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# Can health indicators and psychosocial characteristics predict attrition in youths with overweight and obesity seeking ambulatory treatment? Data from a retrospective longitudinal study in a paediatric clinic in Luxembourg

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## ABSTRACT

**Objectives** The current study aimed to identify factors that could predict attrition in youths starting ambulatory treatment to control or lose weight.

**Design** Retrospective longitudinal study.

**Setting** Paediatric clinic: ambulatory treatment programme.

**Patients and measures** A youth sample (n=191; 89 boys; aged 7–17 years) completed measures of demographic characteristics, and health and psychosocial traits before starting an ambulatory weight management programme. Anthropometric and biological markers related to obesity were also obtained. Tests of mean differences and regression analyses were used to investigate the relationship between these variables and attrition after 1 year.

**Results** The $\chi^2$and t test results showed both psychosocial and health indicators differentiated between participants who continued attending the treatment programme and those who dropped out. More specifically, youths that dropped out of treatment were significantly older, had higher body mass index z scores, higher levels of insulin, triglycerides and HOMA-IR, reported poorer health, had more conduct problems and were more dissatisfied with themselves and their bodies before starting treatment. Results of regression analyses revealed that weight status (anthropometric and biological markers), age and body dissatisfaction predicted attrition (overall prediction success 73%; prediction success for continued attendance 90/91%; prediction success for dropouts 42/44%).

**Conclusion** Attrition, but especially the continued attendance in treatment, can be successfully predicted by age, weight status and body dissatisfaction. For patients who present with one or more risk factors, careful consideration is needed to decide which (combination of) inpatient or outpatient programme may facilitate prolonged engagement of the patient and hence may be most effective in establishing weight loss.

## Strengths and limitations of this study

- Successfully predicting continued attendance for treatment may contribute to more efficient and cost effective weight loss interventions. Success rates of dropout prediction models can be used to assign patients to different treatment modules.
- The study includes both screening measures and biological markers.
- Clinically or developmentally meaningful cut-offs may be more meaningful than the linear components of the relationship between health indicators and psychosocial characteristics and attrition.
- It remains unclear to what extent continued treatment attendance reflects compliance.
- The all-Caucasian sample may reduce generalisability to other countries/settings.
- Replication could increase the external validity of the current findings.

## INTRODUCTION

In Europe, as in other parts of the developed world, there is a high prevalence of obesity and those who are overweight among children and adolescents. Combined overweight and obesity estimates in different countries range from 5% to 25%,[1 2] with a reported average prevalence of 16–22%. Despite efforts by national governments, health providers and international organisations, such as the WHO and the European Association for the Study of Obesity, to promote awareness of weight problems and develop preventive measures, the prevalence of paediatric obesity continues to rise across countries.[3] Given the associated health risks, such as psychological maladjustment, diabetes and cardiovascular disease,[4 5] which in turn may affect quality of life,[6] rising

obesity levels in children and adolescents are of great public health concern. Furthermore, childhood obesity is to a varying extent related to adult obesity,[7] hence successful interventions during childhood or adolescence are of great importance with regard to potential long term health benefits.

Although several outpatient treatments may be available to children and adolescents who are overweight and obese,[8 9] the success of such treatments is significantly hampered by early dropout. Dropout rates vary significantly between studies, but are generally >25% within 4–6 months of starting a treatment programme.[10 11] Hence several attempts have been made to identify factors that may predict attrition.[12 13] Although predictors vary between studies, dropout was related to demographic characteristics (ie, socioeconomic status, age and ethnicity),[12 14] logistical reasons,[11] perceived failure of treatment[10] and psychosocial issues (ie, lower self-concept and depression).[12] Results regarding the influence of weight status and metabolic risk factors were however inconsistent.[10 11] To optimise effectiveness, it is important to develop strategies to minimise the risk of attrition.[11] In this regard, it may be particularly useful to identify predictors that could be detected by screening before treatment commences. This may enable physicians to be more selective in admitting patients to treatment programmes, and hence contribute to more efficient assignment to and cost effectiveness of weight loss interventions. Therefore, the current study aimed to assess to what extent demographic characteristics, health indicators and psychosocial traits were related to attrition in a sample of children and adolescents who were overweight or obese seeking ambulatory treatment. Based on previous research, we expected dropout to be related to weight, family and psychosocial variables. More specifically, we expected weight status, family affluence, psychosocial variables and weight change to affect dropout, such that youths with a higher starting weight, youths from less affluent families, youths experiencing psychosocial adjustment problems and youths that perceived less weight change would be more likely to discontinue participation.

## METHODS

### Participants

A total of 191 Caucasian children and adolescents (53% female), aged 7–17 years (mean 12.07, SD 2.47), who visited a paediatric clinic for weight management advice between September 2006 and June 2008, participated in the study. The sample was compiled by inviting all 7–17-year-old boys and girls, frequenting the Diabetes and Endocrinology Care Paediatric Clinic in order to lose weight, to take part in the study, whereby only youths presenting with syndromic obesity that could affect body composition, such as Prader Willi and Laurence Moon Biedl syndrome, were excluded. Data were collected as part of a study on the effect of treatment programme on outcome in youths who were overweight or obese.[15 16] Using computer software, participants were randomly assigned to either a multidisciplinary group (n=92) or individual therapy (n=99), based on age, gender and weight status (see CONSORT flow diagram in the online supplementary file). The group therapy followed an intensive approach focusing on nutritional and behavioural education in combination with physical exercise,[17 18] improving self-esteem and parental involvement, whereas the individual therapy involved outpatient visits to the paediatrician supported by nutritional education by a dietitian (conventional office visit model[19]). More specifically, the group therapy involved two to three 3-hour sessions per week, in which dietitians organised theoretical and practical educational sessions on nutrition; a psychologist organised sessions focused on improving the children's self-esteem; and a sports teacher organised non-competitive physical activities with a main focus on enjoyment. In contrast, individual therapy was provided by the dedicated paediatrician through outpatient visits in combination with dietary education provided by a dietictan, whereby the number of consultations varied according to the specific needs of the child and family. When necessary, psychological consultation was offered. Parents were invited to attend some sessions in the group therapy as well as some consultations with the paediatrician and dietitian in the individual therapy.

At the first visit, demographic characteristics, health indicators and psychosocial traits were assessed. As some of the questionnaires were only validated for use in children aged 11 years and over, and may cause some difficulties for younger children depending on their level of understanding and literacy, healthcare staff were available to provide support if necessary. Adherence (ie, persisting in following the treatment programme,[20] marked by completing treatment) was measured at 4 months and 1 year. More specifically, based on their continued participation in treatment sessions or clinic visits at 4 months and 1 year, children and adolescents were classified as dropout or adherent.

The study was approved by the National Medical Ethics Committee (CNER) as well as the National Committee for Data Protection (CNPD). Personal or parental consent was obtained for all participants.

### Measures

#### Sociodemographic variables

Data on gender and age were collected by questionnaire. Family affluence was assessed using the Health Behaviour in School aged Children (HBSC) questionnaire.[21] Family affluence is derived from the sum of four items reflective of the family's material conditions (eg, family car ownership). Total scores <3 reflect low affluence, scores between 3 and 5 medium affluence and scores of 6 and above high affluence.[22]

#### Health indicators

Participants' body mass index (BMI) was computed using height and weight measures and transferred to z scores

using the free LMS Growth software (http://www.health-forallchildren.com/?product=lmsgrowth) and according to age and gender. To calculate z scores, we applied the method developed by Tim Cole (extrapolation of the cut-offs for adults of overweight (25 kg/m$^2$) and obesity (30 kg/m$^2$).[23] We used Dutch L, M and S scores,[24] as national LMS data were not available in Luxembourg. Then, we translated z scores into percentiles through a normal law of probability. In our population, the 91th BMI percentile for boys and the 89th BMI percentile for girls are equivalent to the extrapolation, according to age and gender, of the BMI cut-off point of 25 kg/m$^2$ at 18 years of age. The 99th BMI percentiles are equivalent to the extrapolation, according to age and gender, of the BMI cut-off point of 30 kg/m$^2$ at 18 years of age for both boys and girls.

### Biological markers of obesity

Fasting blood samples were taken to determine glucose, insulin, cholesterol and triglyceride levels. These measures were included as surrogate biomarkers for long term risk of cardiometabolic morbidity or mortality.[25] Insulin resistance levels were determined by applying the homeostasis model assessment-estimated insulin resistance (HOMA-IR).[26]

### Perceived health

The HBSC questionnaire[21] provided information on health related quality of life. Perceived health ("Would you say your health is…?") was assessed using a four point Likert scale (1 'excellent' to 4 'poor'). Subjective health complaints reflect the extent to which participants have experienced symptoms in eight domains over the past 6 months: headache, stomach ache, backache, dizziness, feeling low, feeling irritable or bad tempered, feeling nervous or having difficulty sleeping. Items are scored on a five point Likert scale (1 'nearly every day' to 5 'seldom or never'). The first four domains can be summed to derive a somatic health score; the last four domains are summed into a psychological health score.[27] A sum score of all items can be computed to derive a measure of subjective psychosomatic health, whereby higher scores reflect better health.

### Psychosocial variables

Psychosocial adjustment was assessed using the parent and self-report versions of the Strengths and Difficulties Questionnaire (SDQ).[28] The SDQ is a 25 item behavioural screening questionnaire for use with children aged 4 to 17 years. Items refer to positive and negative attributes and generate five subscale scores: conduct problems, hyperactivity and inattention, emotional symptoms, peer problems and pro-social behaviour. A total difficulties score can be computed by summing the first four subscale scores. A test–retest reliability coefficient (intraclass correlation) of 0.85 has been reported for the SDQ total score.[28]

Self-perception, self-confidence and life satisfaction were assessed using items of the HBSC.[21] More specifically, self-perception was assessed by asking participants to indicate the extent to which they felt content with themselves (1 'always', 5 'never'). Similarly, participants indicated their level of confidence on a five point scale. A further question was used to assess participants' level of satisfaction with their body ("Would you like to change anything of your body?"). This question followed a four point response format, ranging from 1 'no, nothing' to 4 'yes, almost everything'. For these three items, scores <2 were considered to reflect content and scores ≥3 discontent. Finally, life satisfaction was measured on an 11 point Cantril ladder, whereby the top of the ladder reflected the best possible life and the bottom of the ladder the worst. A score of 6 or more is perceived as high life satisfaction.[29]

### Statistical analyses

We used $\chi^2$ analyses to investigate the relationship between attrition and gender and weight status (overweight or obese), respectively. For all other independent variables, t test analyses were used to test for differences between groups (continued attendance vs dropout). Logistic regression analyses were conducted to identify markers that could predict attrition, including only variables that differed between groups. Within the logistic regression models, the Nagelkerke $R^2$ can be interpreted as the approximate variance in the outcome accounted for by the predictor variables, whereas the Wald test is used to evaluate the contribution of each individual predictor. A sample of n=191 is sufficient to achieve a stable prediction,[30 31] and a priori power estimates showed an increased dropout probability of 20% due to an individual predictor would be detected with a power of 80% given the sample size of n=191.[32] A post hoc power analysis revealed that for each binary predictor variable, an OR of 2.0 could be detected with a power of 0.75 given a dropout percentage of 37% ($\alpha$=0.05, n=191).[32]

## RESULTS

Of the 191 participants enrolled in the ambulatory treatment programme, 69 were categorised as overweight (36%) and 122 as obese (64%), in accordance with the International Obesity TaskForce definition.[23] Twenty-nine (15%) participants came from low, 75 (39%) from medium and 86 (45%) from high affluent families.[22] Although 121 participants continued treatment for 1 year, 70 participants (37%) dropped out prematurely. Of these, 40% dropped out after 4 months. Attrition was unrelated to therapy module (table 1) and hence further analyses were conducted considering the sample as a whole.

Results of the $\chi^2$ analyses revealed that although gender and family affluence were unrelated to attrition ($\chi^2$ (1, n=191)=0.62, p=0.43, and $\chi^2$ (2, n=190)=2.51, p=0.29, respectively), obese participants were more likely to dropout than participants who were overweight ($\chi^2$ (1,

Table 1 Results of $\chi^2$ test and descriptive statistics for attrition by treatment module (n=191)

| | Attrition 4 months* | | | Attrition 1 year† | | |
|---|---|---|---|---|---|---|
| | Continued attendance | Dropout | Total | Continued attendance | Dropout | Total |
| Individual therapy | 85 (85.9%)‡ | 14 (14.1%) | 99 | 62 (62.6%) | 37 (37.4%) | 99 |
| Group therapy | 78 (84.8%) | 14 (15.2%) | 92 | 59 (64.1%) | 33 (35.9%) | 92 |
| Total | 164 | 28 | 191 | 121 | 70 | 191 |

*$\chi^2$=0.04, df=1, p=0.83; Cramer's *V*=0.02.
†$\chi^2$=0.05, df=1, p=0.83; Cramer's *V*=0.02.
‡Percentages reflect percentage of cases within treatment module.

n=191)=6.71, p=0.01). For all other variables, descriptive statistics and t test results are presented in table 2.

Demographic characteristics, anthropometric parameters and biological markers varied between groups, showing that participants in the dropout group were older and had higher BMI z scores, higher insulin levels, higher triglycerides levels and higher insulin resistance (HOMA-IR) levels. However, no differences were found for glucose or cholesterol levels. With regard to psychosocial parameters, the groups differed for conduct problems, perceived health, self-perception and body satisfaction, with scores for the participants who dropped out all reflecting more problems or negative perceptions. No differences were found for the other three subscales of the SDQ nor for subjective health, self-confidence or general quality of life.

In the first regression model, we included predictor variables that could be acquired using the screening methods (ie, questionnaire and anthropometric data). More specifically, we included age, weight status, conduct problems, perceived health, self-perception and body satisfaction. The therapy module was also included in the model as a covariate. The test of the full model against a constant only model was statistically significant, indicating that the predictors as a set reliably distinguished between participants who continued attending the treatment programme and those who dropped out ($\chi^2$ (7, n=177)=29.60, p<0.001). Although Nagelkerke's $R^2$ of 0.21 indicated a weak relationship between prediction and grouping, overall prediction success was 72% (88% for continued attendance and 43% for dropout). The Wald test demonstrated that the BMI z scores and body satisfaction contributed significantly to predictions, whereas age, conduct problems, self-perception and perceived health did not predict dropout. Participants with higher BMI z scores and participants who were less content with their body were 2.84 and 1.69 times, respectively, more likely to dropout than other participants (table 3).

In a second analysis, we dichotomised the predictor variables, as for each of the psychosocial characteristics and biological markers there are cut-offs available for scores in the 'normal' and 'abnormal' range, generally used by clinicians. For age, we divided the group based on a developmental change between pre-adolescence (7–12 years) and adolescence (13–17 years). In other words, scores beyond a certain point are clinically or developmentally meaningful and may be more interpretable than treating each unit change as having the same effect. Therefore, this analysis demonstrates the predictive power of available clinical and developmental categorisations, which are generally used in healthcare settings, rather than the linear relationships between the variables and dropout.

Again, the test of the full model against a constant only model was statistically significant, indicating that the predictors as a set reliably distinguished between participants who continued attending the treatment programme and those who dropped out ($\chi^2$ (7, n=187)=26.44, p<0.001), with an overall prediction success of 73% (91% for continued attendance and 44% for dropout). The Wald test demonstrated that age, weight status and body satisfaction contributed significantly to predictions (p=0.01–0.03), whereas conduct problems, self-perception and perceived health did not predict dropout. Participants aged 13–17 years were twice as likely to dropout of treatment than 7–12-year-old participants. Similarly, ORs indicated that participants with obesity and participants who were discontent with their body were 2.17 and 2.24 times more likely, respectively, to dropout than other participants. Although participants with conduct problems were 2.32 times as likely to dropout, this OR failed to reach significance (table 4).

In the second model, we replaced the weight status variable by other correlates of obesity (ie, HOMA-IR and triglyceride levels). A blood sample is needed to acquire these measures. As youths may perceive taking blood sample as unpleasant and the blood sample needs to be analysed in the laboratory, such measures could be perceived as more invasive and time consuming. In this second model, we did not consider the psychosocial variables that did not significantly contribute to the prediction in the first model. Although insulin levels also differed between groups, given the high correlation with HOMA-IR levels, only HOMA-IR was used as a surrogate marker for insulin resistance. Again, the $\chi^2$ analysis indicated that the set of predictors (ie, therapy module, age, HOMA-IR, triglycerides, conduct problems and body satisfaction) were able to reliably distinguish between participants who continued attending the treatment programme and those who dropped out ($\chi^2$ (6, n=188)=28.30, p<0.001) and overall prediction success was 69% (87% for continued attendance and 38% for dropout). The Wald criterion demonstrated

Table 2 Descriptive statistics and t test results for continued attendance and dropout groups

| Variable | Continued attendance (n=121) Mean | SD | Dropout (n=70) Mean | SD | p | t | d |
|---|---|---|---|---|---|---|---|
| Demographics | | | | | | | |
| Age (years) | 11.77 | 2.39 | 12.59 | 2.53 | 0.03 | 2.24 | 0.33 |
| Anthropometrics and metabolism | | | | | | | |
| BMI z score | 2.43 | 0.55 | 2.73 | 0.55 | <0.001 | 3.60 | 0.55 |
| Change in BMI z score after 4 months* | 0.10 | 0.20 | 0.10 | 0.21 | 0.81 | 0.24 | 0.04 |
| Glucose (mg/dl) | 86.42 | 6.85 | 86.63 | 6.23 | 0.83 | 0.21 | 0.03 |
| Insulin (mIU/l) | 14.11 | 7.07 | 20.20 | 9.78 | <0.001 | 4.94 | 0.71 |
| Cholesterol (mg/dl) | | | | | | | |
| HDL | 54.91 | 13.33 | 52.00 | 11.09 | 0.13 | 1.54 | 0.24 |
| LDL | 93.23 | 27.24 | 92.81 | 32.42 | 0.92 | 0.10 | 0.01 |
| Triglycerides (mg/dl) | 88.38 | 43.59 | 110.10 | 70.46 | 0.01 | 2.62 | 0.37 |
| HOMA-IR | 3.04 | 1.64 | 4.37 | 2.22 | <0.001 | 4.69 | 0.68 |
| Psychosocial parameters (self-report) | | | | | | | |
| SDQ† conduct | 2.23 | 1.45 | 2.69 | 1.59 | 0.04 | 2.06 | 0.30 |
| SDQ† peer relations | 2.49 | 1.93 | 2.57 | 1.90 | 0.78 | 0.28 | 0.04 |
| SDQ† hyperactivity | 4.10 | 1.87 | 4.33 | 2.13 | 0.43 | 0.79 | 0.11 |
| SDQ† emotional symptoms | 3.61 | 2.30 | 3.64 | 2.39 | 0.94 | 0.08 | 0.01 |
| HBSC perceived health 1 excellent—4 poor | 2.31 | 0.80 | 2.57 | 0.89 | 0.04 | 2.06 | 0.31 |
| HBSC subjective health‡ | | | | | | | |
| -Somatic | 16.87 | 3.02 | 16.61 | 3.24 | 0.58 | 0.56 | 0.08 |
| -Psychological | 15.07 | 3.52 | 14.30 | 3.99 | 0.17 | 1.36 | 0.21 |
| HBSC self confidence 1 confident—5 not confident | 2.18 | 1.08 | 2.22 | 1.07 | 0.84 | 0.20 | 0.04 |
| HBSC self perception 1 content—5 not content | 2.31 | 1.21 | 2.74 | 1.28 | 0.02 | 2.29 | 0.35 |
| HBSC body satisfaction 1 satisfied—4 not satisfied | 2.52 | 0.81 | 2.93 | 0.89 | 0.001 | 3.26 | 0.48 |
| HBSC life satisfaction 1 satisfied—5 not satisfied | 7.14 | 1.97 | 6.75 | 1.90 | 0.19 | 1.31 | 0.20 |

*n=163; for the 28 children that already dropped out by 4 months, no weight data are available.
†Subscale scores ranging from 0 to 10, with higher scores reflecting more problems.
‡Subscale score ranging from 4 to 20, with higher scores reflecting fewer symptoms.
BMI, body mass index; HBSC, Health Behaviour in School aged Children questionnaire; HDL, high density lipoprotein; HOMA-IR, homeostasis model assessment-estimated insulin resistance; LDL, low density lipoprotein; SDQ, Strengths and Difficulties Questionnaire.

that HOMA-IR levels and body satisfaction made significant contributions to predictions whereas age, conduct problems and triglyceride levels did not (table 5). The ORs indicated that participants with higher HOMA-IR levels, and who were less content with their body, were more likely to prematurely dropout as other participants (table 5).

When repeating this analysis using dichotomised variables, the $\chi^2$ analysis indicated again that the set of predictors was able to reliably distinguish between participants who continued attending the treatment programme and those who dropped out ($\chi^2$ (6, n=186)=29.99, p<0.001) with an overall prediction success of 73% (90% for continued attendance and 42% for dropout). The Wald criterion demonstrated that HOMA-IR levels (normal vs at risk),[33] age and body satisfaction made significant contributions to predictions, whereas conduct problems and triglyceride levels (normal vs high)[33] did not (table 6).

The ORs indicated that participants with elevated HOMA-IR levels, participants aged 13–17 years,

Table 3 Predictors of attrition: screening measures

| | OR | 95% CI for Exp(B) Low | High | Wald | p Value |
|---|---|---|---|---|---|
| Type of therapy (individual vs group) | 1.21 | 0.60 | 2.46 | 0.28 | 0.60 |
| Demographic parameters | | | | | |
| Age | 1.09 | 0.94 | 1.25 | 1.28 | 0.26 |
| Anthropometric parameters | | | | | |
| BMI z score | 2.84 | 1.49 | 5.41 | 10.10 | 0.001 |
| Psychosocial parameters | | | | | |
| SDQ conduct problems | 1.13 | 0.88 | 1.44 | 0.93 | 0.34 |
| Perceived health status | 1.03 | 0.97 | 1.09 | 0.77 | 0.38 |
| Self-perception | 1.26 | 0.93 | 1.72 | 2.15 | 0.14 |
| Body satisfaction | 1.69 | 1.11 | 2.57 | 5.94 | 0.02 |
| Constant | 0.001 | | | 15.50 | 0.000 |
| Nagelkerke $R^2$=0.21 | | | | | |

Reference group: dropout.
BMI, body mass index; SDQ, Strengths and Difficulties Questionnaire.

Table 4 Predictors of attrition: screening measures (dichotomised predictor variables)

| | OR | 95% CI for Exp(B) Low | High | Wald | p Value |
|---|---|---|---|---|---|
| Type of therapy (individual vs group) | 0.94 | 0.33 | 1.79 | 0.05 | 0.83 |
| Demographic parameters | | | | | |
| Age (7–12 vs 13–17 years) | 2.02 | 1.03 | 3.95 | 4.22 | 0.04 |
| Anthropometric parameters | | | | | |
| Weight status (overweight vs obese) | 2.17 | 1.06 | 4.41 | 4.56 | 0.03 |
| Psychosocial parameters | | | | | |
| SDQ conduct problems (normal vs abnormal range) | 2.32 | 0.85 | 6.29 | 2.71 | 0.10 |
| Perceived health status (good/excellent vs fair/poor) | 1.34 | 0.68 | 2.63 | 0.73 | 0.39 |
| Self-perception (content vs discontent) | 0.97 | 0.48 | 1.96 | 0.06 | 0.94 |
| Body satisfaction (content vs discontent) | 2.24 | 1.13 | 4.46 | 5.34 | 0.02 |
| Constant | 3.93 | | | 5.67 | 0.02 |
| Nagelkerke $R^2$=0.18 | | | | | |

Reference group: dropout.
SDQ, Strengths and Difficulties Questionnaire.

participants reporting conduct problems or those who were discontent with their body were at least twice as likely to prematurely dropout as other participants (see table 4). In other words, younger participants with lower levels of insulin resistance and who were content with their bodies, were significantly more likely to remain in the programme than other participants. Although participants with conduct problems were 2.81 times as likely to dropout, this OR failed to reach significance (see table 6).

## DISCUSSION

The results of this study show that any combination of risk factors increases the likelihood of dropout, and that youths in the low risk groups are most likely to continue participation in ambulatory treatment. The risk factors we identified were directly related to the weight problem (ie, weight class, HOMA-IR levels or body satisfaction), or more or less independent (ie, conduct problems and age). The results further show that participants who may benefit most from losing weight (ie, whose health is most compromised) may be the most vulnerable to withdraw prematurely.

Although previous findings on the association between weight status and adherence have been inconsistent,[10 11] in the current study both anthropometric and biological correlates to obesity were predictive of continued participation in treatment. This is an important finding, although it warrants replication, as the results indicate that adolescents with obesity and possible pre-diabetes are more likely to dropout and hence may not successfully lose weight or change to a healthier lifestyle. This may have detrimental long term effects as adolescent adiposity has been linked with adult adiposity and carriers long term health risks.[34]

Interestingly, we did not find an association between change in BMI z scores after 4 months and dropout. Previous research has indicated that perceived failure of treatment is associated with dropout.[35] In our study, we used the BMI z score change as an indicator of treatment success, but such changes may not fully reflect youths' perceptions of treatment success. For example, for one person the observed BMI change may match expectations, while for another the same change may be a disappointment. Future research could use measures of perceived treatment success in combination with observed changes in BMI z scores to investigate this relationship further.

Including predictors as continuous or dichotomous variables in the regression analyses yielded differential

**Table 5** Predictors of attritions: screening measures and biological markers

| | OR | 95% CI for Exp(B) Low | High | Wald | p Value |
|---|---|---|---|---|---|
| Therapy (individual vs group) | 1.22 | 0.63 | 2.35 | 0.34 | 0.56 |
| Demographic parameters | | | | | |
| Age | 1.04 | 0.90 | 1.19 | 0.23 | 0.63 |
| Biological markers | | | | | |
| HOMA-IR | 1.31 | 1.08 | 1.59 | 7.23 | 0.007 |
| Triclycerides | 1.00 | 1.00 | 1.01 | 1.13 | 0.29 |
| Psychosocial parameters | | | | | |
| SDQ conduct problems | 1.17 | 0.94 | 1.45 | 1.85 | 0.17 |
| Body satisfaction | 1.48 | 1.01 | 2.16 | 4.00 | 0.05 |
| Constant | 0.22 | | | 14.19 | 0.000 |
| Nagelkerke $R^2$=0.19 | | | | | |

Reference group: dropout.
HOMA-IR, homeostasis model assessment-estimated insulin resistance; SDQ, Strengths and Difficulties Questionnaire.

**Table 6** Predictors of attritions: screening measures and biological markers (dichotomised predictor variables)

| | OR | 95% CI for Exp(B) Low | High | Wald | p Value |
|---|---|---|---|---|---|
| Therapy (individual vs group) | 0.86 | 0.45 | 1.66 | 0.21 | 0.65 |
| Demographic parameters | | | | | |
| Age (7–12 vs 13–17 years) | 2.08 | 1.06 | 4.05 | 4.56 | 0.03 |
| Biological markers | | | | | |
| HOMA-IR (normal vs at risk) | 2.30 | 1.18 | 4.48 | 6.02 | 0.01 |
| Triglycerides (normal vs elevated) | 2.03 | 0.75 | 5.53 | 1.93 | 0.17 |
| Psychosocial parameters | | | | | |
| SDQ conduct problems (normal vs abnormal range) | 2.81 | 0.96 | 8.20 | 3.58 | 0.06 |
| Body satisfaction (content vs discontent) | 2.28 | 1.17 | 4.44 | 5.85 | 0.02 |
| Constant | 8.70 | | | 8.10 | 0.01 |
| Nagelkerke $R^2$=0.20 | | | | | |

Reference group: dropout.

results. More specifically, age as a continuous variable did not contribute significantly to the prediction of dropout whereas age as a dichotomous variable did. This could indicate that the linear component of the relationship between age and attrition is less important than the non-linear component. This further supports our notion that the developmental changes occurring from pre-adolescence to adolescence are more important than just getting older. For the other predictors, results were comparable, but the use of clinical cut-offs may be more useful to clinicians when making treatment decisions.

In line with the results of previous studies,[12 35] our findings suggest younger children are more likely to continue to attend the programme. The age groups in the current study reflect different developmental stages (ie, transition from child to adolescent). Such developmental change may lead to more independence and different expectations/responsibilities. This change is paralleled by the transfer into secondary school, which in Luxembourg generally occurs when the child is aged 12–13 years. Hence the age division reflects possible changes between primary school aged and secondary school aged children/adolescents, which may bring about changes in treatment adherence. The result in our study may therefore have resulted from the fact that 7–12 year olds are generally less independent than 13–17 year olds and may have been more actively coached by parents to continue the treatment such that parents have made sure their children continued attending the sessions. Previous research has indeed indicated that family support is important for continued participation in weight loss programmes.[36–38] Therefore, future research could also include parental questionnaires as possible indicators of youth dropout.

The effect of body satisfaction confirms previous findings—that is, greater body dissatisfaction is generally linked with higher attrition rates.[39] In addition, it may be that the extent to which participants were dissatisfied with their bodies led to unrealistic expectations of treatment, which has been shown to contribute to dropout rates in adults[40] and adolescents.[38]

Although both regression models were equally successful at explaining variance in attrition, the correct prediction of continued participation and dropout was slightly lower in the model including biological markers of the level of (un)healthy weight than in the model using weight status (ie, screening measures only). These findings indicate that the extra intrusion and effort of taking blood samples for selecting patients for treatment modules may not be warranted, although such tests will of course provide the paediatrician with vital information for diagnosing health problems.

By identifying variables as predictors of dropout, and using clinical or developmental significant cut-offs, we were able to reduce the original classification error rate of 37% to 27%. The still relatively unsatisfactory low classification rate of 73% in each model was mainly due to difficulties in accurately predicting dropout, whereas the set of variables enabled 91/90% accurate prediction of

continued participation in model 1 and 2, respectively. This is a significant increase from the 63% observed in the current sample, as well as from values reported in other samples.[10] From our study, we can conclude that an ambulatory treatment programme may be most suitable for pre-adolescents who are overweight but still content with their bodies and do not display any conduct problems. In this regard, early intervention programmes aimed at preventing obesity may be most effective.[41] For teenagers with obesity, who are discontent with their bodies, other treatment programme (eg, inpatient) may be more suitable, especially when behavioural conduct is an issue. This finding is in line with previous research indicating that older youths in particular with psychosocial adjustment problems were most at risk of withdrawing prematurely from a weight management programme.[12]

One limitation of the study relates to the set of predictor variables. Although anthropometric and psychosocial variables have been previously identified as predictors of dropout,[10–12] other variables that may also contribute to discontinuing treatment were not included. For example, although the study included a screening measure for psychosocial adjustment problems, a more detailed psychological assessment, including the presence of an eating disorder pathology, would have provided further information as to why some youths continued participation while others dropped out. Such variables could be considered in future studies, as they may increase the success of dropout prediction, even if they may prove difficult to be determine by screening (eg, logistical difficulties, perceived failure of treatment). Another limitation is the fact that from our data we cannot determine to what extent continued attendance for treatment reflects adherence to the treatment programme. Furthermore, although the all-Caucasian sample may be representative of the Luxembourgian society (ie, 89% of people living in Luxembourg in 2007 had a European/Caucasian background[42]), it may reduce the generalisability to other countries and settings.

In summary, identification of patients who may be more likely to stay in an ambulatory programme may be relatively easily determined based on a simple questionnaire, combining the SDQ and items of the HBSC. Such a questionnaire may not take longer than 10 min to complete and, in combination with anthropometric and demographic information, will provide valuable information to the specialist to guide his/her decision on which treatment programme may best suit the patient.

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