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ORIGINAL ARTICLE

# Correlates and predictors of obesity-specific quality of life of former participants of a residential intensive lifestyle intervention

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## Summary

### *Introduction*

The aim of this study was to investigate the relationship between weight loss during and after a unique type of weight loss intervention, namely, a residential intensive lifestyle intervention (ILI), and participants' obesity-specific health-related quality of life (HRQOL) several years after the intervention. In the residential ILI under investigation, participants attended a 10- to 12-week long course away from their daily living environment, namely, at Ubberup Folk High School located in Denmark.

### *Methods*

A total of 79 former participants (31 male, mean age 36.6; SD = 12.7 years) who had participated in the intervention on average 5.3 (SD = 3.2) years ago were recruited for this study. They completed a questionnaire on weight-related quality of life (IWQOL-lite) and physical activity, as well as measurements of $VO_2$max, blood pressure, Homeostatic Model Assessment for Insulin Resistance, waist circumference and hand grip strength.

### *Results*

The study results showed that weight change after the end of the intervention could predict HRQOL whereas how much weight they lost during the intervention could not. Furthermore, almost all of the investigated physiological factors were related to participants' current HRQOL. Waist circumference showed relationships with four of the five aspects of HRQOL.

### *Conclusion*

Focusing on behavioural change, adhering to improved lifestyle and maintaining weight loss after the end of the intervention seem to be the key not only for cardio-metabolic risk factors but also for sustainable HRQOL.

**Keywords:** behavioural change, cardio-metabolic risk factors, physical activity, $VO_{2max}$.

In addition to objectively measurable outcomes like weight reduction and improvement of cardio-metabolic risk factors (1–3), there is a growing interest in individuals with obesity's perceptions of physical, psychological and social functioning as well as well-being. These aspects that refer to patient-reported outcomes have been investigated under the umbrella term of health-related quality of life (HRQOL). A large systematic review of the relationship between obesity and HRQOL concluded that numerous studies supply evidence for a strong connection between obesity and HRQOL (4). When investigating HRQOL in individuals with obesity, it has been shown to be advantageous to use a disease-specific quality of life measure. An obesity-specific measure is often more sensitive to smaller differences between groups, more responsive to even small changes in HRQOL over time and less prone to ceiling and floor effects (5). Furthermore, specific measures allow assessment of HRQOL in domains important to people with obesity. A widely used obesity-specific HRQOL measure is the impact of weight on quality of life-lite (IWQOL-Lite) (6) scale, which investigates five domains, namely, physical function, self-esteem, sexual function, public distress and work.

A meta-analysis investigating the effects of different types of weight loss interventions on HRQOL (7) showed that obesity-specific HRQOL measures were more likely to show a positive effect than generic measures. Furthermore, clinical interventions seemed to be more effective in improving quality of life than other intervention types (7,8). This result is attributed to the dramatic weight loss (20% and more after bariatric surgery) associated with clinical interventions. One study demonstrated that a diet-induced weight loss of 5.0%–9.9% in individuals with obesity moderately improved HRQOL (measured using the IWQOL-Lite), particularly self-esteem and physical functioning, whereas weight loss of 10% dramatically improved HRQOL (13). On the other hand, evidence from Europe, North America and Australia indicates that as body mass index (BMI) increases, HRQOL decreases (9–11).

The aim of this study was to investigate the effects of a unique type of obesity intervention, namely, a residential intensive lifestyle intervention (ILI), on participants' obesity-specific HRQOL up to several years after the intervention. Numerous studies have shown that ILIs are effective in inducing a 10%–15% weight loss over 3- to 6-month intervention periods (12,13). The major challenge, however, as with all other interventions focusing on behavioural change, is maintaining weight loss and adhering to improved lifestyle over time. After completion of the ILI, a gradual weight regain begins, and after 1 year only about half of the participants maintain a clinical weight loss of $>$10% of body weight, and in subsequent years a further decrease is observed (12,13). The effects of the specific residential ILI under investigation in this study on weight loss and weight loss maintenance have recently been reported elsewhere and indicate that at least 25% maintain weight loss after 1.5 years (14,15).

Although there is knowledge on the effectiveness of ILIs with regard to weight maintenance and other physiological variables, no knowledge of the participants' quality of life in the years after completion of an ILI is available. This study therefore investigates the HRQOL of former participants of this residential ILI several years after its completion and its relationship to weight loss. It is assumed that levels of HRQOL depend on the amount of weight loss or weight gain the participants experienced during and after the ILI.

## Methods

### Sampling and participants

A total of 79 participants (31 male, mean age 36.6 years, SD = 12.7 years) from a population of 2,420, who had participated in and completed a residential ILI for persons with overweight and obesity at Ubberup Folk High School (www.ubberup.dk), were recruited for this study. All former participants were contacted for recruitment purposes by letter and by an advertisement on Facebook. A total of 224 individuals replied to this initial contact; however, 47 did not meet the inclusion criteria, 71 were not interested in participation when informed about the experiments and 1 person was not fasted on the day of testing. Inclusion criteria were an age between 18 and 60 and a BMI over 28 prior to start of the intervention. Some lifestyle-related diseases were expected and medication for these accepted. However, cardiovascular disease, cancer, hypothyroidism or hyperthyroidism, severe psychological disease and bariatric surgery were exclusion criteria. Data on participants' weight at start and finish of the ILI were provided by the Ubberup Folk High School and extracted from their database of all former participants. All the participants were invited to the university for a testing day in which the measurements described later were conducted. Ethical approval was obtained from the local Research Ethics Committee in Copenhagen, Denmark (No. H-3-2013-146). All subjects were informed orally and in writing before providing informed consent, which was obtained from each person individually.

### Intervention

In the residential ILI under investigation, participants attended a 10- to 12-week long course away from their daily living environment, at Ubberup Folk High School located in Denmark. At this course, participants experienced calorie restriction, several hours of daily physical activity and behavioural counselling in a community setting where they were together with like-minded people who shared the goal of losing weight (15).

### Measurements

In addition to supplying general background information on age and gender, participants filled in the standardized measures on HRQOL and physical activity levels on the testing day. Furthermore, physiological measurements described later were conducted.

#### *HRQOL*

HRQOL was assessed with the IWQOL-Lite (6), which is a 31-item, self-report weight-related measure of QOL. It provides a total score and sub-scores in five domains, namely, physical function, self-esteem, sexual function,

public distress and work. The items of the IWQOL-Lite begin with the phrase 'Because of my weight' in order to assess obesity-specific quality of life. Scores were transformed on a 0–100 scale, with higher scores indicating a better QOL. The IWQOL-Lite has been found to be a reliable and valid instrument for assessing weight-related QOL in persons with obesity.

### *Physical activity level*

The daily physical activity level was determined via the short version of the international physical activity questionnaire (16). The questionnaire is designed and validated to measure intensity and volume of a wide range of activities performed over a week.

### *Anthropometrics*

Body weight, height and waist circumference (average of three measurements) were measured, and BMI was calculated. Body composition was determined using both bioimpedance (Tanita BC-418, Tanita, Amsterdam, Holland) and dual energy X-ray absorptiometry technique (Lunar Prodigy Advance, Lunar, Madison, WI, USA). The weight and body height measurements performed at the beginning and at the end of the intervention were obtained from the school's archives and thus represent measurements conducted by the school's nutritionists.

### *Blood pressure*

Resting blood pressure was measured in a seated position three times (interspersed by 2-min breaks) on the upper right arm (A&D Medical Tokyo, Japan).

### *Maximal oxygen uptake*

A graded exercise test was performed on a bicycle ergometer (Monark 839E, Vansboro, Sweden) to determine maximal oxygen uptake ($VO_{2max}$) (Cosmed Quark CPET, Italy). The test continued until voluntary exhaustion. A plateau in $VO_{2max}$ or a respiratory exchange rate $>1.15$ were used as criteria for achieving $VO_{2max}$. $VO_{2max}$ was determined as the highest oxygen uptake over 30 s.

### *Blood analyses*

A blood sample was drawn from the antecubital vein on the right arm. The blood was sampled in iced tubes and immediately centrifuged at 2500 *g* at 4°C for 10 min. The plasma fraction was collected and stored at −80°C prior to analyses. Plasma insulin concentration was measured using an ELISA kit (Alpco, Salem, NH, USA), and plasma glucose concentration was measured on an automated analyser (Hitachi 912, Roche, Mannheim, Germany). Homeostatic model assessment of insulin resistance (HOMA-IR) was calculated as described elsewhere (17). To determine metabolic syndrome status and insulin sensitivity concentrations of blood and plasma substrates, we measured the metabolites and hormones (14,18).

### *Hand grip strength*

Hand grip strength was measured with a Takei, A5401 dynamometer (Physical Company, High Wycombe, UK).

### Statistics

Statistical analysis was conducted using SPSS 23. Scale reliabilities for the IWQOL-Lite (6) were analysed with Cronbach's alpha. A value of 0.70 was regarded as an acceptable value (19). Associations between study variables were analysed via bivariate Pearson's correlations. Separate linear regression analysis was conducted with each IWQOL scale as a dependent variable, and percentage of weight loss during the intervention and percentage of weight loss until follow-up respectively as dependent variables. In each regression analysis age, gender and time to follow-up was adjusted for by adding them as covariates in each regression.

## Results

### Descriptive statistics

The study participants' average BMI at the start of the ILI was 38.2 kg $m^{-2}$ (SD = 7.3), and their BMI at the end of the intervention was 33.4 kg $m^{-2}$ (SD = 6.5). On average the participants had lost 14.6 kg (SD = 6.2 kg) of body weight, which equaled 12.4% (SD = 4.3%) during their stay at the ILI. The least weight lost was 2.2 kg and the highest 32.6 kg during the ILI. On average, participants attended the ILI for 85 d (SD = 9). At the follow-up measurement, participants on average still weighed 3.9 kg (SD = 20.6 kg) less, which equals 4.3% (SD = 16.7%), than at the end of the ILI with a range from − 49 to +62.5 kg. The study participants had attended the ILI 5.3 (SD = 3.2) years ago (range 0.5–13.6 years). A total of 57 participants (72.2%) still weighed less at follow-up than before the start of the ILI, whereas 22 (27.8%) had gained weight. The amount of time passed since the end of the intervention was significantly negatively correlated to percentage weight loss since the end of the intervention ($R = -.62$, $p < 0.05$).

The IWQOL-Lite showed the following reliabilities: physical functioning, $\alpha$ = .92; self-esteem $\alpha$ = .90; sexual life $\alpha$ = .71; public distress, $\alpha$ = .81; and work, $\alpha$ = .73. The values at follow-up range between 56 and 86 with the sample scoring lowest on self-esteem and highest on work-related issues (Table 1). In contrast to weight gain, HRQOL was not related to how long ago participants had attended the ILI. However, age was significantly related to self-esteem ($R$ = .55, $p < 0.01$) and sexual life ($R$ = .22, $p < 0.01$) with older participants scoring higher on these aspects of quality of life. Furthermore, self-esteem showed a gender effect with male participants showing higher values than females.

### Correlation and regression analyses

A linear regression analysis was conducted to analyse whether the percentage of weight loss was significantly related to the former participants' current quality of life. The percentage of weight loss during the intervention and the percentage of weight loss from the end of the intervention until the follow-up measurement were used as dependent variables for separate regression analyses for each subscale. Age, gender and the length of time that had passed since the intervention were controlled for by adding them as covariate in each regression. The results of the regression analyses can be seen in Table 2. HRQOL was not significantly related to the percentage of weight loss during the ILI. However, weight loss after the end of the ILI until the follow-up measurement was related to better overall HRQOL and to all subscales except sexual functioning.

A last step analysed which physiological factors correlated with the participants' current quality of life at follow-up (Table 3) using bivariate correlations. Higher physical functioning was significantly correlated to low waist circumference, low HOMA-IR index, low blood pressure and a higher $VO_{2max}$ (ml $O_2$/min/kg body weight). A higher self-esteem was significantly correlated to higher hand grip strength and higher physical activity levels. Better sexual functioning was significantly correlated to a lower waist circumference. Lower public distress was related to lower waist circumference, lower $VO_{2max}$, lower blood pressure and higher physical activity levels. A better functioning at work correlated significantly with lower waist circumference, higher $VO_{2max}$ and a lower HOMA-IR index.

**Table 1** Descriptive statistics for psychological study variables

| IWQOL scale | Min | Max | Mean | SD |
|---|---|---|---|---|
| Physical function | 9.10 | 100.00 | 76.65 | 21.85 |
| Self-esteem | 0.00 | 100.00 | 56.00 | 25.16 |
| Sexual life | 6.30 | 100.00 | 82.73 | 17.76 |
| Public distress | 20.00 | 100.00 | 85.03 | 19.46 |
| Work | 0.00 | 100.00 | 85.70 | 20.32 |
| Total score | 33.30 | 100.00 | 77.17 | 15.81 |

IWQOL, impact of weight on quality of life.

## Discussion

Descriptives for participants' HRQOL showed that they were lower than that of the general population who show values above 90 (20). Although there is no cut-off score for the measure used in this study, the total score of this sample (77.7) is on the higher end of what has been reported for persons with obesity (range 54.6–77.6) (21,22). One particular area of concern for former participants of an ILI was lack of self-esteem, which received the lowest score of all five HRQOL scales in our study.

When looking at which factors could predict quality of life, it was essential how body weight developed after the ILI and not how much weight was lost during the ILI. Earlier studies had shown that only aspects of physical

**Table 2** Separate linear regression analysis with each IWQOL scale as independent variable (age, gender and time to follow-up were controlled for)

| | Percentage weight loss during intervention as dependent variable | | | Percentage weight loss from intervention end until follow-up as dependent variable | | |
|---|---|---|---|---|---|---|
| IWQOL scale | $p$ | B | CI (B) | $p$ | B | CI (B) |
| Physical function | 0.088 | 1.00 | (−0.15;2.15) | <0.001 | 0.76 | (0.51;1.02) |
| Self-esteem | 0.850 | 0.11 | (−1.07;1.29) | <0.001 | 0.71 | (0.44;0.98) |
| Sexual life | 0.365 | 0.43 | (−0.52;1.38) | 0.082 | 0.22 | (−0.03;0.47) |
| Public distress | 0.124 | 0.81 | (−0.23;1.84) | <0.001 | 0.59 | (0.35;0.84) |
| Work | 0.128 | 0.84 | (−0.25;1.93) | <0.001 | 0.55 | (0.28;0.81) |
| Total score | 0.125 | 0.65 | (−0.18;1.48) | <0.001 | 0.56 | (0.38;0.75) |

IWQOL, impact of weight on quality of life.

**Table 3** Correlations between Physiological factors and IWQOL scales

| Physiological factor/IWQOL scale | $VO_{2max}$ | Blood pressure | HOMA-IR | Physical activity | Waist circumference | Hand grip strength |
|---|---|---|---|---|---|---|
| Physical functioning | 0.550** | −0.424** | −0.482** | 0.196 | −0.586** | 0.002 |
| Self-esteem | 0.147 | 0.202 | −0.098 | 0.253* | −0.037 | 0.256* |
| Sexual life | 0.118 | −0.095 | −0.075 | 0.139 | −0.257* | −0.168 |
| Public distress | 0.480** | −0.282* | −0.404** | 0.284* | −0.588** | −0.049 |
| Work | 0.373** | −0.185 | −0.390** | 0.134 | −0.419** | −0.009 |
| Total score | 0.443** | −0.185 | −0.378** | 0.266* | −0.483** | 0.031 |

IWQOL, impact of weight on quality of life; HOMA-IR, homeostatic model assessment of insulin resistance.
*$p < 0.05$.
**$p < 0.01$.

functioning and self-esteem were related to weight loss (23). This study indicated that four of the five investigated aspects of quality of life showed significant correlations with weight loss. The results of this study therefore go beyond previous findings regarding the relationship between weight loss and HRQOL by showing that more aspects of HRQOL are related to weight loss. The findings of this study could be related to the fact that the follow-up period is longer than in previous studies. Results from the large-scale ILI "Look AHEAD" study indicated short-term effects of weight loss on HRQOL. The long-term effects were, however, unclear (24–27).

Furthermore, the results demonstrated that different physiological parameters were related to different areas of obesity-specific quality of life. Waist circumference was a central indicator since it was related to four of the five areas of quality of life investigated in this study. Other important factors were aerobic fitness ($VO_{2max}$ $kg^{-1}$ body weight), HOMA-IR, index and blood pressure.

A surprising result relates to the HRQOL scale self-esteem. Our results showed that self-esteem is related to gender and age but also related to physical activity levels and hand grip strength. It is, however, not related to the previously listed physiological parameters like waist circumference or aerobic fitness. Earlier studies have shown older populations to be associated with lower self-esteem (23), whereas our results indicate exactly the opposite.

This is a cross-sectional study; no inferences about cause and effect can be made. Also, this study was able to recruit only a small number of former participants of this ILI, and only 22 of the participants were weight regainers. However, these results indicate which physiological parameters were related to which specific areas of quality of life. With regard to participants' low levels of self-esteem, a recommendation might be to increase their physical activity levels as these show a strong correlation to self-esteem. Central for former participants' HRQOL was their weight development after the end of the intervention and not how much weight they lost during the intervention. Therefore, focusing on behavioural change, adhering to improved lifestyle and maintaining weight loss after the end of the intervention should be key not only for cardio-metabolic risk factors but also for sustainable HRQOL. Longitudinal studies investigating the development of HRQOL concomitant with the development of physiological variables are recommended.

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## Conflict of Interest Statement

All authors declare that they have no conflict of interest.

## Ethical approval

Ethical approval was obtained from the local Research Ethics Committee in Copenhagen, Denmark (No. H-3-2013-146). All procedures were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and APA ethical standards.

## Informed consent

Informed consent was obtained from all individual participants included in the study.

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