

1 **The influence of attachment orientation on weight loss, eating behaviour and other**
2 **health outcomes among patients undergoing bariatric surgery: A systematic scoping**
3 **review**

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Abstract

Attachment orientation is a psychological factor concerning our expectations of ourselves and others in interpersonal relationships. An emerging literature has suggested that attachment orientation may influence a range of outcomes associated with bariatric surgery. The purpose of this systematic scoping review was to map the literature and examine the role of attachment orientation in the context of bariatric surgery. Studies conducted with patients who are undergoing or have undergone bariatric surgery, with a measure of attachment orientation and published by 21st July 2019, were located through electronic searches including Scopus, PubMed and Web of Science. 21180 studies were identified, of which 18 were retained for narrative synthesis. The major outcome themes reported were (1) post-surgery weight-loss/ body mass index ($k = 10$), (2) eating behaviour ($k = 9$), (3) attachment orientation differences in bariatric surgery patients compared with control groups ($k = 4$) and 4) other mental and physical health outcomes ($k = 12$). Overall, the results showed that there was little evidence to suggest that poor attachment orientation is predictor of weight-loss following surgery. There was evidence to suggest that poorer attachment orientation relates to poorer eating behaviours both before and after surgery, that patients undergoing bariatric surgery are more likely to have a poorer attachment orientation and attachment orientation is related to mental health outcomes but not physical health outcomes for patients. However, where relationships were identified, there were considerable inconsistencies regarding the dimension of attachment orientation that drove the relationship. Future studies should consider appropriate sample sizes for studies, replication of key findings and longer durations for longitudinal studies.

51 Key words: Attachment orientation; bariatric surgery; weight loss; eating behaviour; mental
52 health; physical health

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54 **1. Introduction**

55 Bariatric surgery, as an intervention to achieve weight loss and improvements in the
56 conditions associated with obesity (e.g., diabetes, cardiovascular disease events and overall
57 mortality), has been shown to be effective with durable results (Sjöström, 2013). For
58 example, results from the Swedish Obese Subjects trial showed that compared to controls
59 (subjects with obesity who had not had bariatric surgery and received usual care), subjects
60 who had undergone bariatric surgery showed greater weight-loss at 2, 10, 15 and 20 years
61 following surgery (Sjöström, 2013).

62 Nevertheless, variability in outcomes following surgery still exist; for example, de
63 Hollanda *et al.* found that patients lost between 22% and 144% of their excess body weight
64 (EBW) (De Hollanda et al., 2015). They observed that poorer weight-loss outcomes were the
65 result of either sustained poor weight loss in 1 in 20 of their patient sample or successful
66 weight loss that was followed by weight regain, such that in 1 in 5 of their patient sample, the
67 final excess weight loss (EWL) was less than 50%.

68 One explanation may be that the variance in weight-loss and regain may, at least in
69 part, be attributable to the use of food to manage emotion evident in pre-bariatric and post-
70 bariatric surgical patients (Chesler, 2012). Generally, if individuals cannot manage the
71 emotions that they feel, when they are felt and how they are expressed, they may turn to a
72 variety of behaviours (including overeating) to alleviate negative emotions (known as ‘affect
73 regulation’) (Gross, 1998). Whilst emotional eating (and other related eating pathologies)
74 tends to decrease following surgery, significant increases have been shown in subsequent
75 follow-up beyond a year post-surgery (Devlin et al., 2017; Nasirzadeh et al., 2018).

76 Moreover, a number of recent studies have suggested that greater eating in response to
77 emotion (and related concepts) is a predictor of poorer post-surgical weight-loss outcome
78 (Janse Van Vuuren, Strodl, White, & Lockie, 2018; Miller-Matero et al., 2018; Subramaniam
79 et al., 2018). Post-surgery, negative feelings may include poor body image, tension associated
80 with altered social relationships and shame associated with regained weight (Natvik,
81 Gjengedal, & Råheim, 2013).

82 Attachment theory has been used as a framework for understanding individual
83 differences in affect regulation (e.g., emotional eating). Fundamentally, it is suggested that
84 attachment constitutes a key behavioural system of the central nervous system that, when
85 activated by stress, triggers a predictable set of behaviours associated with proximity seeking
86 to others, ideally that lead to support and protection (Mikulincer, 1998; Mikulincer & Shaver,
87 2003). The concept of ‘attachment orientation’ reflects this fundamental behavioural system
88 through an understanding of an individual’s expectations and beliefs about their own and
89 others behaviour in interpersonal relationships (Collins & Read, 1994).

90 The prevailing view is that attachment orientation is developed in early childhood
91 through caregiver- child interactions (Bowlby, 1960). These early interactions teach a child
92 about how to act and what to expect in a relationship; ideally this also includes how to
93 regulate and cope with various emotional states through responsive and comforting
94 caregiving (Mikulincer & Shaver, 2019). However, the experience of inconsistent caregiving
95 or coldness and neglect can result in poor attachment and sub-optimal ability to regulate and
96 cope with various emotional states (Mikulincer & Shaver, 2019). Importantly, attachment
97 orientation developed in early childhood seems to persist into adulthood, though with some
98 exceptions (Waters, Merrick, Treboux, Crowell, & Albersheim, 2000).

99 Adult attachment was originally conceptualised as a categorical model of distinct
100 styles/ types but this was superseded by a continuous/ dimensional model of attachment

101 orientations (for a comprehensive review of these competing models, see Frayley, Hudson,
102 Heffernan, & Segal, 2015). In brief, the categorical model tends to use 3 (Hazan & Shaver,
103 1987) or 4 categories (Bartholomew, 1990; Bartholomew & Horowitz, 1991); these models
104 include (a) secure (comfortable with intimacy and autonomy), (b) avoidant/ dismissing
105 (dismissing of intimacy) and (c) anxious-ambivalent/ pre-occupied (pre-occupied with
106 relationships) and the additional (d) fearful (fearful of intimacy but socially avoidant) types.
107 The latter three are viewed broadly as ‘insecure’ attachment styles. By contrast, attachment
108 orientation tends to be conceptualised as two continuous dimensions; ‘attachment anxiety’
109 which reflects a fear of abandonment and a hyper-activation of the attachment system, and
110 ‘attachment avoidance’ which reflects a fear of intimacy and a deactivation of the attachment
111 system (Brennan, Clark, & Shaver, 1998). Being simultaneously low on both attachment
112 anxiety and attachment avoidance dimensions is associated with attachment security whereas
113 being high on either one or both dimensions is associated with attachment insecurity
114 (Brennan et al., 1998). Both approaches continue to be reflected in the adult attachment
115 literature more generally (Frayley et al., 2015).

116 When experiencing a threat or challenge within life, securely attached individuals
117 tend to be able to employ effective emotion-regulation and coping strategies (e.g., support
118 seeking and problem-solving) (Mikulincer & Shaver, 2019). Following such events, securely
119 attached individuals tend to be able to express and communicate any resultant feelings with
120 others (Mikulincer, 1998; Mikulincer & Shaver, 2019). If sources of support are not
121 available, attachment secure adults are able to activate mental representations of others who
122 regularly provide support, this constitutes thoughts and cognitions that help them to deal with
123 a situation successfully (i.e., as if the other person were with them) (Mikulincer & Shaver,
124 2003).

125 By contrast, individuals with an insecure attachment orientation tend to employ less
126 effective or counter-productive emotion regulation and coping strategies in the face of a
127 threat or challenge (Mikulincer & Shaver, 2019). Individuals who are highly attachment
128 avoidant actively inhibit negative emotional states and will consider themselves in a positive
129 light, avoiding the thought of any negative self-views or personal weaknesses (Mikulincer,
130 1998). In so doing, they maintain a deactivated attachment system (Mikulincer & Shaver,
131 2019). Individuals who are highly attachment anxious tend to focus on and exaggerate
132 negative emotions which maintains the hyper-activation of the attachment system
133 (Mikulincer & Shaver, 2019) but when proximity to others is sought, this causes further
134 distress due to anxiety around fear of abandonment (Mikulincer, 1998). This can lead to a
135 cycle that intensifies negative emotions. It is likely for this reason that attachment anxious
136 individuals tend to use external substances (e.g., smoking, substance misuse, food and many
137 others) to ‘break the cycle’ and provide comfort (Maunder & Hunter, 2001).

138 In the case of eating behaviour, a recent meta-analysis has shown that higher
139 attachment insecurity is related to unhealthy eating behaviours, including emotional eating
140 (Faber, Dubé, & Knäuper, 2018). Consistent with attachment theory, Wilkinson et al. (2018)
141 showed that difficulties in emotion regulation, specifically, difficulty engaging in goal-
142 directed behaviours when upset, significantly mediates the relationship between attachment
143 anxiety and eating in response to stress. Additionally, Keating, Mills, & Rawana (2019)
144 showed that difficulty accepting and modulating emotions mediates the relationship between
145 attachment anxiety and binge eating.

146 Furthermore, unhealthy eating behaviours of this kind have been shown to mediate a
147 positive relationship between attachment anxiety and body mass index (BMI) (Hazan &
148 Shaver, 1987; Waters et al., 2000; Wilkinson, Rowe, & Millings, 2019). One meta-analysis
149 examined the relationship between attachment quality and BMI in both children and adults

150 (Diener, Aarts, Gerdes, Brandjes, & Hinnen, 2016). They found in adults higher BMI was
151 associated with higher attachment insecurity and that this was a small but significant effect.
152 In children, a similar effect was evident but just missed statistical significance (Diener et al.,
153 2016).

154 Alongside our growing understanding of the relationship between attachment
155 insecurity and obesity in general, there is an emerging literature specifically concerned with
156 attachment orientation and patients undergoing bariatric surgery. In this context, patients who
157 are awaiting bariatric surgery (candidates) or have already undergone bariatric surgery
158 (recipients) are viewed as a distinct sub-group of individuals with obesity (or who have had
159 obesity in the case of recipients). Some individuals with obesity will be eligible/ selected for
160 surgery while others will not (for example, see Sjöström, 2013). While some individuals do
161 not want to pursue bariatric surgery because they are fearful of the treatment effects and think
162 that surgery is ‘too extreme’ (Lynch, Chang, Ford, & Ibrahim, 2007). Furthermore, a recent
163 article examined demographic and socio-economic disparities in surgery uptake and found
164 that individuals who were male, black and minority ethnic, single and unemployed were less
165 likely to undergo surgery (Zhang, Tomlinson, Wnuk, Sockalingam, & Cram, 2019).

166 Attachment orientation is of interest in the context of bariatric surgery primarily
167 through its relationship with maladaptive eating behaviours (e.g., emotional eating) and the
168 finding that such maladaptive eating behaviours have been associated with poor outcomes
169 following surgery, discussed in more detail above. The overarching hypothesis is that
170 attachment orientation predicts bariatric outcomes via maladaptive eating behaviour which is
171 engaged in because of poor emotion regulation.

172 Indeed, studies have shown that within populations of patients awaiting bariatric
173 surgery, higher attachment anxiety is associated with higher rates of emotional eating (Taube-
174 Schiff et al., 2015), binge eating (Shakory, Exan, et al., 2015), and difficulties controlling

175 eating behaviour (Pratt et al., 2016). Whilst, attachment insecurity in general is associated
176 with disinhibited eating (Wilkinson, Rowe, Sheldon, Johnson, & Brunstrom, 2017). It has
177 also been shown that attachment orientation is related to weight one-year post-surgery (Aarts
178 et al., 2015) and that weight losses were less likely to be maintained by insecurely attached
179 (high anxiety and avoidance) recipients (Harrington, 2008). However, other studies have
180 failed to show any relationship between attachment orientation and post-surgery weight-loss
181 (Appel et al., 2016; Leung et al., 2019; Nancarrow, Hollywood, Ogden, & Hashemi, 2018).

182 Consistent with these findings more generally, studies have also shown that overall
183 attachment insecurity is associated with poorer mental health (Appel et al., 2016) and poorer
184 pre-surgery evaluations by a psychologist (Aarts, Geenen, Gerdes, Brandjes, & Hinnen,
185 2014). Findings have also suggested that attachment anxiety and overall attachment
186 insecurity (averaged anxiety and avoidance) is more prevalent amongst candidates for
187 bariatric surgery than the lean general population (Nancarrow et al., 2018; Wilkinson et al.,
188 2017) respectively. Though one study describes the opposite whereby attachment avoidance
189 was more common among candidates for surgery than a reference group (Pratt et al., 2016).

190 Here we propose a scoping review to systematically examine the role of attachment
191 orientation in the context of bariatric surgery, for the first time. A scoping review can be used
192 to map the literature and the identification of knowledge gaps, sparse outcomes measures and
193 measures that are too heterogeneous to be synthesised. In so doing, a scoping review can
194 provide a valuable precursor to other more focussed systematic reviews (Munn et al., 2018).

195

196 **2. Method**

197 **2.1 Protocol**

198 This review was conducted following the PRISMA 2009 guidelines (Liberati et al., 2009).

199 As an exploratory review, a protocol was not registered.

200

201 **2.2 Eligibility criteria**

202 As an emerging field of research and the first review of its kind, the eligibility criteria
203 remained broad. Articles were only included if they reported primary quantitative research.
204 Each study needed to include at least one standardised measure of attachment orientation, e.g.
205 the Experiences in Close Relationships Questionnaire (Fraley, Waller, Brennan, Brennan, &
206 Clark, 2000). Participants in the included studies needed to be at least 18 years old and either
207 awaiting (candidate) or to have undergone (recipient) bariatric surgery. No restrictions were
208 placed on the outcome measures, however, for a study to be included in the review, studies
209 needed to have hypothesised and measured the influence of attachment orientation on at least
210 one variable related to the experience of candidates and/or recipients of bariatric surgery.
211 Example outcome variables include but are not limited to weight loss, eating behaviour,
212 attachment across clinical/ non-clinical groups and other mental/ physical health outcomes
213 (for a full list see table 2). Also, no restrictions were placed on study design, type of bariatric
214 surgery, inclusion of a control group, language or publication date.

215

216 **2.3 Search strategy**

217 An initial search and three update searches were conducted between 1st December 2016 and
218 21st July 2019. The initial search (conducted 1st December 2016 – 31st January 2017) and first
219 update search (conducted 5th December 2017 and 31st January 2018) included three databases
220 (PubMed, Scopus and Web of Science). The second update search (16th April 2018 and 20th
221 June 2018) included six additional databases (the Cumulative Index to Nursing & Allied
222 Health Literature (CINAHL), MEDLINE, PsycINFO, the Applied Social Sciences Index and
223 Abstracts (ASSIA), the Health Management Information Consortium (HMIC) and

224 PROQUEST). Finally, the third update search, which included all nine previously searched
225 databases was conducted between 24th June 2019 and 21st July 2019.

226

227 Varied combinations of key terms were used in the searches to represent weight and weight
228 change (weight gain, bariatric, weight, BMI), attachment orientation (attachment orientation,
229 attachment insecure, attachment avoidant, attachment anxious, attachment), bariatric surgery
230 (bariatric, weight loss surgery, metabolic, metabolic surgery) and emotion regulation
231 (emotion regulation and emotional eating). A full electronic search strategy is presented in
232 the supplementary file (Appendix 1).

233

234 **2.4 Study selection**

235 Study selection was completed independently by two of the authors (T.D. and L.W.) for
236 indication that the respective study would meet the eligibility criteria for the review. Titles
237 and abstracts were screened first, followed by full texts. Any discrepancies were initially
238 discussed and resolved by the reviewing co-authors and a third co-author (M.L.) was
239 available in the case that a discrepancy could not be resolved. The reference lists of the
240 eligible papers were searched (T.D.) to identify additional papers. Colleagues were also
241 contacted to locate additional articles. Where there appeared to be considerable overlap
242 between a published paper and a thesis (i.e. authors, study methods, sample characteristics,
243 analyses, findings and results) the reviewers favoured the published paper. Two colleagues
244 (K.W. and J.G. See acknowledgements) translated and provided details for the paper which
245 was published in German.

246

247 **2.5 Data extraction**

248 Data extraction was performed by two co-authors (T.D. and L.W.) and is presented in Table
249 I. Data concerning sample characteristics included age, sex, participant group (candidate,
250 recipient or control/reference/lean group) and type of surgery received. Data concerning
251 study characteristics included sample size, study design and measure of attachment (including
252 dimensions/styles). Additionally, the authors extracted the outcomes of studies including
253 statistical findings. Outcomes coalesced around four themes; weight loss/BMI, eating
254 behaviours, attachment across groups and other physical/ mental health outcomes (see header
255 row of Table 2). Upon completion, the data extraction was cross-checked between the co-
256 authors (T.D. and L.W.)¹.

257

258 **2.6 Quality Assessment**

259 The Effective Public Health Practice Project (EPHPP) tool (“Effective Public Health Practice
260 Project.,” 1998) was used to assess the quality of the included studies based on six criteria:
261 selection bias, study design, confounders, blinding, data collection methods, and withdrawals
262 and dropouts. Blinding was omitted from the assessment criteria as this was not applicable to
263 the included studies, as there were no randomised control trials. Each criterion was given a
264 rating of ‘good’, ‘fair’ or ‘poor’, for each study this was subsequently used to generate a
265 global rating of strong (no poor ratings), moderate (one poor rating) or weak (two or more
266 poor ratings). The assessment was conducted by one author (T.D.) and one independent

¹ Meta-analyses are not presented due to the low number of studies (Mode k per outcome was 4) and high heterogeneity (preliminary analyses showed that I^2 for potential study groupings by outcome with attachment avoidance and anxiety sub-groups was above 88% except for in one case where it was 54%).

267 assessor (R.E. see acknowledgements); disagreements which were not resolved were posed to
268 a third assessor and co-author (L.W.).

269

270 **3. Results**

271 The search yielded 21180 articles. Figure 1 presents a summary of the study selection
272 process. After screening these results, 18 studies were eligible for this systematic review. The
273 characteristics of the included studies are presented in Tables I and II. There were 11 studies
274 that were cross-sectional and 7 studies that were longitudinal. Candidates for bariatric surgery
275 were represented by 4206 participants in nine studies and recipients were represented by 862
276 participants across 10 studies².

277

278

279 << Insert Figure 1 >>

280

281

² Of the 10 studies that included recipients of bariatric surgery, 3 studies comprised patients who had undergone Laparoscopic Roux-en-Y gastric bypass, 2 studies comprised patients who had undergone laparoscopic sleeve gastrectomy, 4 studies comprised patients who had undergone either laparoscopic Roux-en-Y gastric bypass, laparoscopic sleeve gastrectomy, adjustable gastric band or other and 1 study comprised patients who had adjustable gastric bands.

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282 *Table I Study author and publication date are listed against study sample size (% female), mean age*
283 *of participants (SD), participant groups included in the study (for brevity, individuals awaiting*
284 *bariatric surgery are referred to as candidates, and individuals who have previously undertaken*
285 *bariatric surgery are referred to as recipients). *Indicates the same sample was used across studies*
286 ***Where standard deviation was not reported, standard error was reported alternatively *** This*
287 *study is reported as a thesis and not published.*
288
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<< Insert Table 1 >>

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293 *Table II Study author and publication date are listed against study outcomes: weight loss and BMI,*
294 *eating behaviour, attachment across groups and the relationship between attachment and other health*
295 *outcomes.*
296

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298

<< Insert Table 2 >>

299 **3.1 The relationship between attachment orientation and weight-loss/ BMI**

300

301 Ten of the included studies explored weight loss/ BMI as an outcome variable. Seven of these
302 studies followed the same group of participants from pre- to post-surgery and reported on
303 weight-loss as a function of attachment orientation; $k = 7$; 2 strong, 3 moderate and 2 weak
304 quality rating (Aarts, Geenen, et al., 2014; Aarts et al., 2015; Appel et al., 2016; Leung et al.,
305 2019; Nancarrow et al., 2018; Russo, 2017; Sockalingam et al., 2013). One study, Harrington
306 (2008) reported on weight-loss maintenance (moderate quality rating) and two studies (Pratt
307 et al., 2016; Wilkinson et al., 2017) reported on BMI across participant groups (one strong
308 and one moderate quality rating).

309

310 No direct relationship between attachment orientation and weight loss was identified (Aarts,
311 Geenen, et al., 2014; Aarts et al., 2015; Appel et al., 2016; Leung et al., 2019; Nancarrow et
312 al., 2018; Russo, 2017; Sockalingam et al., 2013). However, two studies found an *indirect*
313 effect of attachment orientation. One study found that attachment anxiety in particular was
314 related to 12-month post-surgical BMI (when baseline BMI was controlled for) via dietary
315 adherence at 6 months following surgery. Though follow up analysis including dietary
316 adherence at 12 months following surgery failed to show a similar significant indirect effect
317 (Aarts et al., 2015), suggesting that there are changes between 6 and 12 months post-surgery
318 which need to be considered. In a different approach, Harrington (2008) recruited recipients
319 of bariatric surgery and asked them to retrospectively reflect on weight regain and weight
320 maintenance. Consistent with the longitudinal findings, there was no significant relationship
321 between attachment orientation (averaged across avoidance and anxiety) and weight regain or
322 weight maintenance (though the latter is reported as ‘approaching’ significance).

323

324 Two studies compared BMI across participant sub-groups. Wilkinson et al. (2017) found that
325 attachment insecurity (averaged attachment anxiety and attachment avoidance) predicted (via
326 disinhibited eating) group membership of candidates of bariatric surgery compared to a lean
327 control group, which differed in terms of their BMI. Attachment insecurity (via disinhibited
328 eating) could be used to distinguish between recipients of bariatric surgery and a lean control
329 group, which differed in terms of their BMI. Despite differences in BMI between candidates
330 and recipients of bariatric surgery, the results showed no differences in attachment insecurity
331 or disinhibited eating between the groups. Pratt et al. (2016) split their bariatric candidate
332 group according to attachment, however, for the most part they failed to find any effect on
333 BMI, except for participants who had higher than average attachment anxiety towards their
334 significant other who also had higher BMI.

335

336 **3.2 The relationship between attachment orientation and eating behaviour**

337

338 Nine of the studies included measures of eating behaviour as an outcome. Three studies
339 concerned the relationship between attachment orientation and eating behaviour in candidates
340 for bariatric surgery, 2 moderate and 1 weak quality rating (Pratt et al., 2016; Shakory, Exan,
341 et al., 2015; Taube-Schiff et al., 2015). Four studies followed the same group of participants
342 from pre- to post-surgery, 2 weak, 1 moderate and 1 strong quality rating (Aarts et al., 2015;
343 Appel et al., 2016; Leung et al., 2019; Russo, 2017). One study recruited separate groups of
344 participants for the candidates or recipients group (Wilkinson et al., 2017; a strong quality
345 rating) and one study recruited only recipients of bariatric surgery (Harrington, 2008; a
346 moderate quality rating).

347

348 The three studies examining the relationship between attachment orientation and eating
349 behaviour in candidates for bariatric surgery generally showed that greater attachment
350 insecurity was associated with more problematic eating behaviours. However, the exact
351 nature of this relationship differed across studies both in terms of the relevance of a particular
352 dimension of attachment orientation (i.e. attachment anxiety or avoidance) and nature of the
353 problematic eating behaviour (binge eating, uncontrolled eating, emotional eating etc.). For
354 example, Taube-Schiff et al. (2015) showed that attachment anxiety was a direct positive
355 predictor of emotional eating in response to anger and attachment avoidance was a direct
356 negative predictor of emotional eating in response to anxiety. When difficulties in emotion
357 regulation was taken into account as a mediator, both attachment dimensions significantly
358 predicted each type of emotional eating (in response to anger, anxiety and depression).
359 Shakory et al., (2015) reported similar relationships with respect to binge eating. Pratt, (2016)
360 showed that general relationship anxiety was positively correlated with uncontrolled eating
361 behaviour and that those with high attachment anxiety towards a significant other had higher
362 uncontrolled eating than those with low attachment anxiety towards a significant other (Pratt
363 et al., 2016). However, no eating behaviour relationships were found with attachment
364 avoidance (general, towards a significant other or close friend) and no relationship was
365 shown between attachment anxiety towards a significant other or close friend and either
366 cognitive restraint or emotional eating (Pratt et al., 2016).

367

368 The four longitudinal studies all reported significant relationships between attachment
369 orientation and maladaptive eating of some form but there was inconsistency with regard to
370 attachment dimension concerned and nature of eating behaviour. Aarts et al. (2015) found
371 that higher attachment anxiety (but not attachment avoidance) was associated with poorer
372 adherence to dietary recommendations 6 months and 12 months post-surgery (participants

373 could indicate whether they follow dietary recommendations, almost follow them or do not
374 follow them). Appel et al. (2016) showed that attachment security was associated with a
375 reduced prevalence of 'disturbed' eating. By contrast Russo (2017) found positive
376 relationships between attachment avoidance and eating behaviour, namely cognitive restraint
377 and uncontrolled eating but no relationships between these measures and attachment anxiety.
378 Leung et al. (2019) also found that attachment avoidance was a predictor of binge eating two
379 years post-surgery but did not find a relationship with attachment anxiety.

380

381 Of the two cross-sectional studies including recipients of bariatric surgery, both reported
382 significant relationships between attachment orientation and eating behaviour. Wilkinson et
383 al. (2017) found that when attachment insecurity (averaged attachment anxiety and
384 attachment avoidance) was used to predict group membership of candidates for bariatric
385 surgery compared to lean age and sex-matched controls or recipients of bariatric surgery
386 compared to these controls, disinhibited eating significantly mediated this relationship.
387 Furthermore, another study which recruited only recipients of bariatric surgery found that
388 higher attachment security was associated with a reduced risk of developing an eating
389 disorder (Harrington, 2008).

390

391 **3.3 Prevalence of attachment insecurity in candidates and recipients of bariatric surgery**

392 Four studies examined the difference in attachment orientation across different participant
393 groups. All of the studies showed evidence to suggest that candidates for bariatric surgery
394 were more likely to be generally more attachment insecure than a control group (comprising
395 lean/ healthy/ reference participants). However, there was inconsistency amongst studies as to
396 whether this was in terms of attachment anxiety/need for approval ($k = 2$; 1 moderate &
397 1 strong quality rating; Federico et al., 2019; Nancarrow et al., 2018) attachment avoidance(k

398 = 1; moderate quality rating; Pratt et al., 2016) or both - collapsed across measures ($k = 1$;
399 strong quality rating; Wilkinson et al., 2017). Notably, the study that reported a difference in
400 attachment avoidance but not attachment anxiety used less stringent inclusion criteria for
401 their bariatric candidate group than the other studies and the reference control group had
402 unknown BMI and bariatric status (Pratt et al., 2016). This finding is also in direct opposition
403 to another study which showed that control participants were more attachment avoidant than
404 bariatric candidates (Nancarrow et al., 2018).

405

406 One study (Wilkinson et al., 2017) showed that patients who had undergone bariatric surgery
407 (recipients) were more likely to be attachment insecure than a control group and another
408 study (Federico et al., 2019) showed that an obese non-bariatric group scored higher on a
409 need for approval (conceptually similar to attachment anxiety) than a control group. Both
410 studies noted no differences in attachment insecurity between candidates and recipients
411 (Wilkinson et al., 2017) or bariatric candidates and obese non-candidates (Federico et al.,
412 2019).

413

414 Finally, one study (Wilkinson et al., 2017) explored a potential mediator for the difference in
415 attachment orientation across groups in terms of eating behaviour and showed that
416 disinhibited eating mediated the relationship between attachment insecurity and group
417 membership (candidates/recipients vs. control).

418

419 **3.4 The relationship between attachment orientation and other health outcomes**

420 Twelve studies reported on the relationship between attachment orientation and other
421 health-related outcomes amongst candidates for recipients of bariatric surgery. Ten studies
422 reported on outcomes related to psychological measures (Aarts et al., 2014; Aarts, Hinnen,

423 Gerdes, Brandjes, & Geenen, 2013; Appel et al., 2016; Bianciardi et al., 2019; Harrington,
424 2008; Russo, 2017; Shakory, Van Exan, et al., 2015; Sockalingam, Wnuk, Strimas, Hawa, &
425 Okrainec, 2011; Taube-Schiff et al., 2015; 5 moderate and 4 weak quality studies).

426

427 Two studies reported on outcomes related to physical health (Aarts, Hinnen, Gerdes,
428 Acherman, & Dees, 2014; Sockalingam et al., 2011; both moderate quality studies). Two
429 studies reported on multidimensional outcome measures, Quality of Life and Cleveland
430 Clinic Behavioural Rating System – CCBRS (Aarts, Hinnen, et al., 2014; Russo, 2017; one
431 moderate and one weak quality study) and two studies reported on outcomes related to
432 adherence to health-regime (Sockalingam et al., 2013; Sunil et al., 2017; both moderate
433 quality studies).

434

435 All studies except for one (Russo, 2017) reporting on outcomes related to
436 psychological health found that overall attachment insecurity was related to poorer
437 psychological measures amongst patients. However, there was considerable heterogeneity
438 amongst studies regarding whether this was driven by attachment anxiety only ($k = 3$),
439 attachment avoidance only ($k = 1$), attachment security (i.e., low in both anxiety and
440 avoidance) ($k = 2$) or both attachment anxiety and avoidance separately measured ($k = 2$).
441 The majority ($k = 5$) of these studies were cross-sectional studies focussed on candidates for
442 bariatric surgery but one cross sectional study was focussed on recipients of bariatric surgery
443 and showed that those who were more attachment secure were less likely to have experienced
444 trauma symptoms (Harrington, 2008). Two studies were longitudinal and showed that both
445 secure and insecurely attached individuals showed an improvement on psychological health
446 related outcomes following surgery (Appel et al., 2016) and that both attachment anxiety and
447 avoidance were predictors of mental wellbeing at each assessment time-point (from baseline

448 to 12 months post-surgery) but were not significant predictors of the time-course of mental
449 wellbeing for this period (Aarts, Geenen, et al., 2014). It is notable that the only study (Russo,
450 2017) that failed to show any relationship between attachment insecurity and psychological
451 measures of any kind had the smallest sample size ($n = 25$). Similarly, Bianciardi (2019)
452 found that need for approval (conceptually similar to attachment anxiety) was independently
453 predictive of body image satisfaction.

454 One longitudinal and one cross-sectional study reported on outcomes relating to
455 physical health. The longitudinal study (Aarts, Geenen, et al., 2014) showed that neither
456 attachment anxiety or avoidance were predictors of physical functioning at assessment time-
457 points (from baseline to 12 months post-surgery) or time-course of physical functioning for
458 this period. The cross-sectional study showed that amongst candidates for bariatric surgery
459 there was no significant relationship between attachment anxiety or avoidance and the
460 physical component score of a health-related quality of life measure (Sockalingam et al.,
461 2011).

462 One longitudinal and one cross-sectional study reported on multi-dimensional
463 measures related to the health of patients for bariatric surgery. The longitudinal study (Russo,
464 2017) reported on pre-surgery measures and showed that an averaged (but not separate)
465 measure of attachment anxiety and avoidance significantly related to impact of weight on
466 quality of life. The cross-sectional study (Aarts, Hinnen, et al., 2014) reported on the
467 relationship between attachment anxiety and avoidance, and the CCBRS score taken pre-
468 surgery, which includes aspects of consent, expectations, social support, mental health,
469 substance use, eating behaviour, adherence, coping and overall impression. Attachment
470 anxiety significantly related to CCBRS score via anxiety and depression, separately. The
471 same pattern of results was shown for attachment avoidance.

472 Outcomes related to adherence to health-regime were reported by one longitudinal
473 study and one cross-sectional study. The longitudinal study (Sockalingam et al., 2013)
474 showed that attachment avoidance was predictive of non-attendance of follow-up
475 appointments. However, there was no difference in attachment anxiety across attending/ non-
476 attending groups. By contrast, the cross-sectional study (Sunil et al., 2017) showed that there
477 was no difference in attachment avoidance across groups who were adherent or not to their
478 post-surgery vitamin supplement regime. There were mixed findings as to whether
479 attachment anxiety was more prevalent among individuals who were non-adherent. Notably,
480 the difference in these findings reflect the different measures which were used.

481 **3.5 Quality assessment**

482 The quality assessment identified four strong studies, ten moderate studies and four
483 weak studies (see Table III). Studies were rated as 'fair' rather than 'good' due to sub-optimal
484 methodology or reporting. All of the studies recruited participants through suitable means
485 (e.g., clinical services associated with bariatric surgery) and were therefore very likely to be
486 accessing target populations. However, only one study (Bianciardi et al., 2019) provided a
487 detailed description of how many individuals were approached to participate and how many
488 agreed.

489 There was some variation amongst the study designs; there were no randomised
490 controlled trials or controlled clinical trials which garner 'good' ratings for design. Most of
491 the studies received a 'fair' rating ($k = 12$) for designs including prospective cohort studies
492 and case control studies. Six studies received a 'poor' rating for other designs including one-
493 time surveys with no control group.

494 Most studies identified and controlled for potential confounders in their studies, thus
495 these studies were rated as good. However, five studies did not report on potential

496 confounders with sufficient detail to make a proper assessment and therefore were rated as
497 poor.

498 All but one study used valid and reliable methods of data collection. This study was
499 given a poorer rating for this criterion as the researchers generated their own questions
500 regarding mental healthcare utilisation behaviour and this was not assessed for validity or
501 reliability (Aarts et al., 2013). It should be noted that while rated favourably for their primary
502 data collection methods, two studies (Harrington, 2008; Pratt et al., 2016) reported using self-
503 reported weight measurements from the participants which are subject to bias and inaccuracy
504 as participants are likely to misreport their weight.

505 Due to study design, the withdrawal and drop out criterion was only applicable to nine
506 studies (i.e., those with a follow-up component). Of those, three were rated as good, one was
507 rated as fair and five were rated as poor; the primary reason for a poor rating was a lack of
508 detail in the study write-up on this topic.

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512 *Table III Quality assessment: criterion and global ratings*

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<< Insert Table 3 >>

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518 **4. Discussion**

519 This is the first systematic scoping review to explore the relationship between
520 attachment orientation and outcomes associated with bariatric surgery. Nine databases were
521 searched, and 18 eligible studies were identified which examined attachment orientation in
522 the context of bariatric surgery. Four broad categories of outcome were identified; weight-
523 loss/ BMI, eating behaviour, attachment differences across groups and other mental and
524 physical health outcomes. Study results relevant to each outcome were narratively
525 synthesised.

526 Overall, there was no evidence to suggest that attachment insecurity is a direct
527 predictor of weight-loss following bariatric surgery. However, one study suggested that a
528 relationship between these two factors exists but that it is indirect in nature; greater pre-
529 operative attachment anxiety related to poorer adherence to the dietary recommendations
530 received by patients following surgery (assessed 6 months following surgery) which, in turn,
531 related to poorer weight loss one year following surgery. With only one study taking this
532 approach, there is a clear need for a high-quality replication in order to evaluate whether an
533 indirect (but not direct) relationship exists between attachment orientation and weight-loss
534 following surgery. This is key to understanding the clinical value of assessing attachment
535 orientation in patients undergoing bariatric surgery. Future studies might also consider
536 potential moderators of effects on weight-loss – for example, perceived social support has
537 been shown to moderate the effect of attachment anxiety on health outcomes (Stanton &
538 Campbell, 2014).

539 There was clearer evidence to suggest that attachment orientation is related to eating
540 behaviour in candidates and patients undergoing surgery more generally. There was also
541 support for the suggestion that compared to lean/healthy control participants, bariatric surgery
542 patients were significantly more likely to have an insecure attachment. There lacked evidence

543 for a relationship between attachment orientation and measures of physical health but there
544 was agreement amongst studies that higher attachment insecurity was associated with poorer
545 mental health amongst patients who are undergoing or have undergone bariatric surgery.
546 There was, however, considerably less agreement about whether these relationships were
547 driven by attachment anxiety, attachment avoidance or both. Future studies might consider
548 modelling that can account for differential relationships between dimensions of attachment
549 orientation and outcomes (e.g., path analysis or structural equation modelling as used by
550 Taube-Schiff et al. 2015).

551 Overall, this review highlights a number of opportunities for researchers to address
552 gaps in this burgeoning literature. First, a number of the studies included in the review had
553 very small sample sizes and there was a general lack of reported *a priori* power calculations
554 to determine appropriate sample sizes to detect effects robustly. Given the difficulty retaining
555 patients undergoing bariatric surgery as participants in research (Gourash, Lockhart,
556 Kalarchian, Courcoulas, & Nolfi, 2016), one approach to ensuring well-powered studies is to
557 work collaboratively across centres and services. Many of the studies included were either
558 single centre or single service (with multiple centres) and taking a multi-centre/service
559 approach would also enhance the diversity of patients studied and generalisability of findings.

560 Secondly, a number of the studies included in this review were longitudinal in nature.
561 The longest time period covered was 2 years following surgery (Leung et al. 2019). Studies
562 are likely to benefit from having a longer duration given reporting of problematic eating
563 behaviour seven years post-surgery (for a review, see Williams-Kerver, Steffen, & Mitchell,
564 2019). Moreover, such a longitudinal approach might allow for the investigation of a
565 relationship between attachment orientation and other disinhibited behaviours, such as
566 alcohol use (Ivezaj et al., 2019; Reaves, Dickson, Halford, Christiansen, & Hardman, 2019)
567 that might be used as coping strategies (Hardman & Christiansen, 2018). Notably, one study

568 included in this review showed that those with an insecure attachment (particularly
569 attachment avoidant) were less likely to attend appointments following surgery. Future
570 longitudinal studies should consider this potential for bias in sampling.

571 Longitudinal approaches would also give an opportunity for the inclusion of more
572 than one assessment of attachment orientation over time. Whilst attachment orientation is
573 regarded as a relatively stable trait, studies have shown that shifts can occur, especially in the
574 context of considerable life changes (Chopik, Edelstein, & Grimm, 2015; Waters et al.,
575 2000). One possibility is that bariatric surgery and its accompanying interpersonal
576 experiences constitute a major life shift; patients have reported significant life adjustments
577 including generating a new identity and reinserting themselves into society (Ronis
578 Magdaleno, Adami, Egberto, & Turato, 2010), experiencing new emotions such as
579 attractiveness, jealousy and mistrust (Ronis; Magdaleno, Chaim, Pareja, & Turato, 2011;
580 Ronis Magdaleno et al., 2010) and changes in relationship status (Ferriby et al., 2018). This
581 may precipitate a shift in attachment orientation. This is important because those who were
582 considered at risk for maladaptive eating based on their attachment orientation pre-surgery
583 may not be the same group who are at risk post-surgery.

584 Thirdly, a number of studies included in this review focussed on candidates for
585 bariatric surgery. One issue with this focus regards definition of when someone becomes a
586 ‘candidate’ and eligible for a research study on this population. One of the studies included in
587 this review used a different definition to others (Pratt et al. 2016), recruiting people with an
588 interest in having surgery rather than those who have progressed and are a patient on a
589 service awaiting their surgery. One possibility is that this introduces heterogeneity in
590 findings. We suggest caution in labelling participants as ‘candidates for bariatric surgery’.

591 Finally, the included studies used only measures of organised forms of attachment
592 orientation (i.e., attachment anxiety and attachment avoidance). Future studies might consider

593 including a measure of disorganised attachment given that recent evidence has suggested that
594 there is link between disorganised attachment, uncontrolled eating behaviours and BMI
595 (Wilkinson et al., 2019). In addition, the included studies relied on self-report measures of
596 attachment orientation. Although this is a quick and easy method of data collection, self-
597 report measures are subject to bias as they allow participants to misreport their experiences
598 (Ravitz, Maunder, Hunter, Sthankiya, & Lancee, 2010). The Adult Attachment Interview
599 (AAI) is considered the gold standard attachment measure, whereby the participant's
600 interview is coded and used to determine the extent of attachment (in)security (Ravitz et al.,
601 2010). Although a costly and time-consuming method, researchers should, where possible,
602 strive to use the AAI. Though it should be noted that self-report questionnaires of attachment
603 and the AAI have low agreement with each other for a range of reasons (see Bartholomew &
604 Shaver, 1998).

605 The findings of this review suggest that it may be premature to develop attachment-
606 based interventions to aid weight-loss following surgery. However, there does seem to be
607 evidence to suggest that attachment-based interventions may be of value for other outcome
608 targets associated with bariatric surgery. One notable case-study has taken an attachment-
609 informed approach to their practice across their bariatric surgery service (Sockalingam &
610 Hawa, 2016). A recently published randomised control trial (Ferriby et al., 2019) takes an
611 alternative approach, focusing on support figure attendance at appointments within the
612 bariatric surgery clinic, with a hypothesis that it will increase attachment security amongst
613 other related measures.

614 In summary, the present systematic scoping review has mapped the literature relating
615 attachment orientation and bariatric surgery. Broadly this literature concerns four main
616 outcomes (weight-loss/BMI, eating behaviour, attachment differences across groups and
617 other mental and physical health outcomes). A number of gaps in the literature and issues for

618 future studies to consider have been highlighted. As this literature grows and there are more
619 studies per outcome, a meta-analytic approach is likely to be of value (but was premature
620 here). In so doing, sub-group analysis might examine moderators of effects such as
621 attachment dimension, type of surgery and quality of study.

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Table 1 Study author and publication date are listed against study sample size (% female), mean age of participants (SD), participant groups included in the study (for brevity, individuals awaiting bariatric surgery are referred to as candidates, and individuals who have previously undertaken bariatric surgery are referred to as recipients). *Indicates the same sample was used across studies **Where standard deviation was not reported, standard error was reported alternatively *** This study is reported as a thesis and not published.

First author and year of publication	Sample size and sex (% female)	Mean age (SD), years	Participant group	Design	Measure of attachment	Attachment dimensions produced	Type of bariatric surgery
Aarts 2013	260 (84%)	44 (10.8)	Candidates	Cross-sectional	Experiences in Close Relationships Scale-Revised (Frayley et al., 2000, cited in Aarts 2013)	Attachment anxiety & attachment avoidance	n/a
Aarts 2014	250 (84%)	44 (10.9)	Candidates	Cross-sectional	Experiences in Close Relationships Scale-Revised (Frayley et al., 2000, cited in Aarts 2014)	Attachment anxiety & attachment avoidance	n/a
Aarts 2014	105 (81%)*	45 (9.1)	Candidates who became recipients	Longitudinal (≤ 12 months)	Experiences in Close Relationships Scale-Revised (Frayley et al., 2000, cited in Aarts 2014)	Attachment anxiety & attachment avoidance	Laparoscopic Roux-en-Y gastric bypass
Aarts, 2015	105 (81%)*	45 (9.1)	Candidates who became recipients	Longitudinal (≤ 12 months)	Experiences in Close Relationships Scale-Revised (Frayley et al., 2000, cited in Aarts 2015)	Attachment anxiety & attachment avoidance	Laparoscopic Roux-en-Y gastric bypass
Federico 2019	160 (15%)	42.3 (11.5)	Candidates	Cross-sectional	The Attachment Style Questionnaire (Feeney, Noller & Patty, 1993; cited in Amianto 2019)	Confidence (which is conceptually similar to attachment security), need for approval & preoccupation with relationships (conceptually similar to attachment anxiety) and relationships as secondary & discomfort with closeness (conceptually similar to attachment avoidance).	n/a

219 (16%)

Individuals with obesity
not seeking bariatric
surgery

304 (26%)

Individuals with a healthy
BMI

Appel, 2016

32 (75%)

53 (9.84)

Candidates who became
recipients

Longitudinal
(<54 months)

Bielefeld Partnership
Expectations
Questionnaire (Hoger
et al., 2002, cited in
Appel 2016)

Avoiding withdrawing,
ambivalent-clinging,
ambivalent-withdrawing,
secure, particularly secure.
Note: these 5 scores were
combined to generate a
'secure' and 'insecure' score

Laparoscopic
sleeve
gastrectomy

Bianciardi
2019

536 (71%)

43.88
(11.28)

Candidates

Cross-
sectional

The Attachment Style
Questionnaire (Feeney,
Noller & Patty, 1993,
cited in Bianciardi
2019)

Confidence (which is
conceptually similar to
attachment security), need
for approval &
preoccupation with
relationships (conceptually
similar to attachment
anxiety) and relationships as
secondary & discomfort with
closeness (conceptually
similar to attachment

n/a

avoidance).

Harrington 2008***	53 (100%)	47.06 (8.07)	Recipients	Cross-sectional	Experiences in Close Relationships Scale-Revised (Frayley et al., 2000, cited in Harrington 2008)	Attachment anxiety & attachment avoidance	Gastric bypass or gastric band, 45% and 54% respectively
Leung 2019	108 (80.6%)	46.21 (9.73)	Candidates who became recipients	Longitudinal	Experiences in Close Relationships Questionnaire (Lo et al 2009, cited in Leung 2019)	Attachment anxiety & attachment avoidance	Roux-en-Y gastric bypass
Nancarrow 2018	195 (79%)	43.52 (11.93)	Candidates who became recipients	Longitudinal	Experiences in Close Relationships Scale-Revised (Frayley et al., 2000, cited in Nancarrow 2018)	Attachment anxiety & attachment avoidance	Gastric bypass (n = 67), gastric sleeve (n = 73), gastric band (n = 2), Other (n = 1)
Pratt, 2016	125 (70%)	40.24 (11.53)	Individuals considering bariatric surgery. <i>Note, while the authors describe the participants as 'candidates', they were</i>	Cross-sectional	Experiences in close relationships - relationship structures (Fraleley et al. 2006, cited in Pratt 2016)	General attachment anxiety, significant other attachment anxiety, close friend attachment anxiety, General attachment avoidance,	n/a

			<i>recruited from an information session designed for individuals thinking about having surgery</i>			significant other avoidance & close friend avoidance	
Russo 2017***	25 (80%)	47 (12.2)	Candidates who became recipients	Longitudinal	Experiences in Close Relationships Scale-Revised (Frayley et al., 2000, cited in Russo 2017)	Attachment anxiety & attachment avoidance	Sleeve gastrectomy
Shakory 2015	1388 (79%)	44.69 (10.59)	Candidates	Cross-sectional	Experiences in Close Relationships Scale-Revised – 16 item (Lo et al, 2009; cited in Shakory 2015)	Attachment anxiety & attachment avoidance	n/a
Sockalingam 2011	70 (90%)	44.26 (9.9)	Candidates	Cross-sectional	Experiences in Close Relationships Scale-Revised – 16 item (Lo et al, 2009)	Attachment anxiety & attachment avoidance	n/a
Sockalingam 2013	132 (80%)	43.8 (10)	Candidates who became recipients	Longitudinal (<12 months)	Experiences in Close Relationships Scale-Revised – 16 item (Lo et al, 2009, cited in Sockalingam 2013)	Attachment anxiety & attachment avoidance	Laparoscopic Roux-en-Y (n = 122), sleeve gastrectomy (n = 10)
Sunil 2017	92 (80%)	44.9 (10)	Recipients	Cross-sectional	Experiences in Close Relationships Scale-Revised – 16 item (Lo et al, 2009, cited in Sunil 2017)	Attachment anxiety & attachment avoidance	Roux-en-Y (n = 80), sleeve gastrectomy (n = 12)
Taube-Schiff 2015	1383 (75%)	44.72 (10.6)	Candidates	Cross-sectional	Experiences in Close Relationships Scale-Revised – 16 item (Lo et al, 2009, Taube-Schiff 2015)	Attachment anxiety & attachment avoidance	n/a
Wilkinson 2017	34 (76%)	46.5 (1.5**)	Candidates	Cross-sectional	Experiences in Close Relationships Scale-Revised – 36 item (Brennan et al, 1998, cited in Wilkinson 2017)	Attachment anxiety & attachment avoidance	n/a
	15 (67%)	52.3 (40.4**)	Recipients				

54 (72%)

48.5 (1.4**)

Healthy weight
lean control
group (matched
by age and
gender)

Table II Study author and publication date are listed against study outcomes: weight loss and BMI, eating behaviour, attachment across groups and other outcomes.

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Aarts 2013	Not tested.	Not tested.	Not tested.	<p data-bbox="1547 316 2152 528">Mental healthcare visits. Regression analyses showed that attachment anxiety was significantly associated with mental healthcare visits amongst candidates of bariatric surgery (OR = 1.77, 95% CI = 1.16 - 2.73) but attachment avoidance was not (OR = 1.09, 95% CI = .73-1.64) and neither did the interaction between them (OR = .8, 95% CI = .52- 1.21).</p> <p data-bbox="1547 564 2152 743">Prescribed medication. Regression analyses showed that attachment anxiety was significantly associated with previously prescribed medication amongst candidates of bariatric surgery (OR = 2.66, 95% CI = 1.64 - 4.29) but attachment avoidance was not (OR = .90, 95% CI = .55- 1.74).</p> <p data-bbox="1547 780 2152 863">Attachment orientation. The interaction between attachment anxiety and avoidance was significant (OR = .56, 95% CI = .33- .94).</p> <p data-bbox="1547 900 2152 1114">Current use of medication. Regression analyses showed that attachment anxiety was significantly associated with present use of medication amongst candidates of bariatric surgery (OR = 2.22, 95% CI = 1.24 - 3.96) but attachment avoidance was not (OR = .8, 95% CI = .41-1.56) and neither did the interaction between them (OR = .63, 95% CI = .32- 1.25).</p>

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Aarts 2014	Not tested.	<i>Note: Eating behaviour was measured as a component of the pre-surgical evaluation, not as an independent variable, and was therefore analysed as such (see column 'Relationship between attachment and other health outcomes')</i>	Not tested.	<p>Measures. Expectations, social support, mental health, substance use/abuse, eating behaviours, adherence, coping and overall impression were measured collectively using a pre-operative psychological assessment tool, the Cleveland Clinical Behavioural Rating System (CCBRS; as cited in Aarts 2014). Anxiety and depression were measured using the Hospitalised Anxiety and Depression Scale (as cited in Aarts 2014).</p> <p>Anxiety. Mediation analyses found that anxiety significantly mediated the relationship between attachment anxiety and CCBRS score (poor vs. good, $p < .05$ & fair vs. good, $p < .01$). Attachment anxiety also significantly mediated the relationship between attachment avoidance and CCBRS score (poor vs. good, $p < .05$ & fair vs. good, $p < .01$).</p> <p>Depression. Mediation analyses showed that depression was a significant mediator of the relationship between attachment anxiety and CCBRS score (poor vs. good, $p = .01$ & fair vs. good, $p < .01$). Depression was also a significant mediator of the relationship between attachment avoidance and CCBRS score (poor vs. good, $p < .05$ & fair vs. good, $p < .01$).</p>
Aarts 2014	Pearson's correlations showed that there were no significant relationships between attachment anxiety and BMI ($r = .05$, $p > .05$) or attachment avoidance and BMI ($r = .00$, $p > .05$).	Not tested.	Not tested.	<p>Psychological wellbeing. Pearson's correlations showed that there was a significant correlation between attachment anxiety and mental wellbeing ($r = -.42$, $p < .01$) and attachment avoidance and mental wellbeing ($r = -.42$, $p < .01$). There was no significant correlation between attachment anxiety and physical functioning ($r = .13$, $p > .05$) or attachment avoidance and physical functioning ($r = -.07$, $p > .05$). Longitudinally, attachment anxiety was a significant predictor of mental well-being over time (assessed at baseline, 1, 3, 6 and 12 months after surgery; $F = 8.34$, $p = .005$), as was attachment avoidance ($F = 13.74$, $p < .001$).</p> <p>Physical wellbeing. Neither attachment anxiety ($F = 0.38$, $p = .54$) or attachment avoidance ($F = 0.46$, $p = .5$)</p>

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Aarts, 2015	<p data-bbox="277 547 645 695">Measures. Dietary adherence was measured using a four-item self-report scale asking the extent to which one followed/did not follow recommendations.</p> <p data-bbox="277 730 645 1035">Mediation analyses were used and controlled for age and baseline BMI. Results showed that dietary adherence at 6 months mediated a significant relationship between attachment anxiety and BMI (B = 0.51; 95% CI: 0.19 - 1.02). This mediating effect of dietary adherence did not present at 12 months post-surgery.</p>	<p data-bbox="680 547 1043 943">Dietary adherence. Logistic regression analyses showed that showed that at 6 months post-surgery, attachment anxiety (OR = 4.76, p <.001) but not attachment avoidance (OR = 1.63, p = .13) was associated with dietary adherence. Again at 12 months post-surgery, attachment anxiety was identified as a significant predictor (OR = 2.38, p = .009) but not attachment avoidance (OR = 1.18, p = .56).</p>	Not tested.	<p data-bbox="1547 225 2121 373">were significant predictors of physical functioning. In addition, neither attachment anxiety nor attachment avoidance was a predictor of the time course of either mental wellbeing or physical functioning (statistics unreported).</p> <p data-bbox="1547 547 1664 569">Not tested.</p>

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Appel, 2016	<p>Independent t-test and Mann-Whitney U tests were used. There was a significant difference of BMI pre- to post-surgery ($p < .05$). There was no significant difference of BMI between individuals who were securely or insecurely attached, pre- or post-surgery.</p> <p>ANOVAs found a significant effect of time ($F(x) = 187.72$, $p < .01$, $\eta^2 p = .90$), but no significant effect of attachment and no significant interaction of attachment and time.</p>	<p>Maladaptive eating. Independent t-tests and Mann-Whitney U tests were used. Pre-surgery, individuals who were securely attached showed a lower prevalence of maladaptive eating behaviour and higher cognitive control than individuals who were insecurely attached (for all $p < .03$, $t \geq 28$ and Cohen's $d = .87$). No significant differences were found post-surgery. Individuals who were securely attached showed a decrease in maladaptive eating behaviour ($p < .05$, $t \geq 5$ and Cohen's $d = .26$), whereas individuals who were insecurely attached showed an increase in cognitive control and reduced feeling of hunger and maladaptive eating behaviour (for all $p < .01$, $t \geq 14$ and Cohen's $d = .51$).</p> <p>ANOVAs showed a significant effect of time and cognitive control ($F(x) = 10.20$, $p < .01$, $\eta^2 p = 0.27$), feelings of hunger ($F(x) = 9.21$, $p < .01$, $\eta^2 p = .25$) and maladaptive eating ($F(x) = 60.86$, $p < .01$, $\eta^2 p = .69$). No significant effect of attachment or interaction between attachment and time for each of these three measures and eating behaviour were found.</p>	Not tested.	<p>Independent t-tests and Mann Whitney U tests were used.</p> <p>Psychological factors, pre-surgery. Individuals who were securely attached showed a reduced prevalence for depression and psychological distress and a higher prevalence of quality of life and self-esteem than individuals who were insecurely attached (for all $p < .03$, $t \geq 28$ and Cohen's $d = 0.87$).</p> <p>Temporal changes. Post-surgery, individuals who were securely attached showed a reduced prevalence of depression and a higher prevalence of self-esteem than individuals who were insecurely attached (for all $p < .02$, $t \geq 24$ and Cohen's $d = .95$). Individuals who were securely attached showed an improvement in anxiety, psychological distress, quality of life and self-esteem (for all $p < .05$, $t \geq 5$ and Cohen's $d = .26$). Note that the authors inconsistently report the significance of the improvement in anxiety. Individuals who were insecurely attached improved in all outcome measures, quality of life, self-esteem, depression, anxiety and psychological distress (for all $p < .01$, $t \geq 14$ and Cohen's $d > .51$). <i>Note, again the authors inconsistently report the significance of the improvement in anxiety. ANOVAs were also used.</i></p> <p>There was a significant effect of time and self-esteem ($F(x) = 30.08$, $p < .01$, $\eta^2 p = .54$), quality of life ($F(x) = 28.35$, $p < .01$, $\eta^2 p = .52$), anxiety ($F(x) = 11.91$, $p < .01$, $\eta^2 p = .33$), depression ($F(x) = 8.69$, $p = .01$, $\eta^2 p = .27$) and (5) psychological distress ($F(x) = 14.48$, $p < .01$, $\eta^2 p = 0.38$).</p> <p>Attachment. There was a significant effect of attachment and self-esteem ($F(x) = 5.66$, $p = .03$, $\eta^2 p = .18$), quality of life ($F(x) = 4.22$, $p = .05$, $\eta^2 p = .14$) and depression ($F(x) = 10.54$, $p < .01$, $\eta^2 p = .31$). There was no significant effect of the interaction between time and attachment for maladaptive eating behaviour.</p>

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Bianciardi 2019	Not tested.	Not tested.	Not tested.	<p>Prevalence of body image dissatisfaction. Female candidates of bariatric surgery presented with a high degree of body image dissatisfaction than male candidates ($t(534) = 7.39, p < .0001$). Candidates who reported a psychiatric disorder also reported an increased prevalence of body image dissatisfaction ($t(534) = 4.46, p < .0001$).</p> <p>Predictors of body image dissatisfaction. Need for approval, conceptually similar to attachment anxiety ($\beta = 0.15, t = 4.26, <.0001$) were independently predictive of body image dissatisfaction. Neither of the other attachment subscales (confidence, preoccupation with relationships, discomfort with closeness or relationships as secondary, were predictive of body image dissatisfaction.</p>

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Federico 2019	Not tested.	Not tested.	<p>ANCOVA analyses showed a significant differences in the need for approval (closely related to attachment anxiety) was more prevalent among the participants with a health BMI compared to those without and not seeking bariatric surgery across bariatric ($p < .001$).</p> <p>Post-hoc analyses showed that need for approval was significantly higher in recipients of bariatric surgery and individuals who were obese and individuals of a healthy weight. No significant differences were found between the groups for the remaining attachment subscales (confidence, discomfort with closeness, preoccupation with relationships and relationships as secondary).</p>	Not tested.

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Harrington 2008****	Regression analyses showed that a low levels of attachment insecurity was associated with weight loss maintenance ($r = .25$, $p < .06$), note this was described as 'approaching significance'. Attachment orientation was not related to weight regain ($r = -.17$, p-value not reported). Though, a combined effect of attachment and trauma predicted weight loss maintenance ($r^2 = .12$, $p < .05$). Also, a combined effect of attachment orientation, trauma and risk of an eating disorder predicted weight loss maintenance ($r^2 = .11$, $p < .05$).	Eating disorder. Regression analyses showed that attachment security was associated with a reduced risk of developing an eating disorder ($r = .39$, $p < .01$).	Not tested.	<i>Traumatic symptoms were measured using the Trauma Symptom Inventory (as cited in Harrington 2008), a self-report questionnaire designed to assess problematic symptoms of post-traumatic stress disorder and other trauma associated symptoms.</i> Traumatic symptoms. Higher attachment security was associated with experiencing fewer traumatic symptoms ($r = .30$, $p < .05$).
Leung 2019	Multivariate linear analyses showed that neither attachment anxiety ($b = -.286$, $p = .778$) or attachment avoidance ($b = -1.36$, $p = .175$) were significant predictors of total weight loss at 2 years post-surgery.	Emotional eating. Multivariate analyses showed that neither attachment anxiety ($b = 1.35$, $p = .18$) or attachment avoidance ($b = .4$, $p = .69$) predicted emotional eating score 2 years post-surgery. Attachment anxiety ($b = -.13$, $p = .9$) did not significantly predict binge eating score 2 years post-surgery but attachment avoidance was a significant predictor ($b = 2.58$, $p = .01$).	Not tested.	n/a
Nancarrow 2018	T-test analyses showed that neither attachment anxiety ($b = .001$, $p = .900$) nor attachment avoidance ($b = -.01$, $p = .890$) predicted BMI changes <1 year post-surgery.	Not tested.	Chi square analyses showed that patients of bariatric surgery reported significantly high levels of attachment anxiety ($p = .001$) and significantly lower levels of attachment avoidance ($p < .001$), compared to individuals not having surgery.	n/a

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Pratt, 2016	<p>Pearson's correlations showed that there were no significant associations between BMI and close friend and significant other attachment anxiety and avoidance (statistics were unreported).</p> <p>In follow-up analysis, in which the sample was split into groups that were either above or below the mean attachment scores of a large reference sample (Fraley, Heffeman & Vicary, 2011, cited in Pratt 2016). Independent t-tests showed that there was no significant difference in these groups for BMI for significant other avoidance ($t(111) = -1.20, p = .23$) and close friend avoidance or close friend anxiety</p> <p>There was a significant difference in BMI across low ($n = 86$) and high ($n = 34$) groups for significant other attachment anxiety ($t(118) = -2.4, p < .05$).</p>	<p>Cognitive restraint, uncontrolled and emotional eating. Pearson's correlations showed that general relationship anxiety was significantly associated with uncontrolled eating ($r(118) = .19, p < .05$).</p> <p>There were no significant associations between eating behaviours (emotional eating, cognitive restraint or uncontrolled eating) for significant other attachment anxiety, close friend attachment anxiety, General attachment avoidance, significant other avoidance, close friend avoidance. In follow-up analysis, in which the sample was split into groups that were either above or below the mean attachment scores of a large reference sample (Fraley, Heffeman & Vicary, 2011). There was no significant difference in these groups for eating behaviour for significant other and close friend avoidance or close friend anxiety. There was a significant difference in uncontrolled eating across low ($n = 86$) and high ($n = 34$) groups for significant other anxiety ($t(118) = -2.5, p < .01$).</p>	<p>When the bariatric surgery candidate sample was compared to a large reference sample ($n = 21,000$; Fraley, Heffeman & Vicary, 2011) for the different attachment dimensions produced in this study it was found that attachment avoidance for the significant other was significantly higher in the bariatric group than the reference group, $t(21123) = 2.47, p = .01$. There were no significant differences between groups for general attachment avoidance or to close friends. Compared to the reference group members of the bariatric group who exhibited more attachment anxiety towards a significant other ($t(21123) = -4.17, p < .0001$) and attachment anxiety towards close friends, $t(21123) = -3.6, p = .0003$. For global attachment anxiety, the reference group scored significantly higher than the bariatric group, $t(21123) = -5.8, p < .0001$. <i>Note: Significance was tested from means and SDs reported in the paper.</i></p>	n/a

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Russo 2017****	Pearson's correlations showed that neither attachment anxiety ($r = .12$, $p = .564$) nor attachment avoidance ($r = .22$, $p = .294$) were associated with % weight loss.	<p><i>Measures.</i> Eating behaviour was measured using the Three Factor Eating Questionnaire which encompasses three dimensions of eating behaviour, these are emotional eating, uncontrolled eating and cognitive restraint.</p> <p>Cognitive restraint, uncontrolled and emotional eating. Pearson's correlations showed that attachment avoidance was positively correlated with cognitive restraint ($r = .49$, $p = .01$) and uncontrolled eating ($r = .51$, $p = .01$) but not emotional eating ($r = .23$, $p = .277$). Attachment anxiety was not related to either cognitive restraint ($r = .24$, $p = .25$), uncontrolled eating ($r = .37$, $p = .07$) or emotional eating ($r = .28$, $p = .18$).</p>	Not tested.	<p>Psychological wellbeing. Pearson's correlations showed no significant relationship between attachment orientation, measured pre-surgery and changes in depressive symptoms, anxiety symptoms or quality of life. Attachment orientation was analysed independently as attachment anxiety (depression: $r = .24$, $p = .26$; anxiety: $r = .27$, $p = .19$; quality of life: $r = .38$, $p = .06$) and attachment avoidance (depression: $r = .08$, $p = .73$; anxiety: $r = .11$, $p = .59$; $r = .37$, $p = .07$) as well as an overall total attachment score (depression: $r = .19$, $p = .38$; anxiety: $r = .23$, $p = .27$; quality of life: $r = .42$, $p = .04$).</p>

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Shakory 2015	Not tested.	<p>Binge eating. Pearson's correlations showed a significant correlation between binge eating and attachment anxiety ($r = .33$, $p < .01$) and attachment avoidance ($r = .19$, $p < .01$). Mediation analyses showed a significant indirect relationship from attachment anxiety to binge eating via difficulties in emotion regulation (unstandardised regression coefficient = $.01$ (SE = $.001$) 95% confidence interval: $0.008 - 0.012$). Also, a significant indirect relationship from attachment avoidance to binge eating via difficulties in emotion regulation (unstandardised regression coefficient = $.01$ (SE = $.011$) 95% confidence interval: $0.06 - 0.12$).</p>	Not tested	<p>Emotion regulation. Mediation analyses showed that attachment anxiety was significantly predicted emotion regulation via binge eating, $b = .0004$, SE = $.0001$, 95% confidence interval = $.0003 - .0005$. Attachment avoidance did not predict emotion regulation via binge eating, $b = .0005$, SE = $.0006$, 95% CI $-.002 - .001$.</p>
Sockalingam 2011	Not tested.	Not tested.	Not tested.	<p>Health-related quality of life. Multiple regression showed that attachment anxiety was not a significant predictor health-related quality of life, with regards to physical health ($b = -.098$, $p = \text{NS}$) or mental health ($b = -.205$, $p = \text{NS}$). Attachment avoidance was not a significant predictor physical health-related quality of life ($b = .154$, $p = \text{NS}$) but was a significant predictor of mental health-related quality of life ($b = -.207$, $p = .024$). <i>Note: exact p-values were not reported for non-significant findings.</i></p>

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Sockalingam 2013	<p data-bbox="257 220 660 347"><i>Note: non-attenders displayed a significantly higher prevalence of attachment avoidance than attenders.</i></p> <p data-bbox="257 379 660 563">Multivariate logistic regression was used. There were no significant differences between attenders and non-attenders and %total weight loss at 6 months post-surgery (p = .32).</p>	Not tested.	<p data-bbox="1064 220 1534 347">Multivariate logistic regression was used. Attachment avoidance was significantly more prevalent among non-attenders compared to the attenders (p = .02).</p> <p data-bbox="1064 347 1534 467">There was no difference of attachment anxiety between the members of the attenders and non-attenders group (p = .39).</p>	<p data-bbox="1534 220 2177 316">Attendance. High attachment avoidance was predictive of non-attendance at follow-up appointments (b = -.04, SE = .02, OR = .96, CIs = .92 - 1.0).</p>

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Sunil 2017	Not tested.	Not tested.	Not tested	<p data-bbox="1547 220 2152 496"><i>Two measures were used to assess adherence. First, the Morisky medication-taking adherence scale (MMAS-4, as cited in Sunil 2017), a 4-item questionnaire which asks about medication taking. Second, the visual analog scale (VAS, as cited in Sunil 2017), is a validated, self-report tool which asks for adherence to be rated on a continuous scale of 0-100; a cut-off of 80% was used to indicate greater adherence. Wilcoxon and chi square analyses were used.</i></p> <p data-bbox="1547 533 2152 991">There was significant difference of attachment anxiety between individuals who were adherent or non-adherent to vitamin supplementation at 3- and 6-months post-surgery (p = .02). There was no significant difference of attachment avoidance between individuals who were adherent or non-adherent to vitamin supplementation at 3- and 6-months post-surgery (p = .26). VAS: There was no significant difference of attachment anxiety between individuals who were adherent or non-adherent to vitamin supplementation at 3- and 6-months post-surgery (p = .18). There was no significant difference of attachment avoidance between individuals who were adherent or non-adherent to vitamin supplementation at 3-and 6-months post-surgery (p = .29).months post-surgery (p = .29).</p> <p data-bbox="1547 1027 2152 1452">There was no significant difference of anxiety between individuals who were adherent or non-adherent to vitamin supplementation at 3- and 6-months post-surgery. There was no significant difference of depression between individuals who were adherent or non-adherent to vitamin supplementation at 3- and 6-months post-surgery (p = .33). VAS: There was no significant difference of anxiety between individuals who were adherent or non-adherent to vitamin supplementation at 3- and 6-months post-surgery (p = .61). There was no significant difference of depression between individuals who were adherent or non-adherent to vitamin supplementation at 3 and 6 months post-surgery (p = .26). post-surgery (p = .26).</p>

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Taube-Schiff 2015	Not tested.	<p>Emotional eating. Structural equation modelling showed that attachment anxiety had a significant positive direct effect emotional eating in response to anger ($b = .08$, $SE = .03$, $p < .01$). Attachment avoidance had a significant negative direct on emotional eating in response to anxiety ($b = -.05$, $SE = .04$, $p < .01$). Significant mediational pathways were identified whereby high attachment avoidance and high attachment anxiety were each associated with emotion regulation difficulties which in turn was associated with high levels of emotional eating in response to anger, anxiety and depression (all ab paths $b = .02-.05$, $p < .001$(all)).</p>	Not tested.	<p>Emotion regulation difficulty. Structural equation modelling showed that both high attachment anxiety and high attachment avoidance were associated with increased difficulties regulating emotions ($b = .50$, $SE = .05$, $p < .001$ and $b = .51$, $SE = .06$, $p < .001$).</p>

First author and year of publication	Weight loss/BMI outcome	Eating behaviour outcome	Difference in attachment across groups	Relationships between attachment and other health outcomes
Wilkinson 2017	<p>Mediation analyses showed that higher attachment insecurity was associated with a higher weight indicated by membership to the lean and candidates group (b = .51, SE = .23, p = .020). Also, attachment insecurity was not associated with weight, indicated by group membership between members of the lean/recipients group (b = .64, SE = .37, p = .080) and the candidates/recipients group (b = -.07, SE = .27, p = .800).</p>	<p><i>Analyses were conducted three times to account for three models, each comparing the lean/candidates group, lean/recipients group and the candidates/recipients group.</i></p> <p>Disinhibited eating. Mediation analyses showed that higher attachment insecurity predicted increased prevalence of disinhibited eating (b = .98-1.2, SE = .37-.50, p = .002 - .045).</p> <p>Also, disinhibited eating mediated the relationship between attachment insecurity and weight, indicated by membership to the lean/candidates group (b = .20, SE = .07, p =.003) and membership to the lean/recipients group (b = .28, SE = .1, p =.005). There was no such mediated relationship between participants of the candidates and recipients groups (B = .06, SE = .06, p = .54).</p>	<p>Mediation analyses showed that attachment insecurity was significantly more prevalent among candidates of bariatric surgery than the lean control group (p = .045).</p> <p>Attachment insecurity did not differ significantly between candidates and recipients of bariatric surgery and recipients and individuals of a healthy weight, <i>Note: p-values were not reported.</i></p>	Not tested.

Table III. Quality assessment.

First author and year of publication	Selection Bias	Design	Confounders	Data Collection Methods	Withdrawals & Drop outs	Global Rating
Aarts 2014	Fair	Poor	Good	Good	N/A	Moderate
Aarts 2013	Fair	Poor	Good	Poor	N/A	Weak
Aarts, 2015	Fair	Fair	Good	Good	Good	Strong
Aarts, 2014	Fair	Fair	Good	Good	Good	Strong
Appel 2016	Fair	Fair	Poor	Good	Poor	Weak
Bianciardi 2019	Good	Poor	Good	Good	N/A	Moderate
Harrington 2008	Fair	Poor	Good	Good	N/A	Moderate
Federico 2019	Fair	Fair	Good	Good	N/A	Strong
Leung 2019	Fair	Fair	Good	Good	Poor	Moderate
Nancarrow 2018	Fair	Fair	Good	Good	Poor	Moderate
Pratt, 2016	Poor	Fair	Good	Good	Good	Moderate
Russo 2017	Fair	Fair	Poor	Good	Poor	Weak
Shakory, 2015	Fair	Poor	Poor	Good	N/A	Weak
Sockalingam, 2011	Fair	Fair	Poor	Good	N/A	Moderate
Sockalingam, 2013	Fair	Fair	Poor	Good	Fair	Moderate
Sunil 2017	Fair	Fair	Good	Good	Poor	Moderate
Taube-Schiff 2015	Fair	Poor	Good	Good	N/A	Moderate
Wilkinson 2017	Fair	Fair	Good	Good	N/A	Strong