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The Significance of Attachment Quality for Obesity: A Meta-Analytic Review

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Theoretical considerations and empirical results suggest that attachment quality is relevant to obesity. This study used meta-analytic methods to systematically examine the empirical, peer-reviewed evidence regarding the relationship between attachment quality and body mass index (BMI) in separate meta-analyses for children and adults. Relevant peer-reviewed literature published between 1990 and 2013 was obtained from PubMed, PsycINFO, and reference lists of included articles. Results of the meta-analysis for studies with *adults* indicated a small but statistically significant association between attachment quality and BMI (absolute value of weighted average $r = .05$, $p = .03$; 95% confidence interval, CI [.004 to .09]; number of independent studies [k] = 7; $N = 2{,}135$). Specifically, BMI was negatively associated with attachment security. Publication bias analyses did not demonstrate cause for concern about the results. Results of the meta-analysis for studies with *children* indicated a small association between attachment quality and BMI that fell just short of statistical significance (absolute value of weighted average $r = .08$, $p = .06$; 95% CI [−.004 to .16]; $k = 5$; $N = 8{,}602$). Several moderator variables were examined using the aggregated sample including both adults and children, but none of the analyses yielded statistically significant results. Possible explanations for an impact of attachment quality on obesity might involve the underdevelopment of emotion-regulation and heightened psychophysiological responsiveness, which point to avenues for future research.

Keywords: attachment, body mass index, BMI, meta-analysis, obesity

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Obesity is a complex global health problem, which has proven difficult to prevent and treat (James, 2008), and which also affects children. The worldwide prevalence of people classified as overweight or obese in both adults and children increased from 1980 to 2013 (Ng et al., 2014). The United States had the highest body mass index (BMI) of high-income countries (Finucane et al., 2011). Ogden, Carroll, Kit, and Flegal (2012) estimated the prevalence of individuals with overweight in the United States between the years 2007–2008 to be 68%, and the prevalence of obesity to be 34%. The aetiology of many chronic diseases including obesity involves not only genetic and current environmental factors, but also the way in which early repeated interactions with significant others results in enduring ways of reacting to stress and managing negative affectivity (Maunder & Hunter, 2001; McWilliams & Bailey, 2010). Problems with stress management and affect regulation have been repeatedly linked to obesity in both children and adults (Francis & Susman, 2009; Ozier et al., 2008). A theoretical framework that describes individual differences in affect regulation and dealing with stress based on early childhood experiences is attachment theory (Bowlby, 1982).

According to attachment theory, individuals internalize early childhood interactions with primary caregivers in enduring beliefs and expectations about how others behave toward the self and how

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one behaves toward others (Ainsworth, Blehar, Waters, & Wall, 1978; Bartholomew & Horowitz, 1991; Bowlby, 1982; Crowell, Fraley, & Shaver, 1999; Griffin & Bartholomew, 1994; Platts, Tyson, & Mason, 2002). These enduring expectations are referred to as attachment representations and are thought to be the mechanisms by which the influence of childhood experiences are sustained into adulthood (Bartholomew & Horowitz, 1991; Crowell et al., 1999; Griffin & Bartholomew, 1994).

In terms of affective—motivational characteristics, the two dimensions of (a) *anxiety* about rejection and abandonment and (b) *avoidance* of intimacy and interdependence are distinguished (Crowell et al., 1999) and can be combined to yield four categorical attachment styles—secure (low attachment anxiety and low attachment avoidance), preoccupied (high attachment anxiety), dismissing (high attachment avoidance), and fearful (high attachment anxiety and attachment avoidance; Bartholomew & Horowitz, 1991; Griffin & Bartholomew, 1994). Individuals with more attachment security have adaptive psychosocial skills and are capable of using a broad range of coping strategies in times of stress (Maunder & Hunter, 2001). Individuals high on attachment anxiety (i.e., preoccupied) are vulnerable and hypervigilant to threats, resulting in high levels of perceived stress and distress (Maunder & Hunter, 2001). They seek proximity to try and elicit increased attention and support from others, often to the point of being "clingy" in order to regulate their emotions (Brennan, Wu, & Love, 1998; Kobak & Sceery, 1988). Despite these strong desires for closeness and reassurance, research shows that social and emotional support is hardly effective in reducing their distress (George & West, 2001). By contrast, individuals high on attachment avoidance (i.e., dismissing) tend to dismiss symptoms of distress and vulnerability (Maunder & Hunter, 2009). They deal with stressors by distancing, avoiding and repressing negative emotions (Fraley & Shaver, 1997; Mikulincer & Orbach, 1995; Turan, Osar, Turan, Ilkova, & Damci, 2003; Vetere & Myers, 2002). More avoidantly attached individuals may deny their distress while showing considerable biological distress (e.g., increased blood pressure, heart rate variability; Maunder, Lancee, Nolan, Hunter, & Tannenbaum, 2006; Mikulincer & Florian, 1998). Individuals high on both attachment anxiety and attachment avoidance (i.e., fearful) show a mixture of both preoccupied and dismissing attachment patterns (Bartholomew & Horowitz, 1991). Although they may experience intense negative affect, their behaviour suggests that they would rather suffer than seek help (Ciechanowski, Katon, Russo, & Dwight-Johnson, 2002a; Ciechanowski, Walker, Katon, & Russo, 2002b).

Eating is one way in which insecurely attached individuals may deal with stress and regulate their affect. Problematic ways of dealing with stress and negative affectivity have been associated with emotional eating, the tendency to eat when experiencing negative affect, and with obesity (Elfhag & Linné, 2005; Fischer et al., 2007; Zijlstra et al., 2012). Insight into the association between attachment quality and obesity may help to determine who is at risk for obesity and to develop individualized prevention and intervention programs.

Therefore, in the present study we systematically reviewed the literature on the association between attachment quality and obesity (defined as body mass index). Separate meta-analyses were conducted for children and adults because of the differences in attachment between childhood and adulthood (Mikulincer & Shaver, 2007); children, for example, often have one primary attachment figure serving as the primary secure base, whereas adults may have multiple attachment figures.

For both children and adults, we expected positive associations between insecure attachment and obesity, and conversely, negative associations between secure attachment and obesity. Although we did not formulate specific a priori hypotheses about moderators, we examined the potential moderating role of several variables in exploratory analyses: gender of study participants (percentage male), methodological quality of included studies, assessment perspective (i.e., self-report vs. observer-based), whether a longitudinal design was used, and the particular attachment construct used (i.e., security vs. other, and attachment style vs. attachment-related behaviours).

Method

Study Eligibility Criteria

Selected articles covered any aspect of the relation between attachment—in both adults as well as children—and obesity, which were published in English between 1990 and 2013. The search terms did not include restrictions of study design or document types. Dissertations, however, were excluded from the meta-analyses, as recommended by Coyne, Hagedoorn, and Thombs (2011), who argued that methodological weaknesses that are often present in dissertations would result in biased estimates of effect sizes. As an example, a number of meta-analytic reviews have demonstrated an inverse association between methodological quality and effect sizes in studies of psychotherapy for depression (Cuijpers, van Straten, Bohlmeijer, Hollon, & Andersson, 2010; Thoma, McKay, Gerber, Milrod, Edwards, & Kocsis, 2012) and somatoform disorder (Koelen et al., 2014).

Search Strategy and Study Selection

A systematic search was implemented in the PubMed and PsycINFO databases. The search strategy included the following combination of key words/MeSH terms: "attachment" OR "relationship style" AND "obesity" OR "overweight" OR "body weight" OR "body mass index" OR "waist-to-hip ratio" OR "BMI" (see online supplementary materials, Table 1). Consistent with the study eligibility criteria, publication date and human studies limits were applied. Two of the authors (FA and CH) reviewed studies for eligibility for inclusion in the meta-analysis. Titles and abstracts were reviewed first, followed by full-text versions of identified records. Reference sections of included studies were also reviewed to identify other potentially eligible studies. The electronic searches yielded 350 articles in PubMed and 86 articles in PsycINFO, of which 421 articles remained after the removal of duplicates.

Obesity and Attachment Measures

For the evaluation of attachment styles, nine measures were used across the studies of children and adults, comprising both categorical and dimensional measures of attachment. We discuss below each of the attachment measures that were used in the studies included in the present meta-analysis.

Measures of adult attachment. The Relationship Questionnaire (RQ; Bartholomew & Horowitz, 1991) yields four descriptions of prototypical attachment patterns, as they apply in close adult relationships. The Attachment History Questionnaire (AHQ; Pottharst, 1990) provides self-report information about early attachment-related events and peer relationships. It has 51 items, with responses rated on 7-point scales, which assess the frequency and intensity of behaviours by attachment figures.

The Adult Attachment Prototype Rating (AAPR; Strauss, & Lobo-Drost, 1999) is a measure used to rate a semistandardized 1- to 2-hr attachment interview and determines a participant's attachment style. The Experiences in Close Relationships-Revised Scale (ECR-R; Fraley et al., 2000) is a 36-item, self-report measure of adult attachment, which requires participants to reflect on their typical ways of relating in close/romantic relationships.

Measures of child attachment. The Attachment Q-sort (AQS; Waters, & Deane, 1985) is rated by a judge based on approximately 2 hr of observation of a mother–child interaction. The data collector sorts 45 "cards" based on how well the behaviour described on the card applies to the mother–child interaction. From the AQS, a continuous measure of attachment security is derived, which ranges from −1 to 1, with higher values indicating a more securely attached child.

The measurement of attachment quality (MAQ; Carver, 1997), a 14-item, self-report measure of attachment orientation, has separate scales that assess secure attachment tendencies and avoidant tendencies, and two scales reflecting anxious (ambivalent) tendencies. Although it was originally designed as a measure of adult attachment, the study that used it in the present meta-analysis (i.e., Midei & Matthews, 2009) modified it for use with adolescents by revising the language of several items.

The Inventory of Parent and Peer Attachment-Revised version for Children (IPPA-R; Gullone & Robinson, 2005) is a 28-item child self-report questionnaire measuring the quality of attachment to parents (and peers) and how well they serve as a source of psychological security. The Security Scale (SS; Kerns et al., 1996) is a self-report questionnaire that measures attachment toward a participant's mother and father.

Assessment of Study Quality

The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses was used to assess the quality of the observational studies (Wells et al., 2011). This scale provides a summary score that ranges from 0 to 10 that assesses (a) selection method of participants; (b) comparability (i.e., degree of similarity between participants in the different groups and controls for confounds); and (c) outcome. Quality of the included studies was assessed independently by two of the authors (FA and CH). The final score was determined on the basis of consensus (the Appendix in the online supplementary materials provides details on the quality assessment and scoring system that was adapted from the NOS for the present meta-analysis). No attempts were made to mask the authorship, journal name, or author institutional affiliation for the studies.

Calculation of Effect Sizes

An effect size *r* was calculated for each study. If the particular study reported a Pearson correlation coefficient, this was used as the effect size. Standard meta-analytic calculations were used to obtain *r* when studies reported (a) data in a 2 × 2 format (frequencies of obesity for secure vs. insecure participants), (b) odds ratios, or (c) means, *SD*s, and samples sizes (Borenstein, Hedges, Higgins, & Rothstein, 2005, 2009). Effect sizes were assigned a positive value if they were consistent with the a priori predictions, and a negative value if they were inconsistent with the a priori predictions.

To correct for the skewed distributions of *r,* all effect sizes were converted into Fisher's *Z* of *r* (Borenstein et al., 2009). Data analyses were conducted on these Fisher's *Z* of *r* transformations and then converted back into *r*, following standard meta-analytic procedures (e.g., Borenstein et al., 2009; Lipsey & Wilson, 2001). Several studies reported only adjusted β coefficients, in which case we contacted the authors to obtain the zero-order Pearson correlations for the associations between attachment and BMI. No studies had to be excluded because of unavailable data.

In most cases, calculation of effect sizes was straightforward. One exception involved the study of D'Argenio, Mazzi, Pecchioli, Di Lorenzo, Siracusano, and Troisi (2009; A. Troisi, personal communication, March 5, 2015) that reported relevant data for three different groups of participants: (a) nonobese participants, (b) obese participants with no current or past psychiatric disorders, and (c) obese participants with current psychiatric disorders. These groups of participants were treated as independent samples in the present meta-analysis. Another exception was the study by Hintsanen, Jokela, Pulkki-Raback, Viikari, and Keltiangas-Jarvinen (2010), which presented two sets of data, each of which had four effect sizes. In the first set of data, the authors provided four correlations between BMI and attachments ratings collected during adulthood. These data were included in the present meta-analysis. The second set of data-the correlations between BMI measured in childhood/adolescence and attachment ratings during adulthood-were excluded in our study because they were not relevant to our study hypotheses.

Effect Size Aggregation

To meet the statistical assumption of independence required for meta-analysis, multiple effect sizes in a single study (e.g., at different time points, or for different subscales of one attachment measure) were averaged, following standard meta-analytic convention (Horvath & Symonds, 1991; Martin, Garske, & Davis, 2000). Effect sizes were aggregated *across* studies using the random effects method (Hedges & Vevea, 1998). Random effects methods are considered to be more representative of (National Research Council, 1992), and generalizable to, real world data than their fixed effect counterparts (Hedges & Vevea, 1998). All analyses for the present study were performed using version 2 of Comprehensive Meta-Analysis software (Borenstein et al., 2005). Two-tailed *p* values were used, unless otherwise stated.

Publication Bias Analyses

Some critics have argued against the validity of meta-analyses generally, claiming that meta-analyses include only studies that have demonstrated positive findings, whereas negative findings get relegated to their experimenters' file drawers (Rosenthal, 1991). To address this argument, a series of analyses were conducted to examine

the potential for publication bias: (a) Sterne's funnel plot display analysis (Sterne & Egger, 2001; Sterne & Harbord, 2004); (b) Begg and Mazumdar's (1994) rank correlation; (c) Egger's regression intercept (Egger, Davey Smith, Schneider, & Minder, 1997); and (d) Duval and Tweedie's (2000a, 2000b) trim and fill procedure. Given the small number of studies in the present meta-analysis and the inclusion of only published studies, we took a conservative approach by conducting each of these four publication bias analyses.

Moderator Analyses

Categorical moderators. In our categorical moderator analyses, studies were divided into subgroups, and differences in effect sizes between the subgroups were examined for statistical significance using the $Q_{between}$ statistic. Dichotomous moderator variables were created for "self-reported attachment" (yes/no), "longitudinal data" (yes/no), and "attachment construct" (security/other; "security" included a dimensional measure of secure attachment or comparison for secure vs. insecure participants; all other data were coded as "other").

These categorical moderator analyses were conducted using Q tests as an analog to analysis of variance in primary research. When a subgroup for a categorical moderator included less than six studies (cf., Borenstein et al., 2009), we generally pooled the values for weights across all of the categorical subgroups, because pooling relevant weights is likely to yield more accurate results than calculating separate weights for the different subgroups (Borenstein et al., 2009). Each level of the moderator variable (i.e., security and other in the case of the attachment construct moderator, and "longitudinal" and "cross sectional" in the case of the study method moderator) was treated as independent of each other in order to be conservative (M. Borenstein, personal communication, January 1, 2010).

Continuous moderators. Continuous moderator analyses were conducted using mixed effects (method of moments) meta-regression analyses that examined the relation between effect sizes for each study and continuous moderator variables (Borenstein et al., 2009). Meta-regression analyses examined whether study quality, gender, or age moderated the relation between attachment and BMI. Age was defined as participants' age at the time of BMI measurement. In the case of one study (Midei & Matthews, 2009), the ages of participants varied for several of the different effect sizes. Consequently, this study was excluded from this moderator analysis.

Results

Characteristics of Included Studies

For the meta-analysis of adults, seven independent studies—taken from five publications—met the inclusion criteria and were included in this review. These studies included a total of 2,135 participants, with a median number of 85 participants (see Tables 2 and 3 in the online supplementary materials for details of the characteristics of the included studies). All seven studies were cross-sectional. Six of the seven studies used self-report measures of attachment, and one study (Kiesewetter et al., 2012) used an observer rating of attachment.

For the meta-analysis of children, five independent studies met the inclusion criteria and were included in this review. These studies included a total of 8,602 participants, with a median number of 601 participants (see Tables 4 and 5 in the online supplementary materials for details of the characteristics of the included studies). Two studies were longitudinal, two were cross-sectional and one contained both longitudinal and cross-sectional data. Three studies used self-report measures of attachment, and two studies used observer ratings of attachment.

Weighted Mean Effect Size for the Association Between Attachment Quality and Obesity

Results of the meta-analysis for studies with *adults* (see Table 1; see also Figure 1 in the online supplementary materials) indicated a small (Lipsey & Wilson, 2001; cf., Cohen, 1988) relation between attachment quality and obesity that was both statistically significant and consistent with the a priori hypotheses of the meta-analysis (weighted average $r = .05$, $p = .03$; 95 % confidence interval, CI [.004 to .09]). The data indicated that higher BMI was associated with lower attachment security and/or higher attachment insecurity. Conversely, lower BMI was associated with higher attachment security and/or lower attachment insecurity. In examining the variation in effect sizes across the different studies, the data were not demonstrably heterogeneous ($Q[6] = 1.67$ $p = .95$ [one-tailed]), and the percentage of total variation observed that can be attributed to real differences in effect size—rather than random variation—was zero ($I^2 = 0.00$).

Results of the meta-analysis for studies with *children* (see Table 2; see also Figure 1 in the online supplementary materials) indicated that the relation between attachment quality and obesity fell just short of statistical significance (weighted average $r = .08$, $p = .06$; 95 % CI [−.004 to 16]). Although the direction of the weighted mean effect[1] indicated, as in adults, a negative association between BMI and attachment security, the association fell just short of statistical significance and precludes rejection of the null hypothesis. The variation in effect sizes across the studies indicated heterogeneity that was statistically significant ($Q[4] = 15.44$, $p = .004$ [one-tailed]), and the percentage of total variation observed ($I^2 = 74.09$) that can be attributed to real differences in effect size—rather than random variation—fell in the high range (Higgins, Thompson, Deeks, & Altman, 2003).

Post hoc Analyses

Given the substantial heterogeneity of effect sizes in the studies of children, we conducted post hoc analyses to examine if the underlying attachment construct differed between studies based on the specific measures that were used, i.e., whether results varied based on use of a measure of "attachment style" versus "attachment-related behaviours."

Results indicated that the contrast between these two types of underlying attachment constructs was not statistically significant ($Q[1] = 0.004$, $p = .95$). In addition, the meta-analytic results of these two types of attachment constructs were virtually identical;

[1] As detailed in the Method section, all original data that demonstrated a negative correlation between attachment security and body mass index (BMI) were coded as positive, indicating that they were consistent with our a priori hypothesis, as were data that indicated a positive correlation between attachment insecurity and BMI; all other data were *in*consistent with a priori hypotheses and therefore coded as negative. A positive overall weighted mean effect size, therefore, indicates that the meta-analytic results were consistent with our a priori hypotheses.

Table 1
Overall Random Effects Meta-Analysis of the Association Between Attachment and Body Mass Index (BMI) for Adults

Study name	Overall *r*	95% confidence interval		*Z*-value	*p* value
		Lower limit	Upper limit		
Cooper and Warren (2011)	.02	−.15	.19	.20	.84
D'Argenio et al. (2009), Study 1	−.03	−.31	.25	−.21	.84
D'Argenio et al. (2009), Study 2	.06	−.19	.30	.44	.66
D'Argenio et al. (2009), Study 3	.06	−.15	.27	.55	.58
Hintsanen et al. (2010)	.05	−.01	.10	1.77	.08
Kiesewetter et al. (2012)	.21	−.08	.47	1.44	.15
Wilkinson et al. (2010)	.05	−.10	.18	.64	.53
Overall weighted mean *r*	**.05**	**.004**	**.09**	**2.13**	**.03**

attachment style had a weighted mean *r* of .08, $p = .22$, and attachment-related behaviours had a weighted mean *r* of .08, $p = .30$. These results therefore provide empirical support for our decision to aggregate data from these different attachment constructs into an overall meta-analysis for children.

Several of the samples included in the meta-analysis of adults used homogeneous populations. That is, Kiesewetter et al. (2012) studied only obese patients; taken together with the fact that we included as independent samples the three groups of nonobese volunteers, obese participants with no current or past psychiatric diagnosis, and obese participants with a current psychiatric diagnosis from D'Argenio et al. (2009), these methodological features may have resulted in restricted variance that could, in turn, attenuate the correlation between attachment and BMI. To address these concerns, we first reran the meta-analysis for adults, excluding the data from Kiesewetter et al. (2012). Results of these additional analyses were virtually identical with those obtained from the original meta-analytic results presented above. That is, results of the meta-analysis that excluded Kiesewetter et al. (2012) demonstrated a weighted mean *r* of .04, $p = .05$; the test for homogeneity was not statistically significant with $Q(5) = 0.38$, $p = .996$, $I^2 = 0.00$; no studies were trimmed using the publication bias analysis of Duval and Tweedie; and all other publication bias analyses were not statistically significant (all $ps > .10$).

Next, we considered the possibility of restricted variance for the D'Argenio et al. (2009) samples. Although data of all individual participants aggregated together were not available to permit collapsing the three samples in D'Argenio et al. (2009) into a single sample, we do not believe that the data suffered from problems with restricted variance. Thus, the *SD*s for the BMI in the three samples were 2.85, 6.80, and 6.69, (for the control group, the obese group, and the obese psychiatric group, respectively). These *SD*s are reasonably comparable with those of the other adult samples, for example, 2.89 for BMI data in Cooper and Warren (2011), and 3.19 in Wilkinson, Rowe, Bishop, and Brunstrom (2010). If anything, the "homogenous" groups of obese participants had larger *SD*s than the participants in the more heterogeneous groups of the control group of D'Argenio et al. (2009), as well as the participants in Cooper and Warren (2011) and Wilkinson et al. (2010).

Publication Bias

Figure 1 presents funnel plots of the data from the adult and children meta-analyses, respectively. An "eye-ball" test of the funnel plots does not indicate potential bias, since studies with larger effect sizes are not asymmetrically distributed around the inverted funnel (Sterne & Egger, 2001; Sterne & Harbord, 2004). In addition, Begg and Mazumdar's (1994) rank correlations for both adults ($\tau = 0.19$, *p* [one-tailed] = .27) and children ($\tau = 0.00$, *p* [one-tailed] = .50) were not statistically significant. Egger's (Egger et al., 1997) regression intercepts for both adults (intercept = 0.16, *p* [one-tailed] = .33) and children (intercept = 0.18, *p* [one-tailed] = .47) were also not statistically significant. Finally, Duval and Tweedie's (2000a, 2000b) trim and fill procedure indicated that there was no need to trim any studies in either the adult or children meta-analyses, so that the overall observed and adjusted weighted mean effect sizes were identical.

Table 2
Overall Random Effects Meta-Analysis of the Association Between Attachment and Body Mass Index (BMI) for Children

Study name	Overall *r*	95% confidence interval		*Z*-value	*p* value
		Lower limit	Upper limit		
Anderson and Whitaker (2011)	.10	.05	.15	4.00	<.001
Anderson et al. (2012)	.05	−.05	.14	.99	.32
Bahrami et al. (2013)	.27	.14	.39	3.91	<.001
Goossens et al. (2012)	−.02	−.10	.06	−.49	.63
Midei and Matthews (2009)	.02	−.13	.17	.22	.83
Overall weighted mean *r*	**.08**	**−.004**	**.16**	**1.87**	**.06**

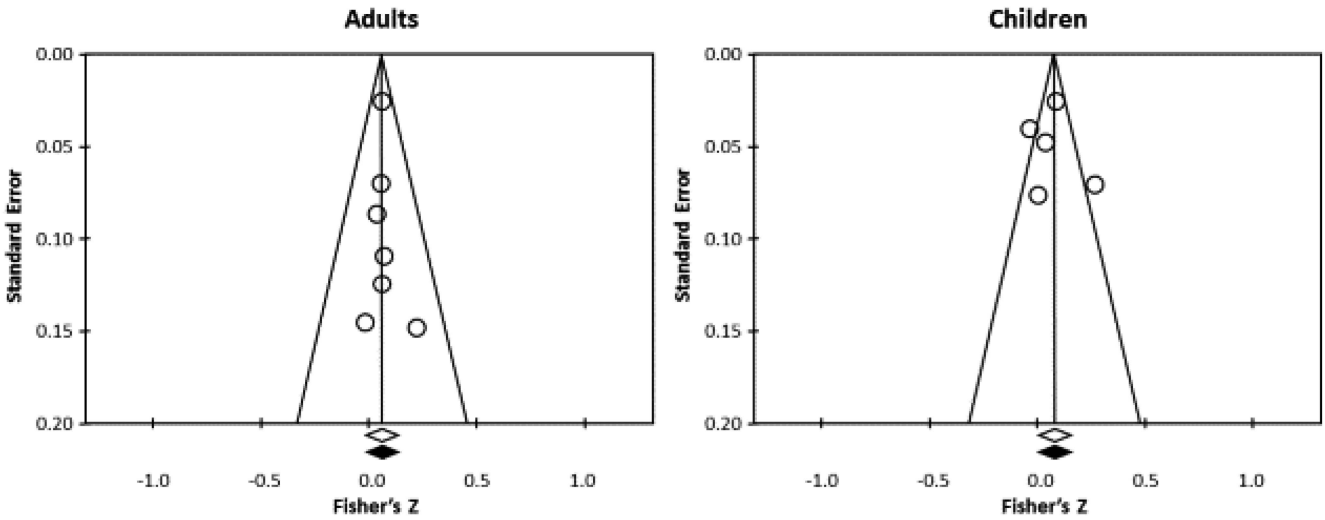

Figure 1. Funnel plots of *SE* by Fisher's Z in studies of adults and children. *Note*. The white circles represent each of the independent studies that were included in the meta-analysis, plotted by the size of the effect (in Fisher's *Z*) on the horizontal axis and the *SE* on the vertical axis. If there was evidence of publication bias, we would expect that the largest effects would have the largest *SE* (yielding void in the lower left quadrant; Borenstein et al., 2009). Studies toward the tip of the triangle have the smallest *SE*. The white diamond represents the weighted average effect size of the actual studies included in the meta-analysis. Duval and Tweedie's (2000a, 2000b) trim and fill analysis uses an iterative procedure to correct for potential publication bias by adjusting the weighted mean effect for studies at the extreme positive side of the graph until the distribution of studies is symmetric. The black diamond represents the weighted average effect size calculated using the studies actually included in the meta-analysis as well as any imputed studies. In the present meta-analysis, however, no studies needed to be trimmed and so the observed and adjusted results were identical.

Moderator Analyses

A priori moderator analyses were conducted using all studies aggregated from both the adult and children meta-analyses. None of the categorical or continuous moderator analyses were statistically significant, that is, adults versus children, attachment construct of security versus other, cross-sectional versus longitudinal designs, self-report versus observer-rated attachment, gender, age, or study quality.

Discussion

This article synthesized empirical studies that examined the association between attachment quality and obesity, using two meta-analyses—one for adults and another for children. The studies of adults indicated a small but statistically significant negative association between attachment quality and BMI. For the meta-analysis of children, results fell just short of statistical significance.

The degree of association between BMI and attachment for *adults* did not differ across studies sufficiently to reject the null hypothesis of homogeneity of effects, but there was substantial heterogeneity for the studies of *children*. Nevertheless, examination of several potential moderators did not yield statistically significant results, including gender, age, study quality, type of attachment construct, study design (i.e., longitudinal vs. cross-sectional), or source of attachment data (i.e., self-report vs. observer-rated).

Given the small magnitude of the statistically significant association between attachment quality and BMI for adults that was obtained in the present meta-analysis, it is necessary to consider the importance of this small association. Effect sizes need to be interpreted in the context of other research findings in the relevant domain of inquiry (Hill, Bloom, Black, & Lipsey, 2008). Ul-Haq, Mackay, Fenwick, and Pell (2013) conducted a meta-analysis of the association between BMI and health-related quality of life in adults, using the 36-Item Short Form Health Survey (SF-36). Results indicated a mean *r* of .02 for the association between BMI and the Mental Health scale of the SF-36, and a mean *r* of .19 for the association between BMI and the Physical Health scale of the SF-36. The overall *r* of .05 that we obtained in the present meta-analyses of the association between attachment quality and BMI for adults, therefore, falls in between the effect size for BMI with SF-36 Mental Health and the effect size for BMI with SF-36 Physical Health.[2]

Meta-analyses of the association between attachment and psychopathology for children have demonstrated statistically significant effect sizes of (a) $r = .13$ (adjusted for potential publication bias) for the overall association between attachment and externalizing behaviour (Fearon, Bakermans-Kranenburg, van IJzendoorn, Lapsley, & Roisman, 2010), and (b) $r = .10$ (adjusted for potential

[2] When aggregating effect sizes across the different group contrasts (e.g., overweight vs. normal weight participants, Class III obese vs. normal weight participants, etc.) reported in Ul-Haq et al. (2013), we were unable to calculate a *weighted* mean effect size, since Ul-Haq et al. (2013) did not provide the necessary information to do so. We calculated instead the *unweighted* mean effect sizes. Ul-Haq et al. (2013) contrasted SF-36 scores across one of various categories of obese participants with normal weight adult participants, and we transformed their results into estimated standardized effects using *SD* values taken from a normative study of the SF-36 conducted by Ware, Kosinski, Bayliss, McHorney, Rogers, and Raczek (1995), obtaining standardized mean difference scores (i.e., *d*), and then transforming them into *r*.

publication bias) for attachment and internalizing problems (Madigan, Atkinson, Laurin, & Benoit, 2013). These meta-analyses included studies that primarily used behavioural measures of attachment of children in infancy. In a more recent meta-analysis (Madigan, Brumariu, Villani, Atkinson, & Lyons-Ruth, 2016) that included studies that specifically used representational or questionnaire measures of attachment for children aged 3–18 years, however, results indicated stronger effect sizes in predicting both internalizing (d = 0.58 and no indication of publication bias, which translates into an r of .28) and externalizing behaviour (d = 0.49 and no indication of publication bias, which translates into an r of .24). Colonnesi et al.'s (2011) meta-analysis found a significant effect size of r = .30 for the association between attachment insecurity and anxiety for children. Finally, Conklin (2012)[3] obtained a significant effect size of r = .28 in a meta-analysis of the association between adult attachment and posttraumatic stress.

Taken together, then, these results suggest that the findings for the present meta-analysis appear roughly comparable with those of at least some of previous meta-analyses on the relation between attachment and psychopathology. Nevertheless, because no formal statistical contrasts were conducted to compare the findings of the present study with those of the aforementioned studies, and because a number of methodological differences between the meta-analyses may contribute to variation in the results, these conclusions regarding the relative strengths of results of the present meta-analysis are tentative.

The aetiology of obesity is complex and multifactorial, involving interacting biological, psychological, and social determinants. Given this high number of potential determinants of obesity, the observation of a correlation between one potential determinant, attachment, and obesity may underscore the importance of this relationship. Several complementary explanations for the association between attachment quality and obesity bear consideration.

One explanation is based on physiological responses to stress (Maunder et al., 2006). The results of previous research suggest that attachment insecurity, particularly attachment anxiety (Jaremka et al., 2013; Powers, Pietromonaco, Gunlicks, & Sayer, 2006), lead to hyperactivity of the hypothalamic-pituitary-adrenal (HPA) axis and the release of glucocorticoids, of which cortisol is the most well-known (Kidd, Hamer, & Steptoe, 2011). Hyperactivity of the HPA axis can cause accumulation of fat deposits in visceral adipose tissues (Bjorntorp, 2001). This can alter glucose metabolism and promote insulin resistance, which changes the degree of appetite-related hormones (e.g., leptin, ghrelin) and feeding neuropeptides that are present. As a result, the secretion of Neuropeptide Y and ghrelin (hunger-stimulating hormone) may increase, while the release of leptin (satiety-stimulating hormone) may decrease (Torres & Nowson, 2007). By modifying glucose metabolism and insulin sensitivity, eating—and especially consumption of high caloric food—may reduce the symptoms of stress (D'Argenio et al., 2009; Nemeroff, 2004; Teicher et al., 2003; Wilkinson et al., 2010). Thus, for people with high attachment anxiety, the heightened physical responses to stressors may stimulate eating, leading eventually to obesity.

Because stress responses not only depend on stressors but also on the appraisal of stressors and one's capability of dealing with stressors (Lazarus, 1991), a supplementary explanation for the association between attachment and obesity can be found in the underdevelopment of emotion-regulation processes. Confronted with a stressor, securely attached individuals seek proximity to significant others, which may reduce the impact of stressors (George, Blazer, Hughes, & Fowler, 1989; Hibbard & Pope, 1993; Stadler, Snyder, Horn, Shrout, & Bolger, 2012). Similar to the effect of satisfying interpersonal relationships, consumption of high caloric foods may calm the areas of the brain involved in stress perception, as demonstrated in animal studies (Dallman et al., 2003; Pecoraro, Reyes, Gomez, Bhargava, & Dallman, 2004; Peters et al., 2007). That is, food intake leads to a release of oxytocin from the hypothalamus that has an anxiolytic effect, akin to the effect of satisfying social interactions with significant others (Onaka, Takayanagi, & Yoshida, 2012). Therefore, to compensate for poor emotion regulation skills, food consumption may serve as a way of "self-medicating" for more anxiously attached individuals, by releasing oxytocin and down-regulating negative affect.

Of note, three of the studies included in the present meta-analysis reported mediational pathways between attachment quality and BMI. The relation between attachment and BMI was partially mediated by mood (i.e., symptoms of anxiety and depression; Cooper & Warren, 2011), eating self-efficacy (Bahrami et al., 2013), and disinhibited eating (Wilkinson et al., 2010). These findings provide direction for future researchers in delineating a more comprehensive understanding of the nature of the association between attachment and obesity.

A number of limitations to this meta-analytic review should be recognised. First, we included 12 independent studies, each of which had its own strengths, but also limitations, such as degree of representativeness of the study sample and diversity of the assessment of attachment styles (i.e., involving categorical ratings based on observation or interview and self-report measures of attachment). However, the results of the meta-regression moderator analysis for study quality were not statistically significant, and the measurement perspective (self-report vs. observer) did not yield significant results, either. Nevertheless, future meta-analyses should examine potential differences between self-reports versus observations of attachment, between assessments relating to the parent–child relationship versus attachment toward peers, parents, and spouses, as well as address other aspects of potential heterogeneity that could not be dealt with in the current study because the number of individual studies in subgroups with homogeneous methods were too few in number.

Another limitation involves the differences between the included studies in the types of attachment relationships that were measured, for example, attachment in close adult peer relationships, early attachment-related events and peer relationships, attachment in close/romantic relationships, attachment with a participant's mother and father, global attachment, and attachment to the mother. This significant variability across attachment measures limits the ability to draw more definitive conclusions from the present study.

Finally, most of the studies included in the present meta-analysis used a cross-sectional design rather than a longitudinal one. As a result, the findings of the meta-analysis are limited in drawing conclusions about the temporal relation between attachment and

[3] Conklin's (2012) meta-analytic study was an unpublished dissertation; we were unable to locate any published meta-analyses that examined the relation between attachment and psychopathology for adults.

obesity. Although the moderator analysis that compared cross-sectional and longitudinal studies was not statistically significant, the accumulation of future longitudinal research would permit firmer conclusions.

Despite the limitations of the present study, a meta-analysis in this newly emerging field of research—the earliest study included in the meta-analysis was from 2009, and we were able to locate only 12 independent studies—is important to quantify the magnitude of relations between attachment quality and obesity. In addition, the present meta-analysis identified areas for future research to build on previous studies.

An important step in future research will be to perform high quality longitudinal studies and research on the predictive role of attachment quality on obesity. The prediction of adult attachment behaviour and obesity from attachment patterns in early childhood is needed to verify the hypothesised etiological role of early attachment behaviour. In these studies, baseline assessments of BMI should be included. Furthermore, the prediction of adult obesity from attachment in adolescence would be particularly useful, because adolescence is a significant period for the onset and increase of obesity, especially among girls (Harding, Maynard, Cruickshank, & Teyhan, 2008). Future studies employing a prospective design could investigate the usefulness of interventions aimed at the guidance of more insecurely attached patients, both during weight loss treatment programs and during treatment of comorbidities.

The current study indicates the potential importance of considering attachment quality in obesity care. Implications can be twofold, although—as previously mentioned—the findings of the present study need to be considered tentatively, given their small magnitude. On an individual level, in select cases in which it may be clinically indicated, attachment quality could be assessed and included in interventions to prevent or reduce obesity. At a broader level, attachment theory may contribute to developing an expanded framework for future research aimed at better understanding the development of obesity.

Résumé

Des considérations théoriques et des résultats empiriques suggèrent que la qualité de l'attachement est reliée à l'obésité. Dans le cadre de cette étude, on a eu recours à des méthodes méta-analytiques pour examiner systématiquement les données empiriques d'études soumises à un examen par les pairs, portant sur la relation entre la qualité de l'attachement et l'indice de masse corporelle (IMC). Des méta-analyses distinctes ont été effectuées pour les études concernant des enfants et celles concernant des adultes. Des articles pertinents soumis à un examen par des pairs publiés entre 1990 et 2013 ont été obtenus dans PubMed, PsycINFO et les listes de références des articles retenus. Les résultats des méta-analyses concernant des *adultes* ont révélé un lien, petit mais statistiquement significatif, entre la qualité de l'attachement et l'IMC (valeur absolue de la moyenne pondérée, $r = 0{,}05$, $p = 0{,}03$; 95 % de l'intervalle de confiance, IC [de 0,004 à 0,09]; nombre d'études indépendantes, [k] = 7; $N = 2135$). Plus précisément, l'IMC était négativement associé à l'attachement sécurisant. Les analyses de biais de publication n'ont révélé aucune source de préoccupation quant aux résultats. Les résultats des méta-analyses concernant des *enfants* ont indiqué une légère association entre la qualité de l'attachement et l'IMC, qui la place à peine sous le seuil d'une signification statistique (valeur absolue de la moyenne pondérée, $r = 0{,}08$, $p = 0{,}06$; 95 % de l'IC [de -0,004 à 0,16]; $k = 5$; $N = 8602$). Plusieurs variables modératrices ont été examinées au moyen d'un échantillon agrégé, incluant des adultes et des enfants, mais aucune de ces analyses n'a donné des résultats statistiquement significatifs. Parmi des explications possibles d'un effet de la qualité d'attachement sur l'obésité figurent le sous-développement de la régulation émotive et une réceptivité psychophysiologique accrue, des éléments à examiner dans le cadre de futures recherches.

Mots-clés : attachement, indice de masse corporelle, IMC, méta-analyse, obésité.

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