

Overweight and Obesity in Early Childhood A Systematic Review of Individual, Family, and Peer Risk Factors

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Abstract

Purpose: The prevalence of children who are overweight or obese has been increasing worldwide. While a variety of biological as well as socio demographic correlates have been identified and reviewed, a systematic review of psychosocial factors, particularly among preschool aged children, is lacking. This systematic review synthesizes the research on individual, family and peer risk factors for overweight and obesity in preschool aged children.

Method: A systematic review of the recent literature on psychosocial factors and overweight or rather obesity in the early stages of childhood was conducted.

Results: A total of 27 studies from 2011-2016 were identified that examined individual, family and social risk factors for obesity in children. Results indicate the importance of eating regulation as well as family factors in understanding early childhood risk for obesity. There was mixed support for associations between behavioral and emotional symptoms and obesity among this age group. For other risk factors examined, too few studies exist to be able to make strong conclusions about their relevance for understanding preschool obesity risk.

Conclusions: Psychosocial factors are associated with overweight and obesity among preschool aged children. However, this review also highlights the dearth of research on several potentially important risk factors for childhood obesity in this age group (such as family violence, parental and peer relationships). Longitudinal studies, which examine multiple risk factors simultaneously over this important developmental period, are sorely needed.

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Introduction

The prevalence of overweight and obesity has dramatically increased during the last three decades – not only for adults, but for children as well [1]. The greatest weight gain has been among children aged 6-12. Accordingly to the WHO, 10.1% of boys and 10.5% of girls aged 4-6 are overweight, 10.2% of boys as well as 7.9% of girls of the same

age group are obese. This means 20.3% of boys and 18.4% of girls have a BMI >25 kg/m². For boys aged 6-9 this value increases to 29.3% and for girls to 25.7%. Among children ages 9 - 12 years old, this total increases to 37.2% for boys and to 30.5% for girls [2].

Children who become overweight or obese during preschool age are likely to retain this weight gain throughout childhood [3]. This is especially concerning because overweight and obesity are accompanied by a range of physical and mental health risks. Overweight children experience impaired psychosocial functioning and quality of

life compared to normal weight children of the same age [4,5]. Accordingly, both early intervention programs, which address key risk factors for obesity among preschool aged children, as well as indicated or selective prevention programs, which address the negative psychosocial consequences among overweight and obese children, are needed.

Prevention measures at preschool age are convenient since parents and children are easily available. Children gain their first step to independence. Unhealthy habits can be guided into the right direction before individual patterns strengthen. In early years, nutrition, motion, etc. is influenced by the caregiver – therefore survey procedures and prevention measures had to bring parents and kindergartens into focus.

Although many biological risk factors have been identified, much of these are not easily modifiable (e.g., genetic risk factors). The purpose of this review is to examine risk factors for childhood obesity with the goal of informing prevention efforts with young children. In summary individual differences in obesity risk must be emphasised and assumed [6,7,8].

From a psychological perspective, risk factors may operate at the individual, family and social levels (Figure 1).

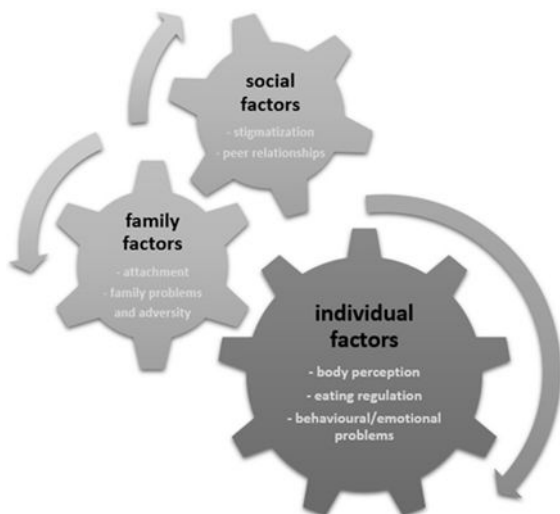


Figure 1: Psychological risk factors

This framework is useful in illustrating how factors influencing health behaviors in relation to childhood overweight and obesity affect at

individual, family and social levels in a complex and interdependent way.

Individual factors

Body dissatisfaction already occurs before school age. The discontent with one's own body leads to diets, restrictive eating behavior, as well as misuse of laxatives and diuretics. This is very often a vicious circle accompanied by a higher risk of overweight and/or obesity [9,10].

In this context, a healthy eating regulation plays a major role concerning overweight and obesity. A healthy eating behavior includes a well-balanced energy intake, a healthy choice of foods and the decision about starting and stopping eating [11]. Several studies examine eating regulation (food responsiveness, food enjoyment, satiety responsiveness, eating in the absence of hunger, reinforcing value of food and the capacity to voluntarily inhibit eating [12,13,14].

Self-control and impulsivity is linked with eating regulation and weight gain [15].

Behavioral or emotional problems, e.g. poor capacity of self-regulation and the awareness of a healthy sense of hunger are associated with a higher BMI and leads to a regulation of emotions through food [16,17,18].

Family factors

Insecure attachments become significant importance. Insecure attachment is associated with poorer body satisfaction [19,20,21]. Insecure attachment also shows significant effects on children's regulation of emotions and of their eating behavior [22,23]. Two reviews show, that insecure attachment is associated with eating pathology in childhood, adolescence and adulthood refer to the risk, that the association may be confounded by depression and low self-esteem [24, 25,26]. Empirical observations corroborate the belief that children with secure attachment are better in dealing with negative emotions and their eating regulation [23,25,26]. As far as a secure attachment is, concerned parents and their style of education play a major role in socializing children's self-regulation and energy intake [27].

A meta-analysis of parent-child relationship and general parenting showed - by means of 156 studies – an association between a higher level of parental

responsiveness and a positive parent-child relationship with lower weight [28].

Family problems and negative life events increase the risk of obesity and overweight (Lumeng, Gannon, Cabral, Frank, & Zuckerman, 2003). Negative life events are associated with poor sleep, child behavioral problems, stress, and changes in metabolism, increased food consumption and reduced self-regulatory capacity [29].

Social factors

Obese children suffer from a higher risk of stigmatization and peer victimisation – that also has an impact on social, psychological and behavioral functioning [30].

The association of overweight and obesity with peer relationship problems is not surprising-given the fact of stigmatization and victimization [31,32].

Method

A systematic literature search in the most important databases PsycINFO, Wiley Online Library, Web of Science and Pubmed has been implemented with the help of individual search terms such as „preschool“ AND „overweight“ OR „obesity“ according to PRISMA guidelines [33]. Additionally, a manual search of relevant references was implemented. Studies, which were peer-reviewed, published in the last five years (2011–2016), and written in German or English, were included. In addition, the following inclusionary criteria were required:

The sample consists of preschool children, which is defined as children who were not yet in school and typically between the ages 3 to 6.

Studies focused on psychosocial factors at the individual, family and social factors.

A direct relationship between weight status and psychosocial factors was examined.

Exclusionary criteria were:

Clinical studies (such as those focused on clinical eating behavioral problems, like picky eating, binge eating, food neophobia ...), clinical subgroups within interventional studies, or studies focused on parental mental health.

Biological risk factors, such as cognitive and temperament factors, because these are inherent and

within behavioral prevention and intervention measures less modifiable.

Results

Figure 2 describes the process of article selection. The literature research yields 8472 hits (only journal articles, no books) from four databases: Wiley Online Library (n=1462), PsycINFO (n=138), Pubmed (n=5273), Web of Science (n=1599). The search for relevant information and further sources reveal 25 additional hits.

8472 abstracts were screened according to the inclusion criteria (preschool children, socioecological factors, and direct relationship to the weight status). 8405 studies were excluded and 92 articles passed the selection process. According to the duplicate removal and full-text screening a total of 27 articles were taken into account.

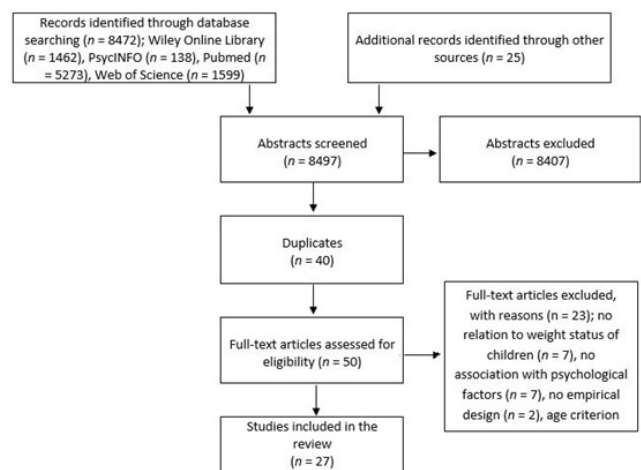


Figure 2: Search history

The included studies were divided into three domains: individual factors (n=22; body perception, n=4; eating regulation, n=11, behavioral/emotional problems, n=7), family factors (n=4; attachment, n=2; family problems and adversity, n=2), and social factors (n=5; stigmatization, n=3; peer relationships, n=2). Four studies examining two domains were included.

The majority of studies had a cross-sectional (n=22) or longitudinal design (n=3). Two studies combined cross-sectional and longitudinal study designs. Most studies took place in the US American area (n=14), followed by Europe (n=9; Asia, n=2 and Australia, n=2). The study’s sample sizes range from 17 (Broome & Brugess, 2012) to 11 202 probands (Griffiths, Dezateux, & Hill, 2011).

Gender relations were mostly balanced, with differences in the number of girls and boys usually less than 10% (n=27). Only three surveys displayed larger variations ranging between 20% and 30%.

Body perception

Body perception was examined in four studies and the results mostly support children’s early self-

awareness about their body size and their desired social standards. Results indicate that body dissatisfaction can already be detected among preschool aged children and body perceptions are influenced by gender, weight status, and parent’s expectations regarding thinness.

Table 1: Body perception

Author(s)	Data, sample size, sex	Location, structure	data	Measure anthropometric data, BMI by definition	Measure body perception	body Results
Broome & Burgess, 2012	Children aged 4–5 years, n=17, 65% female, 35% male	Indiana, pilot study		Weight and height assessed within the study, Centers for Disease Control and Prevention (CDC)	Body satisfaction was assessed using a Figure Rating Scale	Children correctly identified the body shapes representative of someone who is overweight (100%) and underweight (53%).
Jenull & Salem, 2015	Children aged 3–6 years, n=319, 47% female, 53% male	Austria, cross-sectional Study		Weight and height assessed by doctors in a medical check-up, age- and sex-specific BMI percentiles.	Body satisfaction was assessed using a Figure Rating Scale	22% of preschool children were satisfied with their bodies. 43% selected a thinner and 36% a fatter ideal figure. Boys ($\chi^2=13.418$, $df=6$, $p=.037$) and younger children ($\chi^2=31.917$, $df=12$, $p=.001$) often chose a more corpulent figure as ideal.
Tremblay, Lovsin, Zecevic, & Lariviere, 2011	Children aged 3–5 years, n=144, 47% female, 53% male	United States, cross-sectional Study		Weight and height assessed within the study, CDC	Concepts of body image was assessed using a Figure Rating Scale	Overweight children ($\chi^2=[1, N=144]=9.0$, $p < .01$) and their parents ($\chi^2=[1, N=144]=34.9$, $p = < .0001$) underestimated the child’s body size. Normal weight girls were less satisfied than overweight girls ($\chi^2=[1, N=144]=5.05$, $p=.03$)
Wong, Chang, & Lin, 2013	Children aged 4–6 years, n=699, 54% female, 46% male	Taiwan, sectional Study	cross-	Weight and height assessed in school, Taiwan Department of Health	Body satisfaction was assessed using the Figure Rating Scale by children, parents and teachers	If caregiver hoped that the child would be thinner, 58% of the children wanted to be thinner and 31% wanted to keep their weight. Contentedness with the child weight, 40% wanted to be thinner and 38% wanted to keep their weight (χ^2 ; $p < .0001$)

All four surveys used Figure Rating Scales, which showed images of females/males ranging from underweight to obese. The results show, that the ideal of a thin body is highly valued among the youngest generation of our society. With the exception of a pilot study (Broome & Burges, 2012) 40% to 58% of preschool aged children desired a thinner body [34,36,37]. If parents are dissatisfied with their children’s weight status, 2/3 of these children wanted to be thinner as well [37].

Regarding gender differences, Tremblay et al. (2011) found out those girls are more likely dissatisfied with their bodies [38]. One possible explanation for those gender differences could be the fact, that boys associate a larger body size with being muscular. Jenull’s study (2015) showed the desire of boys and younger children to have their dream body with a thicker silhouette because thicker in this case is associated with stronger and/or older.

Jenull et al. (2015) as well as Wong et al. (2013) claim a limitation of their studies in a rural or urban area – therefore the studies outcome is not representative for the remaining population [36, 37].

Broome and Burges (2012) pilot study was limited by a smaller sample. Racial and gender differences could therefore not be examined, furthermore the outcome’s generalization were thereby limited as well [34]. The authors discussed the effect of the children’s self-evaluation report and reliability. Yet the questionnaire tool used in the study was not tested for their validity and reliability.

Eating regulation

Eating regulations that are related to children’s weight status are subject to intensive research while researching 11 surveys could be found.

Table 2: Eating regulation

Author(s)	Data, sample size, sex	Location, structure	data	Measure anthropometric BMI by definition	data,	Measure regulation	eating	Results
Bergmeier, Skouteris, Horwood, Hoooley, & Richardson, 2014	Children aged 2-5 years, n=201, 58% female, 42% male	Australian, cross-sectional prospective study	cross- and	Weight and height reported by CDC	and height by mothers,	Child Behavior Questionnaire (CEBQ)	Eating	Enjoyment of food was associated with child’s BMI ($\beta=.29, p < .01$) at t1 but not for t2
Braungart-Rieker, Moore, Planalp, & Lefever, 2014	Children aged 3-6 years, n=40, 50% female, 50% male	United States, pilot study	pilot	Weight and height assessed by a female experimenter, CDC		CEBQ		Children who scored higher in food approach had higher BMIs ($r=.49, p < .001$)
Cross, Hallett, Ledoux, O’Connor, & Hughes, 2014	African American children aged 4-5 years, n=140, 53% female, 47% male Hispanic children aged 4-5 years, n=159, 49% female, 51% male	Caucasian, cross-sectional study	cross-	Weight and height assessed by trained staff members, CDC	and height	Observation parent-child interactions in home visits Child Feeding Questionnaire (CFQ)		In African American children satiety responsiveness mediated the association between pressure to eat and children’s weight (B (SE)=-0.073 (0.036), $P < .05$)
Domhoff, Kaciroti, Miller, & Lumeng, 2015	Children aged 3-4 years, n=1002, 51%	United States, cross-sectional study	cross-	Weight and height assessed by research assistants, CDC	and height	CEBQ		Food responsiveness ($r=.10, p < .01$), emotional overeating ($r=.08, p < .05$) and

	female, 49% male					enjoyment of food ($r=.18$, $p < .01$) were positively correlated with child's BMI z-scores. Satiety responsiveness ($r=-.18$, $p < .01$), slowness in eating ($r=-.16$, $p < .01$), emotional undereating ($r=-.08$, $p < .05$), and food fussiness ($r=-.07$, $p < .05$) were negative correlated
Frankel et al., 2014	Children aged 3-5 years, n=296, 51% female, 49% male	United States, cross-sectional study	Weight and height assessed within the study, CDC	CEBQ		Satiety ($F[2,291]=7.19$, $p < .001$), food responsiveness ($F[2,289]=6.16$, $p < .01$), and enjoyment of food ($F[3,290]=8.43$, $p < .001$) were associated with higher weight
Hughes, Power, O'Connor, & Fisher, 2015	Children aged 4-6 years, n=187, 48% female, 52% male	United States, cross-sectional study	Weight and height assessed by staff, CDC	CEBQ Observation and parent report to measure child eating beyond satiation snack-time to assess eating in absence of hunger.		Child eating self-regulation was positively associated with eating in the absence of hunger ($r=.20$, $p < .01$ and food responsiveness ($r=.15$, $p < .05$); a negative correlation was found with satiety responsiveness ($r=-.24$, $p < .01$)
Jansen et al., 2012	Children aged 4 years, n=4987, 50% female, 50% male	Netherlands, cross-sectional study	Weight and height assessed by trained staff, Dutch reference curves	CEBQ, CFQ		Enjoyment of food ($r=.155$, $p < .001$), food responsiveness ($r=.219$, $p < .001$) and restriction ($r=.087$, $p < .001$) were positively associated with mean BMI; Fussiness ($r=-.079$, $p < .001$), satiety responsiveness ($r=-.236$, $p < .001$), emotional undereating ($r=-.102$, $p < .001$) and pressure to eat ($r=.186$, $p < .001$) were negatively related
Leung et al., 2015	Children aged 4-6 years, n=379, 50% female, 50% male	United States, longitudinal study	Weight and height (at 4, 5 and 6 years) assessed by trained research assistants, CDC	CEBQ		Food responsiveness and enjoyment of food, were associated with higher BMIs, food responsiveness ($\beta=.21$, $p < .001$), and

					enjoyment of food ($\beta=-.27, p < .001$)	
Mackenbach et al., 2012	Children aged 3-4 years, n=3137, 50% female, 50% male	Netherlands, population-based cohort		Height and weight repeatedly assessed during regular visits to the Child Health Centres, Dutch reference curves	CEBQ	Positive correlations between BMI and food responsiveness ($r=.22, p < .01$) as well as enjoyment of food ($r=.16, p < .01$). Negative correlations were found with higher levels of satiety responsiveness ($r=-.24, p < .01$), fussiness ($r=-.07, p < .01$), and emotional undereating ($r=-.10, p < .01$)
Remy, Issanchou, Chabanet, Boggio, & Nicklaus, 2015	children aged 3-6 years, n=236, 46% female, 54% male	France, experimental study		Weight, height and waist circumference assessed by medical doctors, reference data	Observation of eating in absence of hunger during three sequential settings (lunch, preload and lunch, lunch and post-meal snack)	Eating in absence of hunger was not related to z-BMI or waist circumference
Spence, Carson, Casey, & Boule, 2011	Children aged 4-5 years, n=1730, 49% female, 51% male	Canada, cross sectional study		Weight and height assessed by trained health assistant, CDC	CEBQ	Positive associations between BMI and food responsiveness (F 23.26, $p < 0.01$), enjoyment of food (F 17.51, $p < 0.01$) and emotional overeating (F 6.19, $p < 0.01$); negative associations for satiety responsiveness (F 26.32, $p < 0.01$), slowness in eating (F 17.57, $p < 0.01$), and food fussiness (F 5.27, $p=0.01$)

The most commonly used survey instrument was the Child Eating Behavior Questionnaire (CEBQ) (n=10). The CEBQ covers eight scales (food responsiveness, enjoyment of food, emotional overeating, desire to drink, satiety responsiveness, slowness in eating, emotional underrating, and fussiness), which however were not used consistently. The CEBQ was combined twice with an observation and another two times with the CFQ (Child Feeding Questionnaire) [39,40,41]. Only one experimental study focused on eating in absence of hunger using observations within three sessions [42].

Positive correlations were found in six interdisciplinary surveys concerning the weight status from children and enjoyment of food [41,43-46]. Bergmeier et al. (2014) also confirmed a significant interdisciplinary context between child enjoyment of food and child BMI, but this association changed over time (from t1 to t2 [47].

Furthermore, food responsiveness was associated positively in six studies with a higher BMI of preschool aged children [40,41,43-46]. A pilot study of 40 children showed a relation between higher food approach scores and the weight status [48]. A longitudinal study confirmed a positive

context between food responsiveness, enjoyment of food and a higher BMI range (Leung et al., 2015). Additionally, emotional over-eating showed a positive overall correlation with a higher BMI [43,46].

Hughes et al. (2015) found out the positive correlation between BMI and child eating self-regulation. It showed, that eating in absence of hunger was associated with self-regulation, e.g., delay of gratification. Remy et al. (2015) on the other hand could not find a relation between eating in absence of hunger and children’s BMI or the waist circumference - however comparing girls and boys eating in absence of hunger was more developed for the boys [42].

Satiety responsiveness and children’s weight status showed a negative correlation in five studies [40,41,43,45,46]. By contrast, Frankel et al. (2014) found positive associations between satiety and higher weight. Cross et al. (2014) could not verify a relationship between appetitive characteristics of the child and child weight – however showed that a greater maternal restriction predicted a higher responsiveness to satiety and satiety responsiveness mediated the association between children’s weight and pressure to eat, whereas pressure to eat was associated with children’s weight status [44,49].

The studies limitations concerning the eating regulations are relevant for the studies sample size and design. Due to Remy’s large sample, a survey concerning the interaction between parents and

children’s feeding by video recording could not be implemented [42]. Frankel et al. summarized normal and underweight children – according to that fact, no statement about underweight children can be made [44]. The presented studies focus on homogenous samples, e.g. low income (Frankel et al., 2014; Leung et al., 2015), mothers with upper incomes and education, lack of multiple ethnicities (Hughes et al., 2015) – therefore the results are non-transferable [40,44,47,49].

Mackenbach et al. implemented a nonresponse analysis and showed some selective attrition under-representation of children from low socioeconomic background [44]. Also Bergmeister et al. and Jansen et al. described a selective response [42,47]. Remy et al. (2015) noted a limitation about a subject design and three sessions within his analysis that lead to a boredom effect [42].

Cross et al. noted that the CFQ is an insufficient culturally sensitive questionnaire [39]. The CEBQ requirements when read aloud in the study of Domhoff et al. (2015) could have influenced the results while participants were more or less likely to endorse certain behaviors due to social desirability bias [43].

Behavioral/emotional problems

Seven studies analysed behavioral/emotional problems and the association of overweight or obesity in preschool children.

Table 3: Behavioral/emotional problems

Author(s)	Data, sample size, sex	Location, structure	data	Measure anthropometric data, BMI definition	Measure behavioral/emotional problems	Results
Griffiths et al., 2011	Children aged 3 and 5 years, n=11202, 50% female, 50% male	United Kingdom, cross-sectional and longitudinal study		Weight and height assessed by trained interviewers at 3 and 5 years, IOTF (International Obesity Taskforce)	Behavioral/emotional problems were assessed using the SDQ at age 3 and 5 years	Overweight boys showed higher scores for conduct problems, hyperactivity, inattention, total difficulties and emotional problems. Overweight girls scored higher for total difficulties and peer relationship problems

Hughes et al., 2015	Children aged 4-6 years, n=187, 48% female, 52% male	United States, cross-sectional study	Weight and height assessed by trained staff, CDC	Self-regulation (executive functioning) was observed using the Flexible Item Selection Task and the Tapping Task. Emotional regulation was assessed by observing the gift delay tasks and the delay of gratification.	The results show no correlations with Child BMI z-scores and self-regulation variables
Mackenbach et al., 2012	Children aged 3-4 years, n=3137, 50% female, 50% male	Netherlands, population-based cohort	Height and weight repeatedly assessed during regular visits to the Child Health Centres, Dutch referencecurves	Behavioral problems were assessed using the CBCL by mothers and fathers at age 3 years	The results show no significant associations with behavioral problems and a higher child BMI, but internalizing problem scores was associated with lower mean BMI
Nagata, Hagan, Heyman, & Wojcicki, 2015	Children aged 3 years, n=174, 51% female, 49% male	San Francisco, cross-sectional study	Height and weight were assessed at age three years within the study, CDC	Behavioral problems was assessed using the preschool CBCL (1½-5) by mothers	The results show no associations between obesity and pervasive developmental, affective, anxiety, and attention deficit hyperactivity problems
Pieper & Laugero, 2013	Children aged 3-6 years, n=29, 52% female, 48% male	United States, pilot study	Weight, height and waist circumference assessed by researchers, no information – BMI for age percentile	Emotional arousal was measured through affective Q-sensors via skin conductance. Teacher scored e.g., impulsive control CBQ reportet by parents	The results show negative correlations between BMI for age percentile and impulse control as well as between waist circumference and inhibitory control
Rollins, Loken, Savage, & Birch, 2014	Children aged 3-5 years, n=37, 65% female, 35% male	Pennsylvania, experimental study	Weight and height assessed by trained staff members, CDC	Parents report using the CBQ	There were no sign. correlations between inhibitory control and BMI
Suglia, Duarte, Chambers, & Boynton-Jarrett, 2013	Children aged 3 and 5 years, n=1589, 49% female, 51% male	United states, birth cohort study	Height and weight assessed by trained interviewers at age five years, CDC	Behavioral problems was assessed using the preschool CBCL at age five years	Externalizing behavioral problems were associated with obesity among boys and girls

Pieper and Laugero (2013) assumed that a reduced executive function (e.g., a lower self-regulation and a reduced capacity of emotion regulation) is

connected with an unhealthy eating behavior, which leads to emotional-based overeating [50]. In contrast, Hughes et al. outcomes showed

correlations amongst eating in absence of hunger, emotional, as well as self-regulation but no correlation between BMI and self-regulation variables [39].

As mentioned in the study of Hughes et al. (2015), Pieper and Laugero (2013) the CBQ as a parent-report was used to capture the inhibitory control on a cross functional basis of a further survey [40,50,51]. The author's evaluated children's behavioral response to parent's use of restrictive feeding practices and the risk for weight gain. Children with a lower inhibitory control had a higher food intake in response to restriction. No relations between inhibitory control and the children's BMI could be found.

The CBCL was applied as a parent report within three studies concerning behavioral problems relating to children's weight status. Mackenbach et al. found a correlation between, using a cross-sectional survey with 3137 preschool children, internalizing problems and higher levels of emotional problems with a lower BMI [44]. Nagata et al. (2015) found no correlations between obesity and psychological problems in Latino preschool children, using a smaller sample (n=174). As opposed to Suglia et al. (2013), who reported a correlation between externalizing behavioral problems and obesity.

Griffiths et al. found higher scores using 3-year-old obese boys in a cross functional survey for total difficulties, as well as peer relationships, hyperactivity and inattention and conduct problems [35].

At the age of 5 the outcomes with the same – furthermore obese boys showed a higher value for emotional problems. Obese girls at the age of 5 showed problems solely in peer relationships and

total difficulties. Longitudinal it only showed, that obesity at age 3 was predictive for peer relationship problems at age 5.

Pieper and Laugero and Rollins et al. both mention a small sample size as a limitation [50, 51]. This could lead to reduced power to detect individual differences in effects. Rollins et al. note, that there could be a discrepancy between the response behavior on restriction in preschool and parental home [51]. Preschool children could react differently on these restrictions, because of their knowledge about it, over a long period at home.

Suglia et al. (2013) claim the CBCL as a valid instrument to assess child behavioral problems, but it was not designed to measure specific behaviors associated with obesity, for example reward sensitivity or impulsivity [53]. Other factors that relate to social pressure should be taken into consideration. Emotional eating and emotional regulation is undocumented. The survey of physical activity and nutrition was also limited. Mackenbach et al. discussed the limitation of children from families with lower education and young mothers and their underrepresentation [45].

Furthermore, there was a lack of multiple ethnicities in Hughes et al. study. Rollins used samples from white families with high education and high income [40,51].

Another limitation was the survey of a given cultural sample and the fact, that the results are non-transferable on population elsewhere [52].

Attachment

Two studies focussed on children's' weight status and secure attachment.

Table 4: Attachment

Author(s)	Data, sample size, sex	Location, data structure	Measure anthropometric BMI by definition	Measure data, attachment	Results
Anderson & Whitaker, 2011	Children aged 24 months and their risk for obesity at 4 1/2 years of age, n=665, 49% female, 51% male	United States, longitudinal birth cohort study	Weight and height assessed during the child's home, age- and sex-specific percentiles.	Toddler Attachment Sort	The odds of obesity were higher for children with insecure attachment. Odds of obesity for children with

insecure attachment were 1.30 [95% CI, 1.05-1.62] times higher

Keitel-Korndörfer et al., 2015	Children aged 2-5 years (at commencement of the study), n=62, 58% female, 42% male	Germany, cross-sectional study	Weight and height assessed in laboratory, child's birth weight taken from the birth reports, age- and sex-specific BMI percentiles	Attachment Q-Set (AQS)	The attachment quality predicts child's BMI percentiles AQS total score on the BMI percentile of the child (B=-26.44, SE B=13.59, β =-.24, p =.03, one-tailed, R^2 =.06). That is, the lower the quality of the mother-child attachment the higher the BMI percentile of the child.
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Throughout both studies, correlations between insecure attachment and a higher BMI were found. Half of the respondents in Keitel-Korndörfer's study were obese mothers and their children showed a significant lower bonding security [7]. The authors note that decreased fitness affects the interaction with the child or they are ashamed of their own weight, which leads to mothers who cannot offer their children a secure base for explorative behavior. In a cross-sectional study in Germany, Keitel-Korndörfer and colleagues (2015) assessed 62 preschool children from 31 normal weight and 31 obese mothers and showed that attachment quality predicts child's BMI percentile [7].

Keitel-Korndörfer et al. justified the small sample size with expenses and time exposure [7].

Another possible source of errors could be missing's, so Anderson and Whitaker argued [54]. The authors noted a huge variety of potentially confounding variables has been controlled; a bias due to uncontrolled confounding or measurement cannot be excluded. In addition, too many variables, which could be part of the causal pathway between obesity and attachment security, lead to over controlled potential. Finally, they presume that the observation of attachment security

is not representative in only one day when it comes to a child's typical behavior.

Suglia and colleagues study's subject concerned the risk for obesity using maternal reports of intimate partner violence, maternal substance use and depressive symptoms, father's incarceration, food and housing insecurity [53]. The results show a correlation between more than one social risk factor and higher BMI scores for girls, but not for boys.

Although the death of a parent is the most stressful event in a child's life, the results don't show an association with an increased risk of overweight and the loss of a parent in preschool age [54].

Suglia's survey considered limited health behavior measures [53]. Eating and exercise habits could only be included in the five-year follow up study. Other factors, such as emotional or eating regulation were not captured. As a limitation of Li's study (2012) it is to say, that children were not asked about the characteristics of their bereavement experience, nature of bereavement, quality and bond to the deceased parent [54].

Family problems and adversity

Two studies analysed the correlation between weight status and family problems.

Table 5: Family problems and adversity

Author(s)	Data, sample size, sex	Location, structure	data	Measure anthropometric data, BMI by definition	Measure family problems	Results
Li et al., 2012	Children with bereavement by death of a parent during the first 6 years of life; exposed cohort, n=492, 50% female, 50% male; Unexposed cohort, n=45 909, 49% female, 51% male.	Denmark, population-based cohort study	birth	Weight and height assessed by school doctors and nurses, IOTF.	Death of a parent was asked about the Danish Civil Registration System.	Bereavement during the first 6 years of life was not associated with an increased risk of overweight (-0.03 [95% confidence interval [CI] -0.20 to 0.14]) or average BMI levels at 7-13 years (-0.01 [95% confidence interval [CI] -0.40 to 0.38])
Suglia et al., 2013	Children obtaining at age 3 and age 5, n=1589, 49% girls, 51% boys	United States, cohort study	birth	Weight and height assessed by trained interviewers when the child was 5 years old, CDC	On the basis of maternal reports when the child was 3 years old (father's incarceration, partner violence, maternal substance, etc.) a social risk score was assessed	More than one social risk factor increased the risk for obesity for girls (40.4% vs 31.8%, girls, p < 0.05)

Stigmatization

Three cross-sectional studies explored the role of stigmatization and overweight at preschool age.

Table 6: Stigmatization

Author(s)	Data, sample size, sex	Location, structure	data	Measure anthropometric data, BMI by definition	Measure stigmatization	Results
Holub, Tan, & Patel, 2011	Children aged 3-6 years, n=49, 43% female, 57% male	United States, cross-sectional study		Weight and height assessed within the study, age- and sex-specific BMI percentiles	Weight stereotypes were measured using a thin, average and obese figure from a Figure Rating Scale and ratings across five (negative and positive) adjective pairs	Children showed fewer positive adjectives for the average or thin figure. Older children rated the average figure more positively than younger children did. Children's BMI showed no association with their ratings

Kornilaki, 2014	Children aged 4-5 years, n=85 (average n=48, obese n=37), 51% female, 49% male	Greece, cross-sectional study	Weight and height assessed by a trained assistant, age- and sex-specific BMI percentiles	Stigmatization was assessed by choosing preferred playmate using a drawn figure (thin, average, obese). Additionally they picked a figure (drawn by professional; thin, average, obese) which presented positive or negative characteristics in 13 short stories	The obese figure was less chosen as preferred playmate. Normal weight as well as obese children addressed the positive attributes mostly to the thin and average figure, by the majority of children the negative characteristics were addressed to the obese figure
Spiel, Paxton, & Yager, 2012	Children aged 3-5 years, n=118, 60% female, 40% male	Australia, cross-sectional study	Weight and height was reported, age- and sex-specific BMI percentiles	Stigmatization was assessed using a Figure Rating Scale and questions about what child would be invited/not invited to a party and which child has the most/the least friends. Additionally they picked a figure (from thin to very large) which presented positive or negative characteristics in eight stories	Negative characteristics were addressed to larger figures. Age of the children has a low influence on attributions but not on BMI, the child's perceived body size or gender.

All of the three studies used drawn figures or figures of a rating scale for the children's interview.

This review's results show- despite different approaches -preschool children's preference of thin and normal weight peers as well as negative characteristics and attributions towards overweight and obese figures came to almost identical conclusions [55- 57]. Age played a role 5 year olds assigned negative characteristics significantly and more frequently to the larger figure compared to 3 year olds. With regard to children's own perceived body size the authors found out, that it is predictive for positive, but not for negative attractions. However, for the children the maternal preference (body image attitudes in this case) played a role for negative, as well as positive attribution. Holub et al. (2011) came to a similar conclusion, whereas the maternal fear of fat affected the children's negative attribution [55].

Holub et al. noted a limitation concerning the measurement of anti-fat attitudes influenced by social desirability [55]. Furthermore, mothers were not explicitly asked about beliefs toward

overweight adults but about people, therefore there is no difference between overweight adults and overweight children. Implicit attitudes were not measured. There is evidence, that parents' implicit attitudes are more predictive of children's early developing racial prejudice than explicit attitudes. Ethnic differences could not be evaluated according to the small sample size.

Kornilaki (2014) adhere to the statement that children were grouped according to their BMI, but were not asked about their perceived body size [56]. Children could misjudge their body weight and that would lead to a distortion of the results since they didn't identify with their respective weight group. Spiel's survey (2012) showed an underrepresentation of children with a higher BMI and the participants mainly came from higher socio-economic areas which reduce the generalization of results [57]. Measurement of child attitudes, making a forced choice about a figure may not necessarily mean that a child would attribute this fact towards a real person.

Peer relationships

Solely two studies dealt with peer problems within the elected age group relating to preschool children and their weight status.

Table 7: Peer relationships

Author(s)	Data, sample size, sex	Location, structure	data	Measure anthropometric data, BMI by definition	Measure esteem and satisfaction	body and	Results
Griffiths et al., 2011	Children aged 3 and 5 years, n=11 202, 50% female, 50% male	United Kingdom, cross-sectional and longitudinal study		Weight and height assessed by trained interviewers at 3 and 5 years, IOTF	Peer relationship problems was assessed using the SDQ by parents at 3 and 5 years		Obese boys at age 3 and 5 years, as well as obese 5 years old girls had more peer relationship problems than normal weight children.
Pérez-Bonaventura, Granero, Ezpeleta, 2014	Children at age 3 years (n=611), 4 years (n= 596) and 5 years (n= 564), 50% female, 50% male	Spain, cross-sectional and longitudinal study		Height and weight assessed by nurses, WHO reference curves	SDQ, conduct problems scale by parents report		Cross-sectional the results show a significant association between higher mean scores for peer relationship problems and overweight at age 5 years. Higher BMI z-scores were associated with conduct problems and low prosocial behavior scores at age 4 years. Higher BMI z-scores at age 3 years predicted more peer relationship problems at age 4 and 5 years

Griffiths et al. (2011) cross-sectional analyses showed that obese boys compared to normal weight boys at the age of three demonstrate more peer and conduct problems whereas girls reached more mean scores for prosocially behaviors [35]. At the age of five peer problems could be found for both genders. The longitudinal study demonstrates that obesity at age 3 for boys is a good predictor for peer problems at age 5. Beyond this, emotional and behavioral problems are seen as particular risk factors for boys at that age.

In addition, Perez-Bonaventura and colleagues found a correlation between overweight and peer relationship problems. Longitudinal aspects argued

that a higher BMI at age 3 predicted more peer relationship problems at age 4 and 5 years [50].

As a limitation it should be noted, that the SDQ is a reliable and valid instrument though based on parents statements. This may lead to an over- or underestimation compared to children’s self-assessments. A possible bias could be parents’ childhood memories relating to their own weight history transferring these memories to their children. Gender stereotypes could distort the results as well. Stigmatization, victimization and the predominant ideal of beauty should be associated with peer relationships as a moderating variable.

Discussion

This review integrates the various risk factors for childhood obesity into three levels with relevance for prevention planning.

Individual factors

Body perception studies showed that very young children already judge their bodies in an accurate way. Empirical results are interesting because of the fact that overweight children as well as their parents underestimate the children's body size. This misjudgement could also be found in a large-scale study of parents with 2-5 year old children from 1988 to 1994 and 2007 to 2012. Familial influences, environmental factors, mediation of body ideals play a major role for young people and are in need of serious attention.

Intervention and prevention programs should make body satisfaction and body esteem a subject of discussion in those early ages. Furthermore, it would be important for parents and educators to think critically on their own body weight concept; because primary caregivers could pass their own concepts to their children and a healthy body size concept affect the eating behavior, weight and health.

The findings to eating regulation refer to a context amongst food responsiveness, enjoyment of food and a higher BMI. Emotional over-eating and eating self-regulation were less often associated with a higher weight status. Negative relations concerning the BMI level were especially associated with satiety responsiveness. A very interesting connection shows parental restriction that affects satiety responsiveness. Hughes et al. (2015) found out, that higher levels of satiety responsiveness are linked with lower weight and high levels of emotional regulation [40].

To avoid overweight and the prevention of gaining weight affects the self-regulation capability of the childish food intake. Parents are key figures during infantile development. Besides model effect concerning healthy food, especially all areas of the self-regulation capability. When it comes to overweight there are hints that show parent's reaction to their children food intake. Whenever food is used as a punishment or a reward, it affects the self-regulation capability of a child's energy intake.

In the future, it would be important to examine different eating behavior dimensions and their overlaps, as well as interdependencies and interactions more precisely. Higher values concerning food responsiveness and enjoyment of food could be cancelled due to a higher satiety responsiveness. Studies should take a closer look at ethnic/racial differences concerning feeding habits. Eating practices over time should also be examined and evaluated.

Little evidence was found for a relationship between behavioral/emotional problems and overweight concerning preschool aged children. Externalizing behavioral problems – as opposed to internalizing problems – are related to weight gain [35,45,52,53].

Another three studies analysed self- and eating regulation according to the risk of a higher BMI. It showed a correlation between a lower impulse control and a higher weight status. The results document, that the child eating self-regulation is associated with the emotional regulation (which expresses itself through an unhealthy eating behavior) [40,50,51].

Early deficiencies in self-regulation and externalizing problems show a higher risk in developing weight problems in preschool age and should be examined more precisely. A successful self-regulation contributes to a positive self-effectiveness and plays a major role in the eating regulation. To prevent unhealthy eating behavior it is important to detect behavioral and emotional problems in early years.

Family factors

Attachment security presents a mental and emotional resource. Throughout both studies presented here, insecure bonds claim a higher risk for overweight and obesity. On a critical note, it must be pointed out that the interview and the observation of mothers could be biased and may not reflect the typical daily bonding situation.

Overall, attachment security is paid little attention up to now.

Previous studies refer to a direct bonding effect concerning the dissatisfaction of one's own body and an indirect eating behavior effect [20,21]. A long-term study analysed the influence of an early mother-child-bond on the risk of obesity in young

age [58]. The results show a correlation between an insecure attachment and a higher risk of overweight. Additionally, the authors described a cumulative effect between poor maternal-child relationship and an insecure bond that leads to a higher risk of obesity. Further research projects should also focus on fathers, grandfathers and other attachment figures because it is assumed that relationships with adults are either protective or represent a risk.

For parenting styles for this review no study was enclosed. Sleddens, Gerards, Thijs, de Vries, and Kremers (2011) review showed for infants, toddlers, pre-schoolers, school-aged child's, or adolescent with an age below 18 years, that children from authoritative homes had a lower BMI, were eating healthier and were more active compared to children from authoritarian, permissive/indulgent, uninvolved/neglectful parenting style homes [59].

Hancock, Lawrence, and Zubrick found in a long-term study, that motherly protectiveness could lead to a risk of overweight at the age of 10 to 11, but not for younger children [60]. "Overprotective" defines a parenting behavior, where parental monitoring prevails unlike an independent childlike behavior and the separation of a child causes problems. The relations between a higher weight and highly protective parenting could result from limited motion behavior because of overprotectiveness but also from mothers who react differently when it comes to food preferences.

Highly protective parenting, such as indulgent and uninvolved parenting and feeding styles were stated a risk factor. Cross-sectionally it was shown that feeding practices at children aged 4–12 years old such as pressure to eat and restriction were linked to BMI most strongly, whereas longitudinal parenting style was the strongest and most consistent association with child's BMI [61].

The studies to family problems show, that violence, neglect, abuse etc. increase the risk of overweight and obesity. Future studies should analyse the mechanism of association on growth trajectories of BMI in order to embed childhood education programs as well as prevention and intervention measures and to understand potential mediators and developmental mechanism. The possible higher risk of negative life events for children should also be taken into account.

Mental and physical consequences of life events on family members and important caregivers should be analysed more precisely. Finally yet importantly positive coping strategies should receive more attention in future studies.

Social factors

The stigmatization of overweight people is widely spread and well proven in numerous surveys. Preschool children hold children's negative perceptions towards overweight peers [62]. Positive characteristics are attributed to thinner or normal weight children -whereas negatives are attributed to overweight children [63]. This could hold unfavorable effects on the social development. Affected children fall victim to forms of peer aggression and victims of overt [30].

Sikorski, Luppá, Luck, and Riedel-Heller consider weight stigmatization and discrimination of overweight people as chronic stressor [64]. The authors analysed the influence on psychological well-being of children, adolescents and adults concerned and found a positive mediation through psychological risk factors on mental health outcome throughout all studies. The highest negative association was found relating to self-esteem in adults and children. At the same time, it leads from poorer psychological functioning to unhealthy weight-control strategies [30].

It would be important, that parents and early childhood educators provide protective factors for children in order to protect and prevent them from the negative influence of weight-based stigmatization and victimization. Negative body shape attitudes and stereotypes should be corrected in order to avoid stigmatization [62]. Therefore, prevention measures should not concentrate only on weight loss but address body satisfaction and the acceptance of diverse body shapes [65]. Future studies should include further influence factors, for example father's attitudes and negative stereotyping and media experiences.

The results of two studies, which analysed overweight/obesity in correlation with peer problems, concluded that, a higher weight status is related to peer relationship problems. As early as the age of 3, boys and obesity are linked with peer and conduct problems. At the age of 5 both genders are affected [35]. Longitudinal both studies found out, that a higher weight at the age of 3 predicted

more peer relationship problems at the age of 5 [35,66].

Prevention should focus on self-confidence and a reduction of stigmatization in order to reduce the misery of obese children. Further studies should focus on the relationship between affective disorders, emotional problems and behavioral problems of overweight and obese children. Relationships and friendships interact with the further development and could -in the event of overweight and obesity - have an impact or result in an affective disorder.

Limitations

The reported results give a first overview on the relevance of psychosocial factors influencing the risk of overweight and obesity in preschool age. The majority of selected studies analysed correlations within a cross-sectional design (n=22; there of 3 pilot, 2 experimental and 2 birth cohort studies), that do not allow causal relationships, mediation effects or bidirectional effects, directional associations or interpretations, and conclusions about changes and differences in the developmental course – therefore aetiological mechanisms could not be explained. Three of the studies used a longitudinal design and another two combined cross- and longitudinal designs (whereby the age category remained preschool age throughout all surveys concerning the interpretation of results).

Dropout rates and the sample size's representative status should be considered. Rural and urban studies do not show a generalization when it comes to population in other geographic areas. The same procedure applies with homogenous samples according to socio-economic characteristics.

There was a balanced gender ratio throughout the majority of surveys, therefore differentially affects between female and male pre-schoolers could be reasonably investigated, however the BMI data was defined by means of different guidelines. Few studies analyse musculature and body build. The sole use of the BMI leads to misclassifications because no information about the body-fat-distribution exists. Another opportunity could be other measures of body composition such as hydrostatic weighing or skin fold ratio. On a critical note, it must be pointed out that the physical

activity and eating behavior of children was often unconsidered.

The collection of psychosocial factors occurred in six studies through an investigation of children, 13 studies depended on parents' information and eight studies gathered their relevant aspects through a mix (children, parents and/or teachers, observation...).

Information based on parents' assumptions could reduce validation, which represents a known limitation of this type of research. Reporter bias contain a risk of over- or underestimating psychological problems. Mothers who are more aware in their children problems may also report more difficulties in eating behavior (Mackenbach et al., 2012). Social desirability could distort the results. Triangulation of different perspectives may provide a more complete picture of the psychological factors associated with child obesity (Griffiths et al., 2011).

However, refraction on external data seems necessary especially for the preschool age. On the one hand, there is a lack of high-quality survey procedures for children of that age and on the other hand, young children do not often have the opportunity to describe and rate their own intentions.

A meta-analysis could not be executed for various reasons. First, there was a big heterogeneity concerning the studies, whereby a statistical summary was not possible or reasonable.

Finally, it has to be noted, that this paper only includes publications from 2011 until 2016. Maybe unpublished work or articles from another database could lead to a more complete understanding of the current state of knowledge about the association between psychological factors influencing the risk for preschool overweight or obesity.

Conclusion

There are multiple risk factors and causes for childhood overweight/obesity. Prevention programs need to integrate these risk factors at the individual, family and social levels. To move forward in understanding child obesity, more longitudinal studies are needed which take into account developmental processes, gender differences, as well as differences in subgroups (e.g., based on ethnicity, geographic region).

Considering the young audience parental inclusion is mandatory. Not only feeding and exercise habits are influenced by parents, but also body image, body satisfaction, self-consciousness, media literacy and so on. Parents are role models and so they play an essential role with their parenting styles and communication patterns.

Prevention and intervention programs should include elements of all dimensions as defined by the bio psychosocial models. Psychological factors for example emotional competencies, a positive self-perception and self-esteem, should be drawn more attention. As mentioned before, prevention strategies should also include working with parents to improve parenting skills. Bonding security affects the ability to understand the child's needs and the reflective function. Therefore, we need interventions for both children and parents (mothers and fathers). This would have an impact on the child's potential to overcome pressure and regulate emotions in an adequate way.

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