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PEDIATRIC REVIEW

Health-related quality of life in obese children and adolescents

MD Tsiros[1,2], T Olds[1,2,3], JD Buckley[1,2], P Grimshaw[2], L Brennan[1,4,5], J Walkley[1,4], AP Hills[1,6], PRC Howe[1,2] and AM Coates[1,2]

[1]*Australian Technology Network Centre for Metabolic Fitness, Sansom Institute for Health Research, University of South Australia, Adelaide, South Australia, Australia;* [2]*Nutritional Physiology Research Centre, Sansom Institute for Health Research, University of South Australia, Adelaide, South Australia, Australia;* [3]*Centre for Applied Anthropometry, School of Health Sciences, University of South Australia, Adelaide, South Australia, Australia;* [4]*School of Medical Sciences, RMIT University, Melbourne, Victoria, Australia;* [5]*Parenting Research Centre, Melbourne, Victoria, Australia and* [6]*School of Human Movement Studies, Institute of Health and Biomedical Innovation, Queensland University of Technology, Brisbane, Queensland, Australia*

Objective: This review addresses the effect of overweight and obese weight status on pediatric health-related quality of life (HRQOL).
Method: Web of Science, Medline, CINAHL, Cochrane Library, EMBASE, AMED and PubMed were searched for peer-reviewed studies in English reporting HRQOL and weight status in youth (<21 years), published before March 2008.
Results: Twenty-eight articles were identified. Regression of HRQOL against body mass index (BMI) using pooled data from 13 studies utilizing the Pediatric Quality of Life Inventory identified an inverse relationship between BMI and pediatric HRQOL ($r=-0.7$, $P=0.008$), with impairments in physical and social functioning consistently reported. HRQOL seemed to improve with weight loss, but randomized controlled trials were few and lacked long-term follow-up.
Conclusions: Little is known about the factors associated with reduced HRQOL among overweight or obese youth, although gender, age and obesity-related co-morbidities may play a role. Few studies have examined the differences in HRQOL between community and treatment-seeking samples. Pooled regressions suggest pediatric self-reported HRQOL can be predicted from parent proxy reports, although parents of obese youths tend to perceive worse HRQOL than children do about themselves. Thus, future research should include both pediatric and parent proxy perspectives.
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Keywords: pediatric; HRQOL; BMI; youth; review; overweight

Introduction

Obesity is a key public health concern in developed nations worldwide.[1] Although much research has investigated the medical sequelae associated with obesity, growing evidence indicates that, at least in adult populations, obesity impacts negatively on functional health and well-being, or what is commonly referred to as health-related quality of life (HRQOL).[2] Indeed, adult studies report an inverse relationship between body mass index (BMI) and HRQOL,[2] and indicate that HRQOL improves with weight loss.[2–5] It also appears that adults seeking treatment for obesity have poorer HRQOL than non-treatment seekers after controlling for weight status.[6,7] Although lagging behind the adult literature, the last 6 years has seen an increase in the number of pediatric studies examining the relationship between obesity and HRQOL, but to our knowledge no earlier published reviews have synthesized this literature.

Correspondence: Dr AM Coates, ATN Centre for Metabolic Fitness and Nutritional Physiology Research Centre, Sansom Institute for Health Research, University of South Australia, PO Box 2471, Adelaide, South Australia 5001, Australia.
E-mail: alison.coates@unisa.edu.au
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Defining HRQOL

The World Health Organization defines HRQOL as an individual's quality of life associated with their physical, mental and social well-being.[6] The concept of HRQOL sits outside of the World Health Organization International Classification Framework for Disability and Functioning[8] (Figure 1). However, HRQOL measures typically encompass several International Classification Framework components,

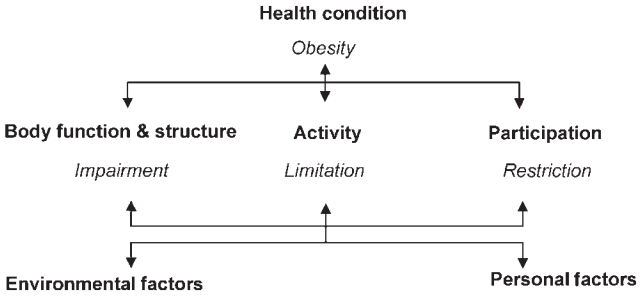

Figure 1 International Classification for Disability and Functioning.[8]

particularly those related to *activity* (i.e. execution of a specific task) and *participation* (i.e. in real-life situations),[9] although they less frequently encompass components related to physiological *body functions* (for example, neuromusculoskeletal function and pain) or contextual factors (i.e. *environmental* and *personal*). A chronic health condition may have varying effects on aspects of a person's functioning. For example, a health condition may cause significant impairments in body functions, although the individual may still be able to participate fully in community life and report positive HRQOL. In contrast, others with minor physical impairments may report significant participation restrictions and impaired HRQOL. Therefore, it is important to examine the effect of a health condition such as obesity on all aspects of functioning. In the case of HRQOL, this is most often assessed using standardized questionnaires.

Measuring HRQOL

Health-related quality of life is usually assessed from the individual's perspective, although parent proxy reports are frequently used if children are too young or unwell to self-report.[10] Dual reporting of HRQOL from parental and pediatric perspectives may also provide insight into different perceptions of functioning. However, parental perceptions are most likely to influence whether healthcare services are sought.[10] Therefore, whether HRQOL is collected from parent proxy report or pediatric self-report is likely to have an effect on research findings. A recent review[10] critically analyzed HRQOL measures, and specified tools that provide options for either parent or pediatric reports such as the Child Health Questionnaire (HealthActCHQInc., Boston, MA, USA) and the Pediatric Quality of Life Inventory (PedsQL, MAPI Research Institute, Lyon, France), which also has age-appropriate versions available.

Health-related quality of life questionnaires can be classified as either *generic* tools (such as the PedsQL or the Child Health Questionnaire) or *condition-specific* tools (such as the Impact of Weight on Quality of Life (IWQOL), Obesity and Quality of Life Consulting, Cincinnati, OH, USA).[2] Generic measures have the benefit of allowing comparisons between health conditions; for example Varni *et al*.[11] examined the effect of 10 different disease clusters on HRQOL and concluded that obese youths self-reported lower quality of life than participants with cardiac conditions, gastrointestinal conditions and diabetes (effect size of 0.78 compared with healthy lean youths). Similarly, two independent studies found that treatment-seeking severely obese youths had a HRQOL similar to youths with cancer.[12,13] Comparisons of this nature can yield information that may be of particular interest to policy-makers and funding agencies.[14] Alternatively, condition-specific measures may be more sensitive to HRQOL limitations experienced as a result of a particular health condition, and may therefore be better suited to detecting specific treatment effects. Kolotkin *et al*.[15] found consistently larger effect sizes for differences between the lowest and highest BMI groups when using the obesity-specific IWQOL-Kids (effect sizes of >1.00 for all subscales except for family relations) compared with the generic PedsQL (effect sizes of 0.46–0.95 for subscales). Condition-specific tools may also be more clinically meaningful as they explore the specific difficulties related to a given condition.[10] Therefore, it may be more appropriate to use both generic and condition-specific measures, although resource implications and participant burden would need to be carefully considered.

The purpose of this review is to explore the relationship between overweight and obesity and HRQOL in children and adolescents, utilizing pooled analyses where feasible. Although there are many definitions of overweight and obesity (for example, Centre for Disease Control growth charts, International Obesity Task Force criteria, UK), this review is not limited to studies employing any one definition. Changes in HRQOL with weight loss are examined, as well as differences between parent proxy and pediatric self-reports and treatment-seeking versus community samples. Other predictors of HRQOL besides weight status are also briefly discussed. Finally, limitations in the literature and recommendations for future research are outlined.

Method

Selection of studies

Studies were included if they met the following criteria: focused on children or adolescents (<21 years); assessed weight status (for example, weight, BMI, body fat and skin folds); assessed HRQOL (either parent proxy or self-report) and reported HRQOL in reference to weight status. Non-English papers, narrative reviews, expert opinions, editorials, letters to the editor, theses or abstracts were excluded, as were studies reporting HRQOL in children or adolescents <21 years with a focus on other primary conditions (for example, cystic fibrosis, brain tumors and arthritis).

Search strategies

Web of Science, Medline (via OVID), CINAHL (via Ebsco-Host), Cochrane Library, EMBASE, AMED and PubMed

databases were searched for papers published before March 2008. The following three search statements were combined: ('health-related quality of life' OR HRQOL OR PedsQL OR 'Pediatric Quality of Life Inventory' OR 'weight-related quality of life' OR SF-36 OR IWQOL-Lite OR 'Impact of weight on quality of life-lite') AND (obese OR obesity OR overweight OR adipose OR adiposity OR BMI OR 'body mass index') AND (child OR children OR adolescent OR adolescence OR pediatric OR paediatric OR youth). Depending on the features of the specific database, wildcards were utilized and searches were limited to English, human, peer-reviewed journal articles and a child/adolescent age range (<21 years). No date limits were set. Manual searching of reference lists from the publications identified by the database searches was also performed to identify any relevant articles that were not picked up by the searches. 'Saturation point' was reached after searching Medline and Web of Science as only one *new* article was located from searches of the other databases.

Synthesis

A descriptive analysis of studies was undertaken, which involved grouping studies by design, and then critically summarizing key features in tables. For observational studies, key features included author, year, study design, country, subjects, definition of obesity, HRQOL tool and informants, relationship between HRQOL and weight status, strengths and limitations. For weight loss studies, treatment, length of follow-up, drop outs, degree of weight loss, change in HRQOL, main findings and limitations were tabulated. Studies utilizing the PedsQL[16] to assess HRQOL, with available means and s.d. for PedsQL scores and BMI, were used for correlational analyses to determine relationships between pediatric and parent-reported PedsQL scores (total, physical and psychosocial) and mean reported BMI. Mean pediatric-reported PedsQL scores were also correlated with mean parent proxy scores. Bland–Altman analyses were also conducted to determine limits of agreement between mean pediatric and mean parent proxy-reported scores. Statistical significance was set at an α level of <0.05.

Results

Abstracts from 439 publications identified from the searches were screened against the inclusion and exclusion criteria (Figure 2). Of these, 344 were deemed ineligible because they involved adults ($\geqslant$21years); did not specifically examine HRQOL or weight status; involved other conditions (for example, asthma, cystic fibrosis, sleep disordered breathing); were non-English or were narrative reviews, editorials or abstracts. Fifty-seven abstracts were duplicates and were therefore excluded. Thirty-eight references were sourced in full text, after which a further 10 articles were found to be ineligible for the same reasons described earlier, leaving twenty-eight articles that met the inclusion criteria

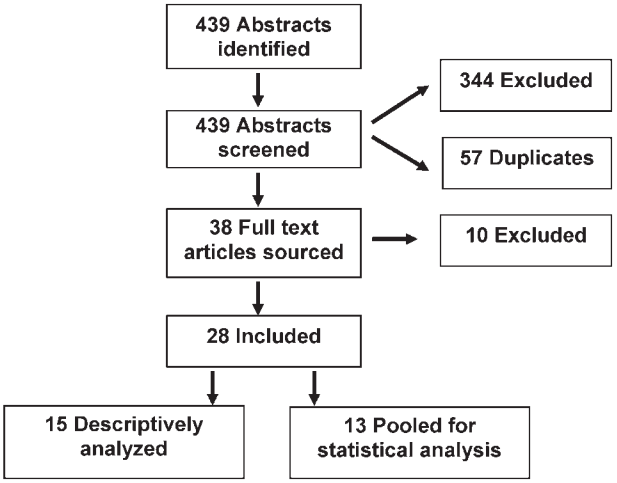

Figure 2 Flowchart depicting results of database searches for articles published before March 2008.

(Figure 2). Of these, 22 studies were cross-sectional (Table 1), which included six population-based studies with participant numbers ranging from 1456 to 69 031.[6,14,17–20] Six studies utilized weight loss interventions (Table 2), of which two were randomized controlled trials (RCTs).[21,22] One paper reported two studies (cross-sectional and intervention) and was therefore included in both the tables.[15] Fifteen studies utilizing the PedsQL were included in the pooled analyses.

Weight-status and HRQOL

Overall HRQOL. Twenty-two cross-sectional and population-based studies report that children and adolescents with obesity have reduced overall HRQOL compared with their lean counterparts, with studies reporting medium[23] to large effect sizes[11,15] of difference (Table 1). Of the 22 studies located, 12 studies report significant inverse relationships between overall HRQOL and weight status in both community and treatment-seeking samples (Table 1), either using dichotomized weight categories as predictors,[18,23,24] or BMI as a continuous predictor.[6,12,14,15,19,24–27] Our pooled analyses indicate that there is an inverse linear relationship between HRQOL (PedsQL total score) and BMI for both pediatric self-report ($r=-0.7$, $P=0.008$, $n=13$) and parent proxy-report ($r=-0.77$, $P=0.003$, $n=12$) (Figure 3). In contrast, three smaller cross-sectional studies from the United States of America did not find a significant inverse relationship between BMI (as a continuous predictor) and overall HRQOL.[13,28,29]

Physical functioning. When examining subsets of HRQOL, 12 studies report significantly lower physical functioning in obese compared with lean children[6,11,12,15,17,23,24,27,28,30–32] (Table 1). Of these, one paper[23] found small effect sizes (0.23), whereas two other papers[11,15] reported large effect sizes of difference (0.74–1.09) between obese and lean

Table 1 Health-related quality of life (HRQOL) and pediatric obesity

Author, year Study design Country	*Subjects*	*Definition of obesity*	*HRQOL tool and informants*	*HRQOL lower in OB? (P < 0.05)*	*BMI and HRQOL inversely related? (P < 0.05)*	*Strengths and limitations*
Simon 2008[a] CS population-based US	6–18 YO $N = 69\,031$	Not specified ? CDC	Customized from available datasets (based on CHIP)	Yes	Yes (β −2.902 to −3.523)	*Strengths:* Very large sample, well powered to look at predictors of HRQOL. *Limitations:* Did not examine specific predictors of HRQOL when dichotomized for weight status. Reliant on parent proxy reports and parent-reported weight
De Beer 2007[b,c,d] CS Netherlands	12–18 YO OB ($n = 31$) and NW ($n = 62$) age matched	IOTF	PedsQL—self-report CHQ—parent report	Yes (partially mediated by obesity-related co-morbidities)	Yes (% variance explained by BMI *z*-score score varied from 5 (physical health) to 33% (global health)	*Strengths:* Explored possible mediating role of co-morbidities and controlled for non-obesity related co-morbidities. Focused exclusively on adolescents. Used a matched control group instead of existing norms. *Limitations:* Parents measured height and weight of NW. Small sample
Hughes 2007[b,c,d] CS, US	5–11YO OB ($n = 126$) (>98th %), NW ($n = 71$), age, gender and SES matched.	IOTF (UK data)	PedsQL Self- and parent report	Yes	—	*Strengths:* Homogenous sample, pair-matched design. *Limitations:* N/a to adolescents. Treatment-seeking sample so not generalizable to community. CS
Ingerski 2007[b,c,d] CS, US	12–17 YO OW/OB ($n = 107$)	CDC	PedsQL Self- and parent report	Yes (cf normative data)	No (although R^2 not specified)	*Strengths:* Looked at effect of ethnicity and social support. *Limitations:* Only $n = 6$ were OW, so only applicable to OB, small sample, CS design, did not report BMI
Janicke 2007[b,c,d] CS, US	8–17 YO OB ($n = 96$)	CDC	PedsQL Self- and parent report	Yes (cf normative data)	No (correlation −0.01 for BMI *z*-score and total parent score)	*Strengths:* Examined mediation of peer victimization, parent distress and depressive symptoms on HRQOL. *Limitations:* Only looked at treatment-seeking sample of OB so findings are less generalizable, CS design, small sample
Pinhas-Hamiel 2006[a,b,c,d] CS, Israel	11.4 ± 4.2YO NW ($n = 94$), OB ($n = 88$) (>95th %)	CDC	PedsQL Self- and parent report	Yes	Yes ($r = -0.47$ for total score)	*Strength:* Looked at differences between hospital and community treatment-seeking OB subjects. *Limitations:* CS, small sample. Community sample was still treatment seeking
Stern 2007[b,c,d] CS, US	11–18YO $N = 100$ OB (95th %)	CDC	PedsQL Self-report	Yes	No (correlation of −0.1)	*Strengths:* Looked at effect of ethnicity and gender (no interactions found), and self-esteem. *Limitations:* Only looked at a treatment-seeking sample of severely OB adolescents, small sample and CS
Taylor 2007[b] CS US	Mean age 12 YO OB ($n = 183$) (>95%) NW ($n = 128$)	National Nutrition Survey data	IWQOL-adolescent Self-report	Yes	—	*Strengths:* Utilized obesity-specific tool. *Limitations:* Small sample, CS and excluded SOB subjects
Tyler 2007[a,c,d] CS US	11–13YO $N = 175$ Mexican NW, OW, OB, SOB (99.5th %)	CDC	PedsQL Self-report	Yes	Yes (main effect across weight, with a medium effect size for total HRQOL, [e]Cohen's $f = 0.35$ ($r = 0.33$)	*Strengths:* Looked at a range of BMIs. *Limitations:* CS, only looked at Mexicans, so less generalizable
Varni 2007[a,b,c,d,f] CS US and Aust	5–18 YO $N = 63$ OB Compares with NW reference data ($n = 9566$)	CDC and IOTF	PedsQL Self- and parent report	Yes (effect size 0.78 cf NW)	—	*Strengths:* Pooled data from 2 studies. *Limitations:* See Schwimmer 2003 and Williams 2005. Did not specifically report BMI. Did not assess the strength of relationship between BMI and HRQOL
Arif 2006[a] CS population-based study US	$N = 5330$ 3–18 YO NW (5–85th %), OW (85–95th %), OB (>95th %)	CDC	KINDL Parent report	Yes	Yes ($\beta = -1.15$, $P < 0.008$ for total score)	*Strengths:* Large sample. Examined other predictors including ethnicity, co-morbidities, etc. and found that hyperglycemia and self-esteem may mediate physical function. *Limitations:* Parent-proxy report only, telephone survey with parent-reported height and weight
Kolotkin 2006[a,b,d,g] CS US	11–19 YO NW ($n = 216$) (<85th %), OW ($n = 64$), OB (n = 362) (>95th %)	CDC	PedsQL and IWQOL-kids Self-report	Yes—effect sizes 0.59–1.33 (IWQOL) and 0.47–0.95 (PedsQL)	Yes $r = -0.54$ for total score	*Strengths:* Looked at data from uncontrolled clinical trial (see Table 2) and also CS data. Examined differences between community and treatment-seeking OB samples. *Limitations:* Primary aim of study was to validate the IWQOL-lite

Table 1 (continued)

Author, year Study design Country	*Subjects*	*Definition of obesity*	*HRQOL tool and informants*	*HRQOL lower in OB? (P < 0.05)*	*BMI and HRQOL inversely related? (P < 0.05)*	*Strengths and limitations*
Rudolf 2006[b,c] CS UK	8–16 YO Moderately to SOB (>98th %) $N=94$	? Unknown	PedsQL Do not specify self/parent report	Yes (cf normative reference data)	—	*Limitation:* Although this study was an uncontrolled clinical trial, f/u data for HRQOL was not reported, so data can only be treated as CS. Did not define whether they used IOTF or CDC criteria, or whether they used self or parent-reported HRQOL
Zeller 2006[b,c,d] Retrospective US	13–18 YO $N=33$ SOB	CDC	PedsQL Self- and parent report	Yes (cf normative reference data)	—	*Strengths:* Considered effect of co-morbidities and found no relationship with HRQOL. *Limitations:* Looked at SOB, pre-bariatric surgery so sig co-morbidities are likely. Small sample. Retrospective analysis of case notes. Unknown if parents were prevented from influencing adolescents when completing questionnaires
Zeller and Modi 2006[b,c,d] CS US	8–18 YO OB (>95th %)	CDC	PedsQL Self- and parent reports	Yes	Yes (adjusted $R^2=0.29$ for physical and 0.54 for social)	*Strengths:* Considered ethnicity (no effects found), included self and parent-reports. *Limitations:* Treatment-seeking sample
Chen 2005[a,d,h] CS population-based Japan	12–13 YO $N=7887$	? Unknown	COOP Charts Q Child report	Yes, but not specified as OB	Yes (HRQOL inversely related to BMI, but strength of relationship not specified)	*Strengths:* Large population-based sample. Homogenous early adolescent age range. Used self-reported HRQOL. *Limitations:* Did not define participants as OW, OB, etc. but looked at relationship with BMI. Aim was not to assess weight-related HRQOL. Only applicable to Japanese 12–13YO
Fallon 2005[b] CS US	14.5 ± 1.5 YO SOB ($n=62$ African American, $n=48$ Caucasian) NW ($n=34$)	CDC	IWQOL–self-report CHQ–parent report	Yes	Yes ($r=-0.4$ to -0.67 for Caucasians in social, self-esteem and daily living subsets)	*Strengths:* Examined differences by age, gender and ethnicity. Used a generic and obesity-specific measure of HRQOL. Used parent and self-reported HRQOL. Exclusive adolescent sample. *Limitations:* Small sample, CS, findings limited to SOB adolescents
Swallen 2005[a] CS population-based US	$N=4743$ 12–20YO UW (<5th %), NW, OW, OB, SOB (>97th %)	CDC	Customized questions (based on PedsQL) Self-report	Yes (OB 3.85 times more likely to have poor general health)	Found increased risk of poor physical health when moving away from NW (OR 1.91 for OB)	*Strengths:* Population-based study, focused on adolescents. Well powered to look at gender, age and ethnicity effects. *Limitations:* CS only included adolescents at school, some aspects of measures were not validated. Decreased power when subsets were stratified despite large sample
Williams 2005[a,c,d] CS Aust.	9–12 YO $N=1456$ OB, OW, NW	IOTF	PedsQL Self- and parent reports	Yes	Yes (presented graphically)	*Strengths:* Used parent proxy and self-reported HRQOL. Large population-based community sample. *Limitations:* Heavier children may be under-represented. Results are limited to 9–12 YO's. Did not report BMI
Friedlander 2003[a] CS, US	8–11 YO, $N=371$ NW, OW, OB, UW	CDC	CHQ Parent report	Yes	—	*Strengths:* Focused on children specifically. Community sample. *Limitations:* Only examined parent proxy HRQOL. Narrow age range, not applicable to adolescents
Schwimmer 2003[b,c,d] CS US	5–18 YO OB ($n=106$) $N=401$ NW (normative data), $N=106$ cancer patients	CDC	PedsQL Self-and parent reports	Yes (cf normative reference data)	Yes ($r=-0.2$ to -0.3 for self-reported physical, social and parent proxy total, physical and psychosocial)	*Strengths:* Compared OB to children with cancer. Considered the effect of co-morbidities, utilized parent and self-reports. *Limitations:* Only generalizable to SOB treatment-seeking sample
Wake 2002[a] CS, Australia	5–13 YO $N=2861$ NW, OW, OB, UW	IOTF, CDC	CHQ Parent report	Yes	—	*Strengths:* Large population-based sample so more generalizable. *Limitations:* Parent proxy-reports and high ceiling effects with CHQ

Abbreviations: BMI, body mass index; CDC, Centre for Disease Control; cf, compared with; CHIP, Child Health and Illness Profile; CHQ, child health questionnaire; COOP, Care Cooperative Information Project Chart System; CS, cross-sectional; Ex, exercise; f/u, follow-up; HRQOL, Health-related Quality of Life; IWQOL-lite, impact of weight on quality of life-lite; IOTF, International Obesity Task Force Criteria; NW, normal weight; OB, obese (overweight by CDC definition); OR, odds ratio; OW, overweight (at risk of overweight by CDC definition); PedsQL, Pediatric Quality of Life Inventory; sig, significant; SES, socioeconomic status; SOB, severely obese (very overweight by CDC definition); UW, underweight; YO, year olds. [a]Community sample, [b]Clinical sample, [c]Study included in the pooled analyses conducted, [d]Study was included in pooled analyses, [e]Cohen's *f* was converted to an r score using $r=\sqrt{(f^2/1+f^2)}$, [f]Pooled data from Schwimmer *et al.*, 2003 and Williams *et al.*, 2005, [9]Validation study utilizing cross-sectional and uncontrolled clinical trial data but only the former is included (see Table 2 for uncontrolled study), [h]Assessed associations between lifestyle and HRQOL rather than obesity, Note. Only first authors are listed.

Table 2 Health-related quality of life (HRQOL) and weight loss

Study	*Subjects*	*Definition of obesity*	*Treatment*	*HRQOL tool and informant*	*F/u and drop outs*	*Weight loss*	*Change in HRQOL*	*Main findings and limitations*
Knopfli 2008 Uncontrolled clinical trial	$N=130$ Mean age 13.8 YO SOB (>98th %)	Not defined	(1) 8-week-inpatient BT, diet (moderate caloric restriction and Ex (supervised, twice daily)	Standardized questionnaire (ILQAKJ in German)	8 weeks	BMI ↓ median of 5 kgm^{-2} (4.5, 5.8)	Sig improvement in all 8 subsets of HRQOL and total scores ($P<0.001$)	- Inpatient BT/Ex/Diet improves HRQOL and weight. *Limitations:* Short-term f/u, no CON, high cost, applicable to SOB only. Did not examine weight—HRQOL relationships
Fullerton 2007[a] RCT US	$N=80$ Mean age 12.1 YO OW (85–95%) and OB (>95%) Mexican	CDC	(1) 12 week, school based—Instructor-led (ILI)– BT, diet, Ex (2) Self help (SH)	PedsQL Self-report	6/12 f/u period 3 drop outs	BMI *z*-score ↓ in ILI (-0.13 ± 0.14), and ↑ in SH ($+0.04\pm0.12$)	ILL had sig greater improvement in physical health (effect size, $f=0.24$). Change BMI *z*-score accounted for sig change in physical HRQOL only.	- ILI achieved WL and greater increases in physical HRQOL cf SH group. Enhanced physical HRQOL was associated with a reduction in BMI *z*-score
Holterman *et al.* 2007[a] Uncontrolled clinical trial	N=10 15–18YO Morbidly obese females BMI 50 ± 13 kgm^{-2}	National Institutes of Health criteria for bariatric surgery (? CDC)	Laparoscopic adjustable Gastric Banding (LAGB)	PedsQL Self- and parent reports	9 months Nil drop outs	Median % of WL was 33%. Mean WL of 49 ± 23 lb. At 9 /12 50% had BMI <40. BMI ↓ by ~8 kgm^{-2}	Improved HRQOL, peaking at 6/12 ($P=0.03$), but dipped at 9/12 and was no longer sig. Similar pattern for parent reports, but sig at all time points ($P<0.002$).	- LAGB resulted in sig WL and improvements in co-morbidities. - sig progressive improvement in HRQOL
Garcia-Morales *et al.* 2006 RCT, double blinded Mexico	$N=46$ 14–18YO BMI>95% all OB.	CDC and WHO criteria	(1) Placebo+diet+Ex ($n=23$) (2) Sibutramine+diet+Ex ($n=23$)	SF-36 Self-report	6 month 5 drop outs	BMI: Group 2 lost 9.2% BMI (CI 6.9–11.6), placebo lost 5.2% (CI 2.4–7.9). Sig within group but not between group changes.	Improvement of 6.7 (CI 1.5–11.9 $P<0.05$) in group 2, compared with 4.4 in placebo (CI 0.7–8.1 $P<0.05$) with no sig between group difference	- sig improvement in HRQOL with WL overall with no sig difference between WL methods
Kolotkin 2006 Uncontrolled clinical trial US	$N=80$ 11–19YO OB	CDC	WL camp—not described	IWQOL-lite PedsQL Self-report	Unknown	BMI: mean change of 3 ± 1.4 kgm^{-2} (range 0.5–7.4 kgm^{-2})	Sig improvement in all scales of IWQOL-lite (total and sub scores). Pre/post effect size of 0.75 for total score	HRQOL improves with ↓ BMI (large effect size). *Limitations:* No details provided about the intervention, f/u or drop outs as it was a validation study
Warschburger 2001 Non-randomized controlled trial US	$N=197$ 9–19 YO 64.2% OB	?CDC	6 weeks inpatient rehab 2 conditions: (1) *CBT*, calorie reduced diet and Ex (2) *CON:* Muscle relaxation+diet and Ex	Custom-designed tool of unknown validity self-report	12 months f/u Drop outs unknown	Both groups lost weight but no statistically sig difference between groups	Group 1 had non-sig improvement in HRQOL at 6/12 cf group 2 ($P=0.08$). Improvement in HRQOL over time in both groups ($P<0.01$).	HRQOL improved in both groups, and more so in CBT at 6/12. *Limitations:* Drop outs not reported, unknown validity of tool. No randomization
Ravebs-Sieberer 2001 Uncontrolled clinical Germany	$N=584$ OB 12 YO	? Unknown	Inpatient rehabilitation	KINDL	Unknown Drop outs not reported	Not reported	Sig ↑ in all KINDL scores after treatment (except psychosocial). OB girls had poorer HRQOL than boys ($P<0.02$), and children >13YO had worse HRQOL ($P<0.04$)	HRQOL of OB differs by age and gender, and HRQOL improves with inpatient rehabilitation. *Limitations:* Limited information about the treatment. Did not report f/u period, drop outs. No CON

Abbreviations: BMI, body mass index; BT, behavior therapy; CBT, cognitive behavioral therapy; CDC, Centre for Disease Control; cf, compared with; CI, confidence interval; CON, control group; Ex, exercise; f/u, follow-up; HRQOL, health-related Quality-of-Life; ILI, instructor led intervention; IWQOL-lite, impact of weight on quality-of-life lite, LAGB, laparoscopic adjustable gastric banding; OB, obese (overweight by CDC definition); OW, overweight; PedsQL, pediatric quality-of-life inventory; RCT, randomized controlled trial; SH, self help; sig, significant; SOB, severely obese (very overweight by CDC definition); WHO, World Health Organization; WL, weight loss; YO, year olds; ↓, decreased; ↑, increased; 9/12, 9 months; 6/12, 6 months. [a]Study was included in pooled analyses. Note. Only first authors are listed here (see reference list for complete citations).

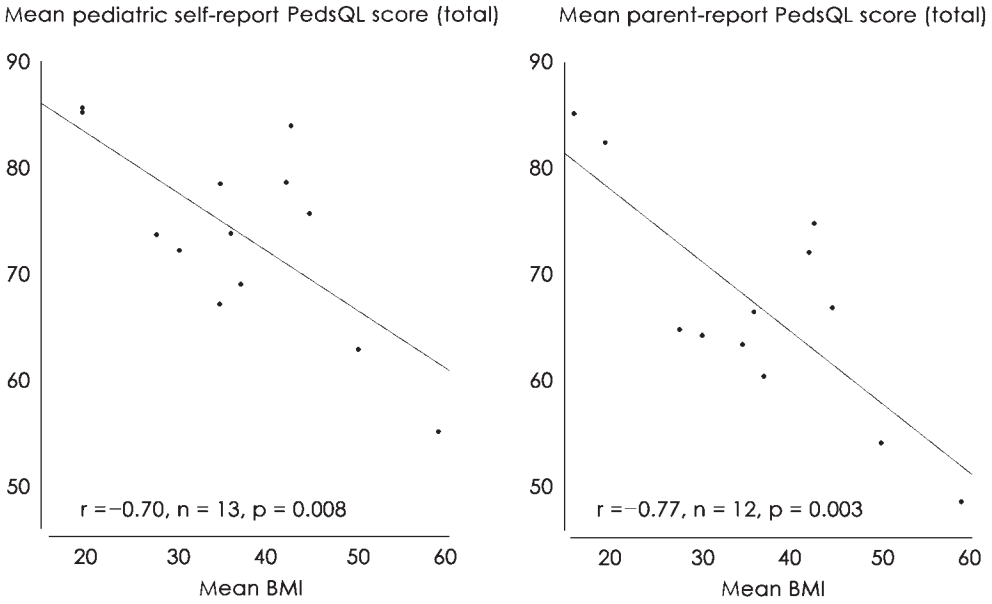

Figure 3 Relationship between mean body mass index (BMI) and pediatric-reported or parent/proxy-reported total Pediatric Quality of Life Inventory (PedsQL) score.

children. Two independent studies report moderate inverse relationships between BMI z-score and physical HRQOL ($r=-0.47$, $P<0.01$[24] and $r=-0.51$, $P<0.0001$[15]), whereas a third study[12] reported a weaker, but still significant, inverse relationship ($r=-0.233$, $P=0.02$). In contrast, one population-based survey found that physical HRQOL was independent of weight status.[18] Some research suggests that the inverse relationship between increasing weight status and physical functioning may be particularly evident in girls.[17,18,26,28] Our pooled analyses showed a strong inverse linear relationship between mean pediatric self-reported physical functioning score and BMI ($r=-0.9$, $P=0.008$, $n=9$). The data available for the present analysis did not permit an investigation of gender effects.

Social functioning. Eight cross-sectional studies report significantly lower social functioning scores (a subset of psychosocial functioning) in obese children and adolescents compared with their lean counterparts,[6,11,12,17,24,27,30,32] reporting large effect sizes (0.75–1.11).[11,15] Tyler *et al*.[23] found significantly lower overall psychosocial functioning in obese participants, but reported a small effect size (0.22). Individual studies have found moderate inverse relationships between BMI *z*-score and pediatric self-reported social functioning ($r=-0.48$, $P<0.0001$,[15] $r=-0.42$, $P<0.01$[24]), with a lower regression coefficient reported by Schwimmer *et al*.[12] for severely obese adolescents ($r=-0.228$, $P=0.02$). Tyler *et al*.[23] examined four weight categories and found that only severe obesity was associated with impaired psychosocial functioning ($f=0.22$, which equates to an r value of -0.21). Our pooled analyses of mean pediatric-reported psychosocial summary scores show a strong inverse linear relationship with BMI ($r=-0.84$, $P=0.002$, $n=10$).

Emotional functioning. Seven studies indicate impaired parent proxy-[20,24,27,30,32] or child-rated[11,15] emotional functioning in obese compared with lean youths. Of these, studies utilizing the PedsQL found medium effect sizes of difference (0.44 & 0.59),[11,15] with large effect sizes (1.28) reported for the body esteem subset of the IWQOL-kids.[15] However, three studies indicate no significant difference in self-reported emotional functioning.[24,27,30] There are exceptions in which parent reports of emotional HRQOL have not differed from self-reports.[6,12,17] Williams *et al*.[6] used parent and child-reported methods, and found no differences in emotional functioning when comparing a community sample of obese, overweight and lean children ($N=1456$, mean age 10.4 ± 1.1 years). In contrast, another population-based study[17] found that adolescent-reported emotional functioning was only impaired in the 12–14-year-old age group. Schwimmer *et al*.,[12] found a large difference between severely obese and lean adolescents for parent proxy (effect size 1.16) and self-reports (effect size 0.9).

Pinhas-Hamiel *et al*.[24] found a weak relationship between child-reported emotional functioning (PedsQL) and BMI *z*-score ($r=-0.16$, $P=0.03$), whereas Zeller and Modi[26] (also using the PedsQL) found that BMI *z*-score did not significantly predict emotional functioning (regression coefficient not reported). In contrast, Kolotkin *et al*.,[15] utilizing the obesity-specific measure (IWQOL) reported a moderate relationship between BMI *z*-score and body esteem ($r=-0.51$, $P<0.0001$).

School functioning. Most,[6,11,17,27,31] but not all,[24,30] studies indicate that school functioning scores are not significantly different when comparing obese and lean samples. For example, Williams *et al*.[6] assessed 1456 Australian school children and found no significant differences in school

functioning scores between obese and lean children (75 ± 14.5 versus 77.1 ± 15.4, $P = 0.19$, respectively), compared with significant differences of at least five points or more for other subsets of the PedsQL. Similarly, a population-based study by Swallen *et al*.[17] found that obese adolescents were only 1.33 times more likely to have impaired school functioning compared with lean adolescents (95% confidence interval of 0.93–1.9). Conversely, Hughes *et al*.[30] found that school functioning was significantly impaired in parent proxy but not child reports, whereas Pinhas-Hamiel *et al*.[24] found a significant inverse relationship between BMI *z*-score and school functioning subsets of HRQOL ($r = -0.22$ for child reports and $r = -0.32$ for parent reports).

HRQOL and weight loss

Seven pediatric weight loss intervention studies were located that have assessed HRQOL (Table 2). These include two RCTs,[21,22] one validation study,[15] one non-randomized controlled trial[33] and three uncontrolled clinical trials.[34–36] Without exception these studies examined the effects in adolescent participants. They tested a range of weight loss treatments, including laparoscopic adjustable gastric banding surgery,[35] combined pharmacotherapy (sibutramine), diet and exercise,[22,36] behavioral or cognitive-behavioral therapy[21,33,36] and weight loss camps.[15] These studies documented significant improvements in HRQOL with weight loss, but pooling data to examine a possible quantitative relationship for the purposes of the present review was not possible as these studies assessed changes in weight status differently (see Table 2) and few utilized common tools to assess HRQOL.[21,35] Fullerton *et al*.[21] found that improvements in BMI z-scores explained significant changes in physical functioning ($\beta = -0.22$, $P < 0.005$), but not psychosocial functioning after a 12-week behavioral therapy intervention (Table 2). Knopfli *et al*.[36] reported improvements in all subsets of HRQOL in severely obese adolescents with a median BMI reduction of 5 kgm^{-2} after an 8-week inpatient program. Similarly, Ravens-Sieberer *et al*.[34] reported improvements in all HRQOL scores (assessed using the KINDL tool), except for psychosocial functioning, although they did not specify the magnitude of changes in weight status.

Pediatric self-reported versus parent proxy-reported HRQOL

Moderate correlations have been reported between HRQOL scores assessed by parent proxy and pediatric reports (*r* values of 0.46–0.57 reported by Pinhas-Hamiel *et al*.[24] and intraclass correlation coefficients of 0.49–0.6 reported by Varni *et al*.[37]). Although, greater agreement between parent and adolescent reports was noted by Zeller *et al*.[31] (*r* values ranging from 0.59 to 0.81). Our pooled analyses showed a strong linear relationship between self-reported PedsQL scores and parent proxy-reported values for total HRQOL score ($r = 0.93$, $P < 0.0001$), physical score ($r = 0.93$, $P < 0.0001$) and psychosocial score ($r = 0.87$, $P < 0.0001$). However, Bland–Altman plots showed a systematic bias

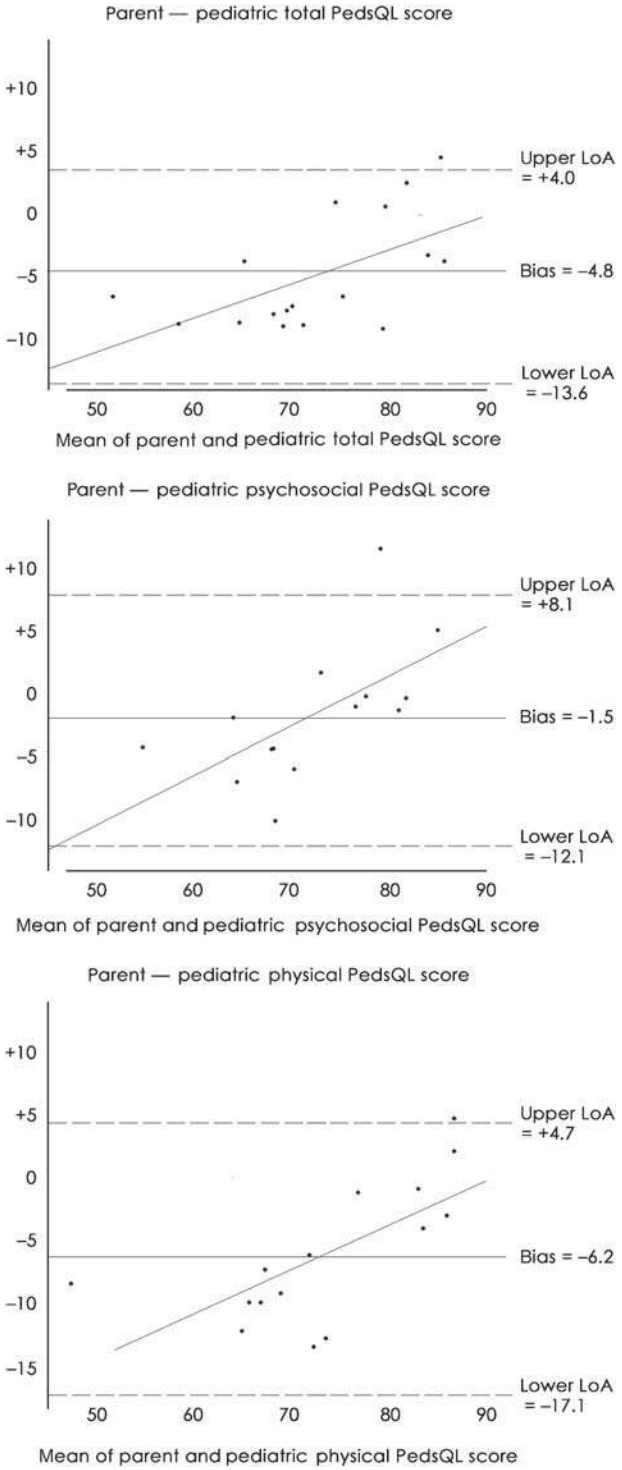

Figure 4 Bland–Altman plot of parent and pediatric total Pediatric Quality of Life Inventory (PedsQL) scores in 12 studies.

between parent- and pediatric-reported scores (Figure 4, $r=-0.58$, $P=0.015$, $n=12$), with parents rating HRQOL lower than youths when scores were low (<75–85), and higher when scores were high (>85). Similarly, many pediatric obesity studies find parent proxy reports of HRQOL to be lower than pediatric reports,[6,11,12,24,26,28–30,35] with the exception of one population-based study,[6] which found less agreement between parent proxy and child-reported HRQOL in a 12-year-old age group compared with younger children. The pooled analyses conducted in this review showed that pediatric self-ratings became progressively more positive than parent ratings with increasing age (Figure 4, $r=-0.54$, $P=0.03$, $n=12$). However, this finding contrasts with a large study ($n=8591$) of 5–16-years-olds,[38] which found a trend for increasing inter-correlations between pediatric and parent proxy PedsQL scores with age.

Treatment-seeking versus community samples

Two pediatric studies[15,24] have specifically examined differences in HRQOL between community and clinical samples of obese children. Pinhas-Hamiel *et al*.[24] found no significant differences in HRQOL, or subcomponents of HRQOL, between two treatment-seeking pediatric samples recruited from either a hospital-based clinic or the community, after controlling for BMI, age and gender. In contrast, Kolotkin *et al*.[15] examined differences between a clinical and non-treatment-seeking community sample and found significantly lower scores in all aspects of HRQOL (total score and subscales) in the treatment-seeking clinical sample after controlling for weight status. Similarly, Williams *et al*.[6] found that HRQOL in a community sample of obese children was not as impaired as that reported by Schwimmer *et al*.[12] in severely obese adolescents who were seeking treatment for their obesity.

Other predictors of HRQOL

Gender. Numerous studies report that females have lower HRQOL scores in one or more domains[15,17–19,26,28,31,34] which is most often physical functioning.[17,18,26,28,29,34] In contrast, Wake *et al*.[20] report that overweight/obese boys are more likely to score below the 15th percentile for seven of the 12 Child Health Questionnaire subscales, compared with only two scales for girls. In contrast, other studies have found no significant gender-effects on HRQOL.[11,13,25,30]

Age. Two studies report finding no age-effects on HRQOL,[11,28] whereas other research has identified age-effects. Specifically, Swallen *et al*.[17] found lower HRQOL scores in social, emotional and school functioning in 12–14-year-old overweight/obese children, compared with older adolescents. The only significant age-effect found by Williams *et al*.[6] was in the 11-year-old age band who reported significantly lower total PedsQL scores ($P=0.02$) compared with 9, 10 and 12-year-olds ($P=0.37$, 0.06 and 0.09, respectively). Findings from a very large epidemiological study[14] indicated that parent proxy-reported HRQOL declined across all weight ranges during early adolescence ($\beta=-2.902$ to -3.060). Similarly, Ravens-Sieberer *et al*.[34] in an uncontrolled clinical trial found that participants older than 13 years of age had significantly worse physical, self-esteem and school functioning compared with younger children ($t=2.08$, 3.11 and 3.48, respectively $P<0.037$). Arif and Rohrer[18] also found lower overall HRQOL scores for 'older' children, although they did not specify the exact age-range.

Other predictors of HRQOL have also been reported in the literature. Social and emotional support may have a positive link to HRQOL.[26,28,34] Teasing appears to have a negative relationship with HRQOL,[13,29] with some evidence that self-esteem may mediate the effects of teasing.[13] Single-parent families may also have a negative association with pediatric HRQOL,[14,17] as may lower maternal education[6,14] and parental income.[29]

Discussion

Weight-status and HRQOL

Studies consistently report that obese young people have poorer HRQOL than lean individuals, with studies of severely obese adolescents suggesting they have a HRQOL similar to individuals with cancer.[12,13] Judging from the findings of our pooled analyses and those of individual studies (Table 1), it appears likely that increasing weight status has a moderate to strong negative influence on HRQOL in pediatric populations, whereby decrements in HRQOL are evident as soon as BMI is above healthy normal limits[6,15,17,23] (Table 1). Even though some smaller US studies did not find a significant relationship between BMI and HRQOL,[13,28,29] this may have been attributable to insufficient power because of the small sample sizes and a narrow range of BMI scores.[13]

When examining the subsets of HRQOL, studies consistently report that obese young people have impaired physical functioning compared with lean children.[6,11,12,17,23,24,27,28,30–32] Our pooled analyses and the findings of individual studies[15,24] suggest that a moderate to strong inverse relationship between weight status and physical functioning is likely, with increasing weight status having a detrimental effect on physical function. Although Schwimmer *et al*.[12] reported a weaker inverse relationship, their study was limited, in that it only examined severely obese adolescents and thus had a very narrow BMI range. In contrast, Arif *et al*.[18] reported that physical HRQOL was independent of weight status, but this conflicting finding may be in part attributed to their use of dichotomized BMI categories instead of BMI as a continuous predictor, as well as a different tool (the KINDL) to assess HRQOL. Furthermore, although some research suggests that

increasing weight status may have a particularly negative influence on physical functioning in females,[12,17,28] the reasons for this have not been explored.

Although physical functioning difficulties in obese children appear likely, HRQOL tools only provide limited insight regarding specific restrictions by typically including only a handful of questions. Furthermore, little is known about specific obesity-related factors and their contribution to functional difficulties. In a population-based *adult* study ($N = 155\,989$), Heo *et al*.[39] found that the inverse relationship between HRQOL (general, physical and mental) and BMI was partially mediated by musculoskeletal pain. Another US study examined 9173 adults[40] and found that HRQOL was directly related to physical activity levels independent of BMI category, with inactive adults being 3.14 times more likely to report physical limitations than physically active adults (defined as 30 min of moderate activity 5 days per week and/or 20 min of vigorous activity 3 days per week). There are no comparable studies in the pediatric literature and further research is needed to establish the specific obesity-related factors associated with reduced physical functioning in obese children and adolescents.

Obesity also appears to impact negatively on aspects of pediatric psychosocial functioning, in particular social functioning.[6,11,12,17,24,27,30,32] Our pooled analyses and the findings of individual studies[15,24] suggest that increasing weight status is likely to have a moderate to strong relationship with decrements in psychosocial functioning. Interestingly, Tyler *et al*.[23] found that only severe obesity was associated with impairments in psychosocial functioning, although the relationship was weak which may have been related to their use of dichotomized BMI categories. Schwimmer *et al*.[12] also found a weak relationship between BMI and psychosocial functioning, but as they only examined severely obese adolescents, the narrow BMI range may have contributed to the weaker observed relationship.

Few studies specifically investigate the effects of increasing weight status on emotional HRQOL in youths. Assessments indicating impaired emotional functioning are more common when parent proxy methods are utilized.[20,24,27,30,32] Conversely, when self-report methods are employed, some studies support significant differences between obese and lean participants[11,15] whereas others do not.[24,27,30] This appears to provide some support to the premise that parents may catastrophize ill-being in their obese children/adolescents or, alternatively, that young people may be hesitant to admit the effect that their weight has on their lives. However, there are exceptions in which parent reports of emotional HRQOL have not differed from self-reports.[6,12,17] Most notably, Swallen *et al*.[17] found that adolescent-reported emotional functioning was only impaired in the 12–14-year-old age group, perhaps tagging early adolescence as a crucial period for emotional development. Schwimmer *et al*.[12] found a large difference between severely obese and lean adolescents for parent proxy and self-reports, although these findings may not be generalizable to other overweight or obese groups.

Most,[6,17,27,31] but not all,[24,30] studies indicate that school functioning is unaffected by weight status. Interestingly, studies supporting impaired school functioning[24,30] have focused on treatment-seeking samples, compared with community samples in the majority of other studies reporting no or minimal deficits in school functioning.[6,17,27] This perhaps suggests that individuals seeking treatment may experience more impairment.

In summary, increasing weight status appears to impact negatively on the overall pediatric HRQOL, which mirrors the findings of adult studies.[2] Physical and social functioning seems to be most affected, with some evidence to support decrements in emotional functioning and minimal evidence of impaired school functioning, especially in community compared with treatment-seeking obese samples. Additional research utilizing obesity-specific tools is needed to enable a better understanding of the relationship between specific components of obesity and/or associated co-morbidities and their effect on HRQOL.

HRQOL and weight loss

Although the assessment of outcomes from the perspective of the individual has been recognized as an important consideration when evaluating weight loss interventions, only seven pediatric studies have assessed HRQOL (Table 2). Judging from the findings of these studies, it seems that weight loss may have a positive influence on the overall HRQOL[15,22,33–36] and subsets of HRQOL,[15,34,36] although it is worth noting that only two of the seven studies were RCTs.[21,22] Furthermore, it is difficult to ascertain the change in weight status that is required before a positive influence on HRQOL is noted, as studies have reported changes in weight status differently, with one study not quantifying weight status changes at all.[34] Interestingly, some research suggests that psychosocial functioning may be more resistive to improvement,[21,34] which may perhaps be a reflection of psychological changes that may take longer to improve after weight loss. Fullerton *et al*.[21] in their RCTs included overweight and obese young people and found improvements in physical functioning specifically that could be explained by changes in BMI z-scores, perhaps providing early evidence that physical functioning may be more responsive to improvement with weight loss.

In summary, preliminary evidence suggests that weight loss may result in improvements in HRQOL, although it is yet to be determined if such improvements are maintained over time and whether weight relapse is associated with decrements in HRQOL, as suggested by a 10-year longitudinal study in adults.[41] Furthermore, studies have not investigated the effect of factors other than weight loss on HRQOL. It is also likely that the treatment approach used influences the psychosocial outcomes. For example, some

interventions have included physical activity to assist in achieving weight loss, and adult research suggests this has an independent effect on improving HRQOL.[40,42] Similarly, adult studies have also indicated that obesity-related co-morbidities or musculoskeletal pain associated with obesity may exert a negative influence on HRQOL,[2,27,39] and the effects of weight loss on HRQOL may be mediated by these effects. In summary, more RCTs are needed to investigate changes in HRQOL with weight loss, including longer term follow-up, and examination of possible mediating/confounding factors such as physical activity, pain and obesity-related co-morbidities.

Pediatric reported versus parent proxy-reported HRQOL

Parent proxy and pediatric self-report have been used either in isolation or in combination to assess HRQOL (Tables 1 and 2). The evidence available suggests that the perspective of respondent (i.e. parent proxy or self-report) influences the resultant HRQOL scores. The findings of our pooled analyses and those of individual studies[24,31,37] suggest that pediatric HRQOL can be accurately predicted from parent proxy reports with moderate to strong linear relationships between the two methods of report. However, it is worth noting that the study by Zeller *et al*.[31] involved a retrospective analysis of clinical case notes and, it is not known whether parents were discouraged from influencing their adolescent when completing questionnaires. If parents did inadvertently influence adolescent responses, then this may have resulted in inflated agreement between parent and adolescent scores.

Although there were strong relationships between different methods of assessing HRQOL, it was found that parents tended to perceive more extreme levels of both high and low HRQOL relative to their children/adolescents (Figure 4). This finding is supported by many pediatric obesity studies whereby parent proxy reports of HRQOL have been consistently lower than pediatric reports,[11,12,24,26,28–30,35] with the exception of one population-based study.[6] Hence, research findings should be carefully interpreted when comparing studies utilizing *only* parent proxy reports or pediatric reports.

The reasons why parents and children/adolescents perceive HRQOL differently are not clear. It is possible that parents of obese young people may catastrophize the effect of weight status on functioning, or they may have a limited understanding of the lived experience of their child/adolescent and their psychosocial and physical functioning. Alternatively, the reported discrepancies may reflect the different age-related cognitive perspectives of children, with younger children possibly perceiving HRQOL in a more 'immediate sense', whereby they rate their HRQOL based on the 'here and now' and what they are experiencing at that moment in time.[30] In contrast, parents may invoke a broader perspective of their child's overall functioning and may be more able to compare their child's HRQOL relative to others.[28,30]

Williams *et al*.[6] found less agreement between parent proxy and child-reported HRQOL in a 12-year-old age group compared with younger children. This may suggest that HRQOL perceptions between parents and children start to diverge with increasing age as the child develops a more sophisticated and independent understanding of the world, rather than modeling and accepting their parents' beliefs. This divergence of HRQOL perceptions is supported by the pooled analyses conducted in this review, which showed greater discord between parent proxy and pediatric reports with increasing child age, with pediatric self-ratings becoming progressively greater than parent-ratings with increasing age (Figure 4, $r=-0.54$, $P=0.03$, $n=12$). However, this is in contrast to the findings of Varni *et al*.[38] who examined 5–16-years-olds and found better parent–pediatric agreement in PedsQL scores with age. This discrepancy in findings in relation to agreement between pediatric and parent proxy reports of HRQOL from different studies was identified in a comprehensive meta-analysis by Eiser and Morse[43] in which they found variable levels of agreement between parent and pediatric self-report of HRQOL across different age ranges. However, a paradigm shift toward an increasing reliance on patient-rated outcomes in clinical trials[44] suggests that pediatric self-report of HRQOL is more appropriate.

On the basis of the differences between parent proxy and pediatric-reported HRQOL, it has been recommended that both parent and pediatric self-reports be used to assess HRQOL in order to gain a more complete picture of functioning.[28] It has been further proposed that pediatric-reported HRQOL be considered the *primary* outcome measure,[38] with parent proxy reports providing *supplementary* information. This suggestion is made as it is believed that parental reports may be biased towards low HRQOL, given the parent typically seeks treatment for their child based on their perception that there is a problem.[30,37]

Treatment-seeking versus community samples

When interpreting the results of studies, which have examined pediatric HRQOL, consideration should be given as to whether findings are on the basis of treatment-seeking or community samples, as this may explain some of discrepancies in findings between studies. Although not specifically examining HRQOL, Braet *et al*.[45] found that behavioral and emotional problems were more prevalent in a sample of children seeking treatment for their obesity compared with a community sample of obese children. Similarly, Williams *et al*.[6] found that HRQOL in a community sample of obese children was not as impaired as that reported by Schwimmer *et al*.[12] in severely obese adolescents who were seeking treatment for their obesity. However, these latter studies examined differing age ranges of children and, possibly participants with differing degrees of obesity, although this is not clear as Williams *et al*.[6] did not report group mean BMI scores. To date, only two pediatric studies[15,24] have specifically examined differences in HRQOL

between community and clinical samples of obese children. Pinhas-Hamiel *et al*.[24] found no differences in HRQOL, or subcomponents of HRQOL, between two treatment-seeking pediatric samples recruited from either a hospital-based clinic or the community, after controlling for BMI, age and gender. This apparent lack of difference between groups may also be explained by the higher mean BMI z-score in the clinic group, and also by the fact that both samples were still treatment-seeking. Certainly, the findings of Kolotkin *et al*.,[15] who examined differences between a clinical and non-treatment-seeking community sample, found significantly lower scores in all aspects of HRQOL (total score and subscales) in the treatment-seeking clinical sample after controlling for weight status. A large study ($n=3353$)[7] of obese adults dichotomized according to the intensity of treatment (no treatment, infrequent, weekly, daily or surgery) found that impairments in HRQOL increased with treatment intensity after controlling for BMI and age (significant main effect for treatment intensity $P<0.001$). Furthermore, BMI explained almost 28% of the variance in HRQOL scores.[7] However, further research is needed to differentiate between varying intensities of treatment-seeking and non-treatment-seeking pediatric samples. Whether the poorer HRQOL reported in treatment-seeking samples[12] is attributable to a greater degree of obesity and/or obesity-related co-morbidities prompting them to seek more intense treatments also remains to be explored.

Other predictors of HRQOL

There is some evidence in obese pediatric populations, mainly from cross sectional and epidemiological studies, that being female may be associated with poorer HRQOL in one or more domains,[15,17–19,26,28,31,34] most often physical functioning,[17,18,26,28,29,34] with similar gender differences reported in adults.[7] Kolotkin *et al*.[7] examined 3353 adults aged 18–90 years finding that women experienced greater impairments in HRQOL than men (assessed using the IWQOL-lite, $P\leqslant 0.019$) after controlling for BMI and age. In pediatric populations, it has been hypothesized that differences in physical functioning may not emerge until adolescence. Certainly, population-based longitudinal research suggests that obese females have significant decrements in their self-esteem scores when transitioning into adolescence compared with mild decrements in obese males.[46] In contrast, the findings of Wake *et al*.[20] suggest that overweight/obese boys may be more at risk of lower HRQOL than girls, whereas other studies suggest that gender does not play a role.[11,13,25,30]

Although not reported consistently across all studies,[11,28] there appears to be an increasing evidence that early adolescence may be a particularly vulnerable period for decrements in HRQOL in overweight/obese youths,[6,14,17,18,34] possibly relating to heightened awareness of social exclusion and participation limitations. Therefore, ongoing research is needed to establish the effect of age on HRQOL in obese children, particularly as they enter and progress through adolescence, and caution should be exercised when extrapolating findings around HRQOL and obesity between child and adolescent populations.

Limitations

There are a number of limitations in the literature, which may affect the results of this review. With the exception of seven studies, of which only two were RCTs, most research has been cross-sectional. Even though a number of epidemiological studies exist, more RCTs and longitudinal studies examining changes in HRQOL with weight-loss (or weight-gain) are needed to determine causation in pediatric populations.

Comparisons between studies and pooling of data were complicated by the use of differing definitions of obesity (for example, Centre for Disease Control growth charts and International Obesity Task Force criteria, UK) and the use of different HRQOL tools. Fortunately, clusters of studies have utilized similar metrics, enabling some pooling of data, as was done in this review. Some studies have also relied on parent-reported height and weight measures of their child or adolescent which may be inaccurate.[14,27] As discussed earlier, although the inclusion of both parent and pediatric-reported HRQOL has been recommended, many studies have only included parent proxy-assessments, which is likely to bias findings. Furthermore, generic HRQOL tools predominate in the literature, and these can be less sensitive to detecting decrements in obesity-specific HRQOL. Finally, few studies have investigated specific obesity-related factors that may mediate the relationship between obesity and HRQOL in children. It is also recognized that a myriad of factors, besides obesity, may affect HRQOL (such as emotional/social support, socioecomomic status, family structure, teasing etc.); these factors need to be specifically addressed in future reviews.

Thus, there is a lack of information on the specific effects of obesity that contribute directly to poor HRQOL in obese children and adolescents in both community and treatment-seeking samples, making it difficult to identify targets for intervention to improve HRQOL. Furthermore, studies of long-term follow-up of HRQOL after weight loss are needed to ascertain whether improvements in HRQOL, which occur concurrently with weight loss, are maintained over time, and to determine the potential effect of weight re-gain. Interestingly, no research has considered whether parental catastrophizing about the effects of obesity on HRQOL has a negative influence on pediatric HRQOL over time, and longitudinal studies are also needed to ascertain the effect of transitioning into adolescence on HRQOL in obese populations.

Despite the need for further research, a number of conclusions can be drawn from the available evidence. It appears that obesity is inversely associated with pediatric HRQOL, in particular, physical and psychosocial functioning

with school functioning being largely unaffected. Emerging research suggests that treatment-seeking pediatric populations have poorer HRQOL than community samples, and parent proxy-assessments of HRQOL are consistently lower than pediatric reports in obese samples, irrespective of treatment-seeking status. Although speculative, these latter observations may explain some discrepancies in findings between studies, and it is therefore recommended that clinicians and researchers utilize pediatric self-reports as primary outcome measures, and parent proxy reports as supplementary measures.

In conclusion, there is a clear role for clinicians and researchers to include assessments of HRQOL when evaluating health in obese pediatric populations. Although evidence from short-term weight loss intervention studies suggests that HRQOL improves with weight loss, the loss of weight and maintenance of an ideal body weight can be difficult to achieve. It may therefore be appropriate to investigate the mechanisms by which obesity impacts negatively on HRQOL in order to identify targets for interventions to improve HRQOL whilst the longer term, and somewhat more difficult task of achieving weight loss is addressed.

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