi-institutionalized persons with mental retardation in Brazil. *Res Dev Disabil* 2009; **30/5**: 839–846.
- Bégarie J, Maïano C, Leconte P, Ninot G. The prevalence and determinants of overweight and obesity among French youths and adults with intellectual disabilities attending special education schools. *Res Dev Disabil* 2013; **34/5**: 1417–1425.
- Choi E, Park H, Ha Y, Hwang WJ. Prevalence of overweight and obesity in children with intellectual disabilities in Korea. *J Appl Res Intellect Disabil* 2012; **25/5**: 476–483.
- Foley JT, Lloyd M, Vogl D, Temple VA. Obesity trends of 8–18 year old Special Olympians: 2005–2010. *Res Dev Disabil* 2014; **35/3**: 705–710.
- Fox R, Hartney CW, Rotatori AF, Kurpiers EM. Incidence of obesity among retarded children. *Educ Train Ment Retard* 1985; **20/3**: 175–181.
- Krause S, Ware R, McPherson L, Lennox N, OCallaghan M. Obesity in adolescents with intellectual disability: prevalence and associated characteristics. *Obes Res Clin Pract* 2015 Advance online publication. DOI: 10.1016/j.orcp.2015.10.006.
- Lin JD, Yen CF, Li CW, Wu JL. Patterns of obesity among children and adolescents with intellectual disabilities in Taiwan. *J Appl Res Intellect Disabil* 2005; **18/2**: 123–129.
- Mikulovic J, Marcellini A, Compte R *et al.* Prevalence of overweight in adolescents with intellectual deficiency. Differences in socio-educative context, physical activity and dietary habits. *Appetite* 2011; **56**: 403–407.
- Nogay NH. Nutritional status in mentally disabled children and adolescents: a study from Western Turkey. *Pak J Med Sci* 2013; **29/2**: 614–617.
- Phillips KL, Schieve LA, Visser S *et al.* Prevalence and impact of unhealthy weight in a national sample of US adolescents with autism and other learning and behavioral disabilities. *Matern Child Health J* 2014; **18/8**: 1964–1975.
- Rimmer JH, Yamaki K, Lowry BMD, Wang E, Vogel LC. Obesity and obesity-related secondary conditions in adolescents with intellectual/developmental disabilities. *J Intellect Disabil Res* 2010; **54**: 787–794.

40. Salaun L, Berthouze-Aranda S. Obesity in school children with intellectual disabilities in France. *J Appl Res Intellect Disabil* 2011; **24**: 333–340.
41. Takeuchi E. Incidence of obesity among school children with mental retardation in Japan. *Am J Ment Retard* 1994; **99**/3: 283–288.
42. Tamin TZ, Idris FH, Mansyur M, Syarif DR. Prevalence and determinants of obesity in students with intellectual disability in Jakarta. *Med J Indones* 2014; **23**/2: 106–111.
43. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *Br Med J* 2000; **320**: 1240–1243.
44. Wang Y, Lobstein TIM. Worldwide trends in childhood overweight and obesity. *Int J Pediatr Obes* 2006; **1**/1: 11–25.
45. Wang Y, Lim H. The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. *Int Rev Psychiatry* 2012; **24**/3: 176–188.
46. Bibiloni MDM, Pons A, Tur JA. Prevalence of overweight and obesity in adolescents: a systematic review. *Int Sch Res Notices Obes* 2013: 392747.
47. Haug E, Rasmussen M, Samdal O *et al.* Overweight in school-aged children and its relationship with demographic and lifestyle factors: results from the WHO-Collaborative Health Behaviour in School-aged Children (HBSC) study. *Int J Public Health* 2009; **54**/2: 167–179.
48. Lissau I, Overpeck MD, Ruan WJ, Due P, Holstein BE, Hediger ML. Body mass index and overweight in adolescents in 13 European countries, Israel, and the United States. *Arch Pediatr Adolesc Med* 2004; **158**/1: 27–33.
49. Reilly JJ, Kelly J, Wilson DC. Accuracy of simple clinical and epidemiological definitions of childhood obesity: systematic review and evidence appraisal. *Obes Rev* 2010; **11**/9: 645–655.
50. De Onis M, Lobstein T. Defining obesity risk status in the general childhood population: which cut-offs should we use? *Int J Pediatr Obes* 2010; **5**/6: 458–460.
51. Rolland-Cachera MF. Childhood obesity: current definitions and recommendations for their use. *Int J Pediatr Obes* 2011; **6**/5-6: 325–331.
52. van Schrojenstein Lantman-de HM, Walsh PN. Managing health problems in people with intellectual disabilities. *Br Med J* 2008; **337**: a2507.
53. Casey AF, Rasmussen R. Reduction measures and percent body fat in individuals with intellectual disabilities: a scoping review. *Disabil Health J* 2013; **6**: 2–7.
54. Maïano C, Normand CL, Aimé A, Bégarie J. Lifestyle interventions targeting changes in body weight and composition among youth with an intellectual disability: a systematic review. *Res Dev Disabil* 2014; **35**/8: 1914–1926.