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Metabolic and psychosocial variables as predictors of attrition in overweight and obese youth seeking ambulatory treatment.

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Ineke Pit-ten Cate: Dr. Pit-ten Cate conceptualized the study, carried out the literature review and data-analyses, drafted the initial manuscript and approved the final manuscript as submitted.

Hanen Samouda: Dr. Samouda conceptualized and designed the study, collated the research materialized, collected the data, reviewed the manuscript and approved the final manuscript as submitted.

Ulrike Schierloh: Dr Schierloh conceptualized the study, collected data, reviewed the manuscript and approved the final manuscript as submitted.

Julien Jacobs: Mr Jacobs, was involved in the conceptualization of the study, prepared the dataset and carried out the initial data analyses, reviewed the manuscript and approved the final manuscript as submitted.

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All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Data sharing statement:

No additional data available

ABSTRACT

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

Design: cross-sectional study

Setting: paediatric clinic: ambulatory treatment program

Patients and measures: A youth sample (*N*=191; 89 boys; age 7-17 years) completed measures of demographic characteristics, health and psychosocial traits before starting an ambulatory weight management program. Anthropometric and biological characteristics related to obesity were also obtained. Test of mean differences and regression analyses were used to investigate the relationship between these variables and attrition after one year.

Results: Chi-square and t-test results showed differences between participant that continued attending the treatment program and those that dropped out for both psychosocial and biological variables. More specifically, youth that dropped out of treatment were significantly older, had higher BMI-Z scores, higher levels of insulin, triglycerides and HOMA-IR, reported poorer health and 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 correlates), age, conduct problems, and body dissatisfaction predict attrition (overall prediction success 73%; prediction success for continued attendance 90/91%; prediction success for dropout 42/44%).

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

Key words: Obesity; Attrition; Ambulatory treatment; Adolescents, Children

Strengths and limitations of this study:

Strengths:

- Continued attendance to treatment can be predicted by age, weight status, body dissatisfaction and conduct problems
- The study not only considers the level of association between metabolic and psychosocial variables but also regards the success rates of prediction models
- Screening for (a combination of) risk factors may facilitate choosing best weight management program in terms of patient engagement
- Early intervention may be most successful
- Minimizing the risk of dropout will optimize the effectiveness of paediatric obesity management

Limitations:

- Metabolic and psychosocial variables considered in the current study are less successful in the prediction of dropout and more predictive of continued program attendance
- The study is not able to address to what extent continued program attendance reflects compliance

INTRODUCTION

In Europe, as in other parts of the developed world, there is a high prevalence of overweight and obesity among children and adolescents. Combined overweight and obesity estimates in different countries range from 5-25%[1,2] with a reported average prevalence of 16-22%. Despite efforts taken by national governments, health providers, and international organizations, such as the World Health Organization (WHO) and the European Association for the Study of Obesity (EASO), to promote awareness of weight problems and develop preventive measures, paediatric obesity prevalence 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 impact quality of life[6], rising obesity levels in children and adolescents are of great public health concern. Furthermore, childhood obesity is to varying extent related to adult obesity[7], hence successful interventions during childhood or adolescence are of great importance in regards to potential long-term health benefits.

Although several outpatient treatments may be available to overweight and obese children and adolescents[8-9], success of such treatments is significantly hampered by early dropout. Dropout rates vary significantly between studies, but are generally above 25% within 4-6 months of starting a treatment program[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 (i.e. socioeconomic status, age and ethnicity)[12], logistical reasons[11], perceived failure of treatment[10], and psychosocial issues (i.e. lower self-concept and depression)[12]. Results regarding the influence of weight status and metabolic risk factors were however inconsistent[10-11]. To optimize effectiveness, it is important to develop strategies to minimize 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 programs, 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 overweight and obese children and adolescents seeking ambulatory treatment.

METHODS

Participants

One-hundred-ninety-one Caucasian children and adolescents (53% female), aged 7-17 years (Mean= 12.07, SD = 2.47), who visited a paediatric clinic for weight management advise between September 2006 and June 2008, participated in the study. Data were collected as part of a study into the effect of treatment programs on outcome in overweight and obese youth[14,15]. Participants were randomly assigned to either an ambulatory group (n=92) or individual therapy (n=99). The ambulatory group therapy followed an intensive interdisciplinary approach focusing on nutrition as well as physical activity, improving self-esteem and parental involvement, whereas the individual therapy involved outpatient visits to the paediatrician supported by nutritional education by a dietician (conventional office-visit model[16]). Adherence (i.e. persisting in following the treatment program[17], marked by attending all sessions) was measured at 4 months and 1 year. Personal or parental consent was obtained for all participants.

Measures

Sociodemographic variables

Data on gender and age was collected by questionnaire. Family affluence was assessed using the Health Behaviour in School aged Children (HBSC) questionnaire[18]. Family affluence is derived from the sum of 4 items reflective of the family's material conditions (e.g. family car ownership). Total scores below 3 reflect low affluence, scores between 3 and 5 medium affluence and scores of 6 and above high affluence[19].

Health indicators

Anthropometric characteristics

Participants' BMI was computed using height and weight measures and transferred to Z scores using the free LMS Growth software (http://www.healthforallchildren.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 adults of overweight (25 kg/m^2) and obesity (30 kg/m^2)[20]. We did use Dutch L, M and S scores[21], as national LMS data are 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 old. The 99th BMI percentile are equivalent to the extrapolation, according to age and gender, of the BMI cut-off point of 30 kg/m^2 at 18 years old for both boys and girls.

Biological correlates 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 cardio-metabolic morbidity or mortality[22]. Insulin resistance levels were determined by applying the homeostasis model assessment-estimated insulin resistance (HOMA-IR)[23].

Perceived health

The HBSC questionnaire[18] provided information on health related quality of life. Perceived health ("Would you say your health is…?") was assessed using a 4-point Likert scale (1 "excellent" to 4 "poor"). Subjective health complaints reflect the extent to which participants have experienced symptoms in 8 domains the last six months: headache, stomach ache, backache, dizziness, feeling low, feeling irritability or bad tempered, feeling nervous or having difficulty sleeping. Items are scored on a 5-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[24]. 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)[25]. 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 5 sub-scale 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 sub-scale scores. A test-retest reliability coefficient (intraclass correlation) of .85 has been reported for the SDQ total score[25]. Self-perception, self-confidence and life satisfaction were assessed using items of the HBSC[18]. More specifically, self-perception was assessed by asking participant to indicate the extent to which they felt content with themselves (1 “always”, 5 “never”). Similarly, participants indicated their level of confidence on a 5-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 4-point response format ranging from 1 “no, nothing” to 4 “yes, almost everything”. For these three items, scores less than 2 were considered to reflect content, scores equal or greater than 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[26].

Statistical Analyses

Chi-square analyses were used 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. The sample of N=191 is sufficient to achieve a

stable prediction[27,28] and a-priori power estimates showed an increased dropout probability of 20% due to an individual predictor, would be detected with power of 80% given the sample of N=191.[29] A post hoc power analysis revealed that for each binary predictor variable odds ratio of 2.0 could be detected with a power of .75 given a dropout percentage of 37% (α=.05, N=191).[29]**RESULTS**

Of the 191 participant enrolled in the ambulatory treatment programs, 69 were categorized as overweight (36%) and 122 as obese (64%) in accordance with the IOTF definition[20]. Twenty-nine (15%) participants came from low, 75 (39%) from medium and 86 (45%) from high affluent families[19]. Although 122 participants continued treatment for 1 year, 70 participants (37%) dropped out prematurely. Of these, 40% already dropped out after 4 months. Attrition was unrelated to therapy module (see Table 1) hence further analyses were conducted considering the sample as a whole.

Table 1: Results of Chi-square Test and Descriptive Statistics for attrition by treatment module (N=191)

	Attrition 4 months[a]			Attrition 1 year[b]		
	Continued attendance	Dropout	Total	Continued attendance	dropout	Total
Individual therapy	85 (85.9%)[c]	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

[a] $\chi^2 = 0.04$, df = 1, $p = .83$; Cramer´s $V = .02$

[b] $\chi^2 = 0.05$, df = 1, $p = .83$; Cramer´s $V = .02$

[c] Percentage reflect percentage of cases within treatment module

Results of the Chi-square analyses revealed that although gender and family affluence were unrelated to attrition ($\chi^2(1, N=191) = 0.62$, $p=.43$, and $\chi^2(2, N=190) = 2.51$, $p=.29$, respectively), obese participants were more likely to dropout than overweight

participants ($\chi^2(1, N=191)= 6.71, p=.01$). For all other variables, descriptive statistics and *t*-test results are presented in Table 2.

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

	Continued attendance (n = 121)		Dropout (n = 70)				
Variable	Mean	SD	Mean	SD	*p*	*t*	*d*
Demographics							
Age in years	11.77	2.39	12.59	2.53	.03	2.24	0.33
Anthropometrics & Metabolism							
BMI-Z Score	2.43	0.55	2.73	0.55	<.001	3.60	0.55
Glucose in mg/dl	86.42	6.85	86.63	6.23	.83	0.21	0.03
Insulin in mIU/l	14.11	7.07	20.20	9.78	<.001	4.94	0.71
Cholesterol in mg/dl							
HDL	54.91	13.33	52.00	11.09	.13	1.54	0.24
LDL	93.23	27.24	92.81	32.42	.92	0.10	0.01
Triglycerides in mg/dl	88.38	43.59	110.10	70.46	.01	2.62	0.37
HOMA-IR	3.04	1.64	4.37	2.22	<.001	4.69	0.68
Psychosocial parameters (self-report)							
SDQ[a]-conduct	2.23	1.45	2.69	1.59	.04	2.06	0.30
SDQ[a]-peer relations	2.49	1.93	2.57	1.90	.78	0.28	0.04
SDQ[a]-hyperactivity	4.10	1.87	4.33	2.13	.43	0.79	0.11
SDQ[a]-emotional symptoms	3.61	2.30	3.64	2.39	.94	0.08	0.01
HBSC-perceived health 1 excellent – 4 poor	2.31	0.80	2.57	0.89	.04	2.06	0.31
HBSC-Subjective health[b]	16.87	3.02	16.61	3.24		0.56	0.08
-Somatic	15.07	3.52	14.30	3.99	.58	1.36	0.21
-Psychological					.17		
HBSC-self confidence 1 confident – 5 not confident	2.18	1.08	2.22	1.07	.84	0.20	0.04
HBSC-self perception	2.31	1.21	2.74	1.28	.02	2.29	0.35

1 content – 5 not content							
HBSC-body satisfaction 1 satisfied - 4 not satisfied	2.52	0.81	2.93	0.89	.001	3.26	0.48
HBSC-life satisfaction 1 satisfied – 5 not satisfied	7.14	1.97	6.75	1.90	.19	1.31	0.20

[a] Subscale scores ranging from 0-10 with higher scores reflecting more problems

[b] Subscale score ranging from 4-20, with Higher scores reflecting fewer symptoms

Demographic, anthropometric and biological correlates 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, 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, subjective health, self-confidence or general quality of life.

In the first regression model we included predictor variables that could be acquired using non-invasive methods (i.e. questionnaire and anthropometric data). These variables included age (7-12 vs. 13-17 years), weight status (overweight vs. obese), conduct problems (normal vs. abnormal range), perceived health (good/excellent vs. fair/poor), self-perception (content vs. discontent) and body satisfaction (content vs. discontent). The therapy module was also included in the model as a covariate. A test of the full model against a constant only model was statistically significant, indicating that the predictors as a set reliably distinguished between participants that continued attending the treatment program and participants that dropped out (χ^2 (7, N=187) = 26.44, $p < .001$). Although Nagelkerke's R^2 of .18 indicated a weak relationship between prediction and grouping, overall prediction success was 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 ranges between .01 and .03), whereas conduct problems, perceived health and life satisfaction did

not predict dropout. Participants aged 13-17 years were twice as likely to drop-out of treatment than 7-12-year-old participants. Similarly, odds ratios indicated that obese participants and participants who were discontent with their body were 2.17 and 2.24 times more likely to dropout than other participants. Although participants with conduct problems were 2.32 times as likely to dropout, this odds ratio failed to reach significance (see Table 3).

Table 3: Predictors of attrition - Non-invasive measures

		95% CI for Exp(B)			
	Odds ratio	Low	High	*Wald*	*p*-value
Type of therapy Individual vs. Group	0.94	0.33	1.79	0.05	.83
Demographic parameters					
Age 7-12 vs. 13-17 years	2.02	1.03	3.95	4.22	.04
Anthropometric parameters					
Weight status Overweight vs. obese	2.17	1.06	4.41	4.56	.03
Psychosocial parameters					
SDQ-Conduct problems Normal vs. abnormal range	2.32	0.85	6.29	2.71	.10
Perceived health status Good/excellent vs. fair/poor	1.34	0.68	2.63	0.73	.39
Self-perception Content vs. discontent	0.97	0.48	1.96	0.06	.94
Body satisfaction Content vs. discontent	2.24	1.13	4.46	5.34	.02
Constant	3.93			5.67	.02
Nagelkerke R^2 = 0.18					

Reference group: dropout

In the second model we replaced the weight status variable by other correlates of obesity (i.e. HOMA-IR and triglyceride levels). A blood sample is needed to acquire these measures, and hence could be perceived as more invasive. 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 the HOMA-IR levels, only HOMA-IR was used as a surrogate marker for insulin resistance. Again, the Chi-square analysis indicated that the set of predictors were able to reliably distinguish between participants that continued attending the treatment program and participants that dropped out (χ^2 (6, N=186) = 29.99, $p < .001$) and overall prediction success was 73% (90% for continued attendance and 42% for dropout). The Wald criterion demonstrated that HOMA-IR levels (normal vs. at risk)[30], age, body satisfaction and conduct problems made significant contributions to predictions ($p < .06$), whereas triglyceride levels (normal vs. high)[30] did not (see Table 4).

Table 4: Predictors of attritions - Invasive and non-invasive measures

		95% CI for Exp(B)			
	Odds Ratio	Low	High	Wald	*p*-value
Therapy Individual vs. Group	0.86	0.45	1.66	0.21	.65
Demographic parameters					
Age 7-12 vs. 13-17 years	2.08	1.06	4.05	4.56	.03
Biological parameters					
HOMA-IR Normal vs. at risk	2.30	1.18	4.48	6.02	.01
Triclycerides Normal vs. elevated	2.03	0.75	5.53	1.93	.17
Psychosocial parameters					
SDQ-Conduct problems Normal vs. abnormal range	2.81	0.96	8.20	3.58	.06

Body satisfaction Content vs. discontent	2.28	1.17	4.44	5.85	.02
Constant	8.70			8.109.43	.01
Nagelkerke R^2 = 0.20					

Reference group: dropout

The odds ratios indicated that participants with elevated HOMA-IR levels, participants aged 13-17 years, 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, who were content with their bodies and not presenting with conduct problems, were significantly more likely to remain in the program than other participants.

DISCUSSION

Results of this study show that it is mainly the absence of risk factors, which predicts the continued attendance to ambulatory treatment programs, whereas any combination of risk factors increases the likelihood of dropout. The risk factors we identified were either directly related to the weight problem (i.e. weight class, HOMA-IR levels or body satisfaction), or more or less independent (i.e. conduct problems and age). The results further show that participants that may benefit most from losing weight (i.e. whose health is most compromised), may be most vulnerable to withdraw prematurely.

Previous studies have not clearly identified an association between weight status and adherence[11], whereas in the current study both anthropometric and biological correlates to obesity were predictive of attrition. This is an important finding, although it warrants replication, as results indicate that obese adolescents with possible pre-onset 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[31].

Conform some previous studies[12,32] our findings suggest younger children are more likely to continue to attend the program. The age groups in the current study reflect

different developmental stages (i.e. 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 attendance. 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.

The effect of body satisfaction confirms previous findings, i.e. greater body dissatisfaction is generally linked with higher attrition rates[33]. In addition, it may be that the extent to which participants were dissatisfied with their bodies lead to unrealistic expectations of treatment, which in adults has been shown to contribute to dropout[34].

Although model 1 and 2 are equally successful at explaining variance in attrition, the correct prediction of continued attendance and dropout is slightly lower in model 2 (including the blood same results) than in model 1 (non-invasive measure 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 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, was the set of variables enabled 91/90% accurate prediction of continued attendance in model 1 and 2, respectively. This is a significant increase from the 63% observed in the current sample, as well as from percentages reported in other samples[10]. From our study we can conclude that ambulatory treatment programs 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 programs aimed to prevent obesity may be most effective[35].

For obese teenagers, who are discontent with their bodies, other treatment programs (e.g. inpatient) may be more suitable, especially when behavioural conduct is an issue.

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. 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 (e.g. logistical difficulties, perceived failure of treatment). Another limitation is the fact that from our data we cannot determine to what extent continued attendance to treatment reflects the adherence to the treatment program.

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

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Table 2: Alternative Table 2: Descriptive statistics and *t*-test results for continued attendance and dropout groups

	Continued attendance (n = 121)		Dropout (n = 70)		Mean difference	95% CI for mean difference				
Variable	Mean	SD	Mean	SD		Lower	Upper	*p*	*t*	*d*
Demographics										
Age	11.77	2.39	12.59	2.53	0.82	0.10	1.54	.03	2.24	0.33
Anthropometrics & Metabolism										
BMI-Z Score	2.43	0.55	2.73	0.55	0.30	0.14	0.46	<.001	3.60	0.55
Glucose	86.42	6.85	86.63	6.23	-0.21	-2.18	1.76	.83	0.21	0.03
Insulin	14.11	7.07	20.20	9.78	6.10	3.66	8.53	<.001	4.94	0.71
Cholesterol										
HDL	54.91	13.33	52.00	11.09	2.91	-0.83	6.66	.13	1.54	0.24
LDL	93.23	27.24	92.81	32.42	0.42	-8.29	9.13	.92	0.10	0.01
Triglycerides	88.38	43.59	110.10	70.46	21.72	5.35	38.08	.01	2.62	0.37
HOMA-IR	3.04	1.64	4.37	2.22	1.33	0.77	1.89	<.001	4.69	0.68
Psychosocial parameters (self-report)										
SDQ-conduct	2.23	1.45	2.69	1.59	0.46	0.02	0.91	.04	2.06	0.30

SDQ-peer relations	2.49	1.93	2.57	1.90	-0.08	-0.65	0.49	.78	0.28	0.04
SDQ-hyperactivity	4.10	1.87	4.33	2.13	-0.23	-0.82	0.35	.43	0.79	0.11
SDQ-emotional symptoms	3.61	2.30	3.64	2.39	-0.03	-0.73	0.67	.94	0.08	0.01
HBSC-perceived health	2.31	0.80	2.57	0.89	0.26	0.01	0.50	.04	2.06	0.31
HBSC-Subjective health	32.06	5.53	31.00	6.25	1.06	-0.72	2.84	.24	1.18	0.18
-Somatic	16.87	3.02	16.61	3.24	0.27	-0.67	1.21	.58	0.56	0.08
-Psychological	15.07	3.52	14.30	3.99	0.77	-0.34	1.88	.17	1.36	0.21
HBSC-self confidence	2.18	1.08	2.22	1.07	-0.03	-0.35	0.29	.84	0.20	0.04
HBSC-self perception	2.31	1.21	2.74	1.28	0.43	0.06	0.80	.02	2.29	0.35
HBSC-body satisfaction	2.52	0.81	2.93	0.89	0.41	0.16	0.66	.001	3.26	0.48
HBSC-life satisfaction	7.14	1.97	6.75	1.90	0.39	-0.20	0.97	.19	1.31	0.20

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Metabolic and psychosocial variables as predictors of attrition in youth with overweight and obesity seeking ambulatory treatment in a paediatric clinic

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Metabolic and psychosocial variables as predictors of attrition in youth with overweight and obesity seeking ambulatory treatment in a paediatric clinic.

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Supplementary files:

1) Marked copy: “OSPEL_Maintext_BMJOpen_revised” – indicates changes to original manuscript following reviewers´ comments
2) Consort Flow diagram – for the original RCT, that provided data for the current study

Contributorship statement:

Ineke Pit-ten Cate: Dr Pit-ten Cate conceptualized the study, carried out the literature review and data-analyses, drafted the initial manuscript and approved the final manuscript as submitted.

Hanen Samouda: Dr Samouda conceptualized and designed the study, collated the research materialized, collected the data, reviewed the manuscript and approved the final manuscript as submitted.

Ulrike Schierloh: Dr Schierloh conceptualized the study, collected data, reviewed the manuscript and approved the final manuscript as submitted.

Julien Jacobs: Mr Jacobs, was involved in the conceptualization of the study, prepared the dataset and carried out the initial data analyses, reviewed the manuscript and approved the final manuscript as submitted.

Jean Francois Vervier: Dr Vervier was involved in the conceptualization of the study, collated the research materials, reviewed the manuscript and approved the final manuscript as submitted.

Saverio Stranges: Prof Stranges was involved in the conceptualization of the study, reviewed the manuscript and approved the final manuscript as submitted.

Marie Lise Lair: Ms Lair conceptualized and planned the study, reviewed the manuscript and approved the final manuscript as submitted.

Carine de Beaufort: Prof de Beaufort conceptualized and planned the study, collated research materials, collected data, reviewed the manuscript and approved the final manuscript as submitted.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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No additional data available

ABSTRACT

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

Design: cross-sectional study

Setting: paediatric clinic: ambulatory treatment program

Patients and measures: A youth sample (*N*=191; 89 boys; age 7-17 years) completed measures of demographic characteristics, health and psychosocial traits before starting an ambulatory weight management program. Anthropometric and biological characteristics related to obesity were also obtained. Test of mean differences and regression analyses were used to investigate the relationship between these variables and attrition after one year.

Results: Chi-square and t-test results showed both psychosocial and biological variables differentiated between participant who continued attending the treatment program and those that dropped out. More specifically, youth that dropped out of treatment were significantly older, had higher BMI-Z scores, higher levels of insulin, triglycerides and HOMA-IR, reported poorer health and 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 correlates), age and body dissatisfaction predict attrition (overall prediction success 73%; prediction success for continued attendance 90/91%; prediction success for dropout 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) in- or outpatient program may facilitate prolonged engagement of the patient and hence may be most effective in establishing weight loss.

Key words: Obesity; Attrition; Ambulatory treatment; Adolescents, Children

Strengths and limitations of this study:

Strengths:

- The study identifies variables associated with the continued attendance to treatment
- The study also regards the success rates of prediction models
- Screening may facilitate choosing best weight management program for youth
- Early intervention may be most successful
- Reducing dropout risk will optimise the effectiveness of paediatric obesity treatment

Limitations:

- Study variables are most predictive of continued program attendance not dropout
- It remains unclear to what extent continued treatment attendance reflects compliance
- The all-Caucasian sample may reduce the generalizability 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 overweight and obesity among children and adolescents. Combined overweight and obesity estimates in different countries range from 5-25%[1,2] with a reported average prevalence of 16-22%. Despite efforts taken by national governments, health providers, and international organizations, such as the World Health Organization (WHO) and the European Association for the Study of Obesity (EASO), to promote awareness of weight problems and develop preventive measures, paediatric obesity prevalence 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 varying extent related to adult obesity[7], hence successful interventions during childhood or adolescence are of great importance in regards to potential long-term health benefits.

Although several outpatient treatments may be available to children and adolescents with overweight and obesity[8-9], success of such treatments is significantly hampered by early dropout. Dropout rates vary significantly between studies, but are generally above 25% within 4-6 months of starting a treatment program[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 (i.e. socioeconomic status, age and ethnicity)[12,14], logistical reasons[11], perceived failure of treatment[10], and psychosocial issues (i.e. lower self-concept and depression)[12]. Results regarding the influence of weight status and metabolic risk factors were however inconsistent[10-11]. To optimize effectiveness, it is important to develop strategies to minimize 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 programs, 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 with overweight and obesity seeking ambulatory treatment. Based on previous research, we expected dropout to be related to both weight, family and psychosocial variables. More specifically, we expected weight status, family affluence, psychosocial variables and weight change to affect dropout such that youth with higher starting weight, youth from less affluent families, youth experiencing psychosocial adjustment problems and youth that perceived less weight change would be more likely to discontinue participation.

METHODS

Participants

One-hundred-ninety-one Caucasian children and adolescents (53% female), aged 7-17 years (Mean= 12.07, SD = 2.47), who visited a paediatric clinic for weight management advise 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 Pediatric Clinic in order to lose weight to take part in the study, whereby only youth 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 into the effect of treatment programs on outcome in youth with overweight and obesity[15,16]. Using computer software, participants were randomly assigned to either an multidisciplinary group (n=92) or individual therapy (n=99), based on age, gender and weight status. 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 organized theoretical and practical educational sessions on nutrition; a psychologist organized sessions focused on improving the children´s self-esteem; and a sport teacher organized 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 dietician, 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 dietician in the individual therapy.

Adherence (i.e. persisting in following the treatment program[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 adolescent were either classified as dropout or adherent. The study was approved by the National Medical Ethical 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 was 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 4 items reflective of the family's material conditions (e.g. family car ownership). Total scores below 3 reflect low affluence, scores between 3 and 5 medium affluence and scores of 6 and above high affluence[22].

Health indicators

Anthropometric characteristics

Participants' BMI was computed using height and weight measures and transferred to Z scores using the free LMS Growth software (http://www.healthforallchildren.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 adults of overweight (25 kg/m^2) and obesity (30 kg/m^2)[23]. We did use Dutch L, M and S scores[24], as national LMS data are 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 old. The 99th BMI percentile are equivalent to the extrapolation, according to age and gender, of the BMI cut-off point of 30 kg/m^2 at 18 years old for both boys and girls.

Biological correlates 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 cardio-metabolic 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 4-point Likert scale (1 "excellent" to 4 "poor"). Subjective health complaints reflect the extent to which participants have experienced symptoms in 8 domains the last six months: headache, stomach ache, backache, dizziness, feeling low, feeling irritability or bad tempered, feeling nervous or having difficulty sleeping. Items are scored on a 5-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 5 sub-scale 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 sub-scale scores. A test-retest reliability coefficient (intraclass correlation) of .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 participant to indicate the extent to which they felt content with themselves (1 “always”, 5 “never”). Similarly, participants indicated their level of confidence on a 5-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 4-point response format ranging from 1 “no, nothing” to 4 “yes, almost everything”. For these three items, scores less than 2 were considered to reflect content, scores equal or greater than 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

Chi-square analyses were used 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. The 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 power of 80% given the sample of N=191.[32] A post hoc power analysis revealed that for each binary predictor variable odds ratio of 2.0 could be detected with a power of .75 given a dropout percentage of 37% (α=.05, N=191).[32]

RESULTS

Of the 191 participant enrolled in the ambulatory treatment programs, 69 were categorized as overweight (36%) and 122 as obese (64%) in accordance with the IOTF 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% already dropped out after 4 months. Attrition was unrelated to therapy module (see Table 1) hence further analyses were conducted considering the sample as a whole.

Table 1: Results of Chi-square Test and Descriptive Statistics for attrition by treatment module (N=191)

	Attrition 4 months[a]			Attrition 1 year[b]		
	Continued attendance	Dropout	Total	Continued attendance	dropout	Total
Individual therapy	85 (85.9%)[c]	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

[a] χ^2 = 0.04, df = 1, p = .83; Cramer´s V = .02

[b] χ^2 = 0.05, df = 1, p =. 83; Cramer´s V = .02

[c] Percentage reflect percentage of cases within treatment module

Results of the Chi-square analyses revealed that although gender and family affluence were unrelated to attrition (χ^2(1, N=191)= 0.62, p=.43, and χ^2(2, N=190)= 2.51, p=.29, respectively), participants with obesity were more likely to dropout than overweight participants (χ^2(1, N=191)= 6.71, p=.01). For all other variables, descriptive statistics and t-test results are presented in Table 2.

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

	Continued attendance (n = 121)		Dropout (n = 70)				
Variable	Mean	SD	Mean	SD	p	t	d
Demographics							

Age in years	11.77	2.39	12.59	2.53	.03	2.24	0.33
Anthropometrics & Metabolism							
BMI-Z Score	2.43	0.55	2.73	0.55	<.001	3.60	0.55
Change in BMI-Z score after 4 months*	.10	.20	.10	.21	.81	.24	.04
Glucose in mg/dl	86.42	6.85	86.63	6.23	.83	0.21	0.03
Insulin in mIU/l	14.11	7.07	20.20	9.78	<.001	4.94	0.71
Cholesterol in mg/dl							
HDL	54.91	13.33	52.00	11.09	.13	1.54	0.24
LDL	93.23	27.24	92.81	32.42	.92	0.10	0.01
Triglycerides in mg/dl	88.38	43.59	110.10	70.46	.01	2.62	0.37
HOMA-IR	3.04	1.64	4.37	2.22	<.001	4.69	0.68
Psychosocial parameters (self-report)							
SDQ[a]-conduct	2.23	1.45	2.69	1.59	.04	2.06	0.30
SDQ[a]-peer relations	2.49	1.93	2.57	1.90	.78	0.28	0.04
SDQ[a]-hyperactivity	4.10	1.87	4.33	2.13	.43	0.79	0.11
SDQ[a]-emotional symptoms	3.61	2.30	3.64	2.39	.94	0.08	0.01
HBSC-perceived health 1 excellent – 4 poor	2.31	0.80	2.57	0.89	.04	2.06	0.31
HBSC-Subjective health[b]							
-Somatic	16.87	3.02	16.61	3.24	.58	0.56	0.08
-Psychological	15.07	3.52	14.30	3.99	.17	1.36	0.21
HBSC-self confidence 1 confident – 5 not confident	2.18	1.08	2.22	1.07	.84	0.20	0.04
HBSC-self perception 1 content – 5 not content	2.31	1.21	2.74	1.28	.02	2.29	0.35
HBSC-body satisfaction 1 satisfied - 4 not satisfied	2.52	0.81	2.93	0.89	.001	3.26	0.48
HBSC-life satisfaction 1 satisfied – 5 not satisfied	7.14	1.97	6.75	1.90	.19	1.31	0.20

[a] Subscale scores ranging from 0-10 with higher scores reflecting more problems

[b] Subscale score ranging from 4-20, with Higher scores reflecting fewer symptoms

*N=163 as for the 28 children that already dropped out by 4 months no weight data is available

Demographic, anthropometric and biological correlates 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, 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, subjective health, self-confidence or general quality of life.

In the first regression model we included predictor variables that could be acquired using screening methods (i.e. questionnaire and anthropometric data). These variables included age (7-12 vs. 13-17 years), weight status (overweight vs. obese), conduct problems (normal vs. abnormal range), perceived health (good/excellent vs. fair/poor), self-perception (content vs. discontent) and body satisfaction (content vs. discontent). The therapy module was also included in the model as a covariate. A 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 program and those who dropped out (χ^2 (7, N=187) = 26.44, $p < .001$). Although Nagelkerke's R^2 of .18 indicated a weak relationship between prediction and grouping, overall prediction success was 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 ranges between .01 and .03), whereas conduct problems, self-perception and perceived health did not predict dropout. Participants aged 13-17 years were twice as likely to drop-out of treatment than 7-12-year-old participants. Similarly, odds ratios indicated that participants with obesity and participants who were discontent with their body were 2.17 and 2.24 times more likely to

dropout than other participants. Although participants with conduct problems were 2.32 times as likely to dropout, this odds ratio failed to reach significance (see Table 3).

Table 3: Predictors of attrition Screening measures

		95% CI for Exp(B)			
	Odds ratio	Low	High	*Wald*	*p*-value
Type of therapy Individual vs. Group	0.94	0.33	1.79	0.05	.83
Demographic parameters					
Age 7-12 vs. 13-17 years	2.02	1.03	3.95	4.22	.04
Anthropometric parameters					
Weight status Overweight vs. obese	2.17	1.06	4.41	4.56	.03
Psychosocial parameters					
SDQ-Conduct problems Normal vs. abnormal range	2.32	0.85	6.29	2.71	.10
Perceived health status Good/excellent vs. fair/poor	1.34	0.68	2.63	0.73	.39
Self-perception Content vs. discontent	0.97	0.48	1.96	0.06	.94
Body satisfaction Content vs. discontent	2.24	1.13	4.46	5.34	.02
Constant	3.93			5.67	.02
Nagelkerke R^2 = 0.18					

Reference group: dropout

In the second model we replaced the weight status variable by other correlates of obesity (i.e. HOMA-IR and triglyceride levels). A blood sample is needed to acquire these measures. As youth may perceive taking the 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 the HOMA-IR levels, only HOMA-IR was used as a surrogate marker for insulin resistance. Again, the Chi-square analysis indicated that the set of predictors (i.e. therapy module, age, HOMA-IR, triglycerides, conduct problems and body satisfaction) were able to reliably distinguish between participants who continued attending the treatment program and those who dropped out (χ^2 (6, N=186) = 29.99, $p < .001$) and overall prediction success was 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 (see Table 4).

Table 4: Predictors of attritions – Screening measures and plasma levels

		95% CI for Exp(B)			
	Odds Ratio	Low	High	Wald	*p*-value
Therapy Individual vs. Group	0.86	0.45	1.66	0.21	.65
Demographic parameters					
Age 7-12 vs. 13-17 years	2.08	1.06	4.05	4.56	.03
Biological parameters					
HOMA-IR Normal vs. at risk	2.30	1.18	4.48	6.02	.01
Triclycerides Normal vs. elevated	2.03	0.75	5.53	1.93	.17
Psychosocial parameters					
SDQ-Conduct problems Normal vs. abnormal range	2.81	0.96	8.20	3.58	.06
Body satisfaction Content vs. discontent	2.28	1.17	4.44	5.85	.02

Constant	8.70			8.10	.01
Nagelkerke R^2 = 0.20					

Reference group: dropout

The odds ratios indicated that participants with elevated HOMA-IR levels, participants aged 13-17 years, 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 program than other participants. Although participants with conduct problems were 2.81 times as likely to dropout, this odds ratio failed to reach significance (see Table 4).

DISCUSSION

Results of this study show that any combination of risk factors increases the likelihood of dropout and that youth in the low risk groups are most likely to continue participation to ambulatory treatment. The risk factors we identified were either directly related to the weight problem (i.e. weight class, HOMA-IR levels or body satisfaction), or more or less independent (i.e. conduct problems and age). The results further show that participants who may benefit most from losing weight (i.e. whose health is most compromised), may be 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 the continued participation in treatment. This is an important finding, although it warrants replication, as 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 indicator of treatment success, however such change may not fully reflect youth´ perceptions of treatment success. For example, for one person the observed BMI change may match expectations, whilst for another the same change may be a disappointment. Future research could utilise measures of perceived treatment success in combination with observed changes in BMI-Z scores to investigate this relationship further. In line with the results of previous studies[12,35] our findings suggest younger children are more likely to continue to attend the program. The age groups in the current study reflect different developmental stages (i.e. 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 programs[36-38]. Therefore, future research could also include parental questionnaires as possible indicators of youth dropout.

The effect of body satisfaction confirms previous findings, i.e. 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 lead to unrealistic expectations of treatment, which has been shown to contribute to dropout in adults[40] and adolescents[38].

Although both regression models are equally successful at explaining variance in attrition, the correct prediction of continued participation and dropout is slightly lower in the model including plasma levels as markers of the level of (un)healthy weight than in the model using weight status (i.e. 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, 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, was 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 percentages reported in other samples[10]. From our study, we can conclude that ambulatory treatment programs 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 programs aimed to prevent obesity may be most effective[41]. For teenagers with obesity, who are discontent with their bodies, other treatment programs (e.g. inpatient) may be more suitable, especially when behavioural conduct is an issue. This finding is in line with previous research indicating that especially older youth with psychosocial adjustment problems were most at risk to withdraw prematurely from a weight management program[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 eating disorder pathology, would have provided further information to why some youth continued participation whilst 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 (e.g. logistical difficulties, perceived failure of treatment). Another limitation is the fact that from our data we cannot determine to what extent continued attendance to treatment reflects the adherence to the treatment program. Furthermore, although the all-Caucasian sample may be representative of the Luxembourgish society (i.e. 89% of people living in Luxembourg in 2007 had a European/Caucasian background[42]), it may reduce the generalizability to other countries and settings.

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

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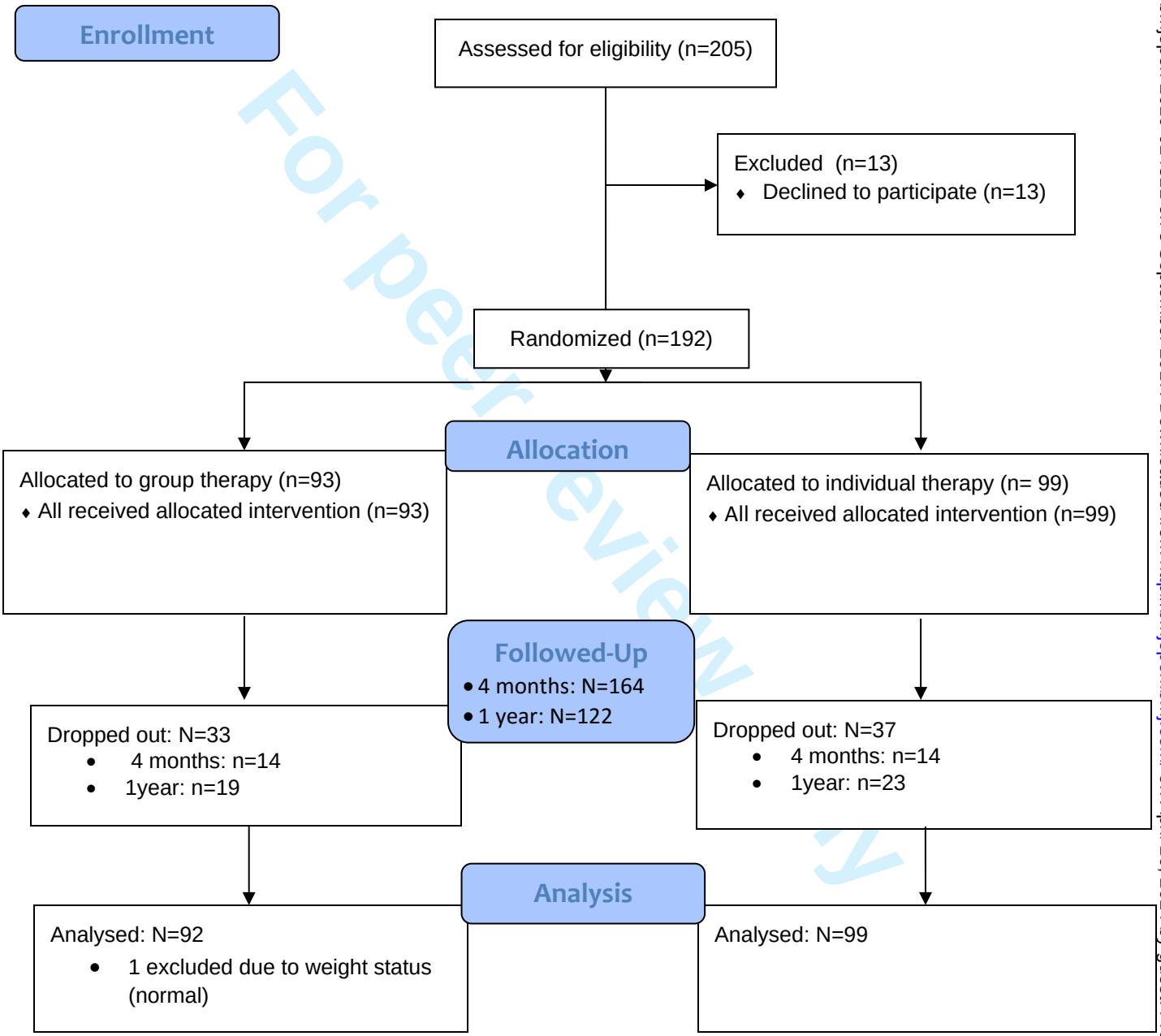
CONSORT Flow Diagram



STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported (page 5-6)
Objectives	3	State specific objectives, including any prespecified hypotheses (page 6)
Methods		
Study design	4	Present key elements of study design early in the paper (page 6-7)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection (page 6)
Participants	6	(*a*) *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants (page 6)
Variables	7	Clearly define all outcomes, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable (page 7-9)
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). (page 7-9)
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at (page 9; response letter)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why (page 7-9)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding (page 9)
		(*b*) Describe any methods used to examine subgroups and interactions (10-14)
		(*c*) Explain how missing data were addressed
		(*d*) *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy (page 6)

Continued on next page

Results		
Participants	13	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (page 6, page 10-13)
Descriptive data	14	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (page 6)
		(b) Indicate number of participants with missing data for each variable of interest (page 10-13)
Outcome data	15	*Cross-sectional study*—Report numbers of outcome events or summary measures (page 7-9)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (page 10-13)
		(*b*) Report category boundaries when continuous variables were categorized (page 10-13)
Other analyses	17	Report other analyses done (response letter)
Discussion		
Key results	18	Summarise key results with reference to study objectives (page 15-17)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. (page 18)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence (page 15-18)
Generalisability	21	Discuss the generalisability (external validity) of the study results (page 18)
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based (page 19)

BMJ Open

Can health indicators and psychosocial characteristics predict attrition in youth with overweight and obesity seeking ambulatory treatment? Data from a paediatric clinic in Luxembourg.

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Can health indicators and psychosocial characteristics predict attrition in youth with overweight and obesity seeking ambulatory treatment? Data from a paediatric clinic in Luxembourg.

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Supplementary files:

1) Marked copy: “OSPEL_Maintext_BMJOpen_revised” – indicates changes to original manuscript following reviewers´ comments
2) Marked copy: “OSPEL_Maintext_BMJOpen_revised2” – indicates changes to revised manuscript following additional reviewers´ comments
3) Consort Flow diagram – for the original RCT, that provided data for the current study

Contributorship statement:

Ineke Pit-ten Cate: Dr Pit-ten Cate conceptualized the study, carried out the literature review and data-analyses, drafted the initial manuscript and approved the final manuscript as submitted.

Hanen Samouda: Dr Samouda conceptualized and designed the study, collated the research materialized, collected the data, reviewed the manuscript and approved the final manuscript as submitted.

Ulrike Schierloh: Dr Schierloh conceptualized the study, collected data, reviewed the manuscript and approved the final manuscript as submitted.

Julien Jacobs: Mr Jacobs, was involved in the conceptualization of the study, prepared the dataset and carried out the initial data analyses, reviewed the manuscript and approved the final manuscript as submitted.

Jean Francois Vervier: Dr Vervier was involved in the conceptualization of the study, collated the research materials, reviewed the manuscript and approved the final manuscript as submitted.

Saverio Stranges: Prof Stranges was involved in the conceptualization of the study, reviewed the manuscript and approved the final manuscript as submitted.

Marie Lise Lair: Ms Lair conceptualized and planned the study, reviewed the manuscript and approved the final manuscript as submitted.

Carine de Beaufort: Prof de Beaufort conceptualized and planned the study, collated research materials, collected data, reviewed the manuscript and approved the final manuscript as submitted.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Data sharing statement:

No additional data available

ABSTRACT

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

Design: cross-sectional study

Setting: paediatric clinic: ambulatory treatment program

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

Results: Chi-square and t-test results showed both psychosocial and health indicators differentiated between participants who continued attending the treatment program and those that dropped out. More specifically, youth that dropped out of treatment were significantly older, had higher BMI-Z scores, higher levels of insulin, triglycerides and HOMA-IR, reported poorer health and 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 predict attrition (overall prediction success 73%; prediction success for continued attendance 90/91%; prediction success for dropout 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) in- or outpatient program may facilitate prolonged engagement of the patient and hence may be most effective in establishing weight loss.

Key words: Obesity; Attrition; Ambulatory treatment; Adolescents, Children

Strengths and limitations of this study:

Strengths:

- The study identifies variables associated with the continued attendance to treatment
- The study regards the success rates of prediction models
- The study includes both screening measures and biological markers

Limitations:

- It remains unclear to what extent continued treatment attendance reflects compliance
- The all-Caucasian sample may reduce the generalizability 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 overweight and obesity among children and adolescents. Combined overweight and obesity estimates in different countries range from 5-25%[1,2] with a reported average prevalence of 16-22%. Despite efforts taken by national governments, health providers, and international organizations, such as the World Health Organization (WHO) and the European Association for the Study of Obesity (EASO), to promote awareness of weight problems and develop preventive measures, paediatric obesity prevalence 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 varying extent related to adult obesity[7], hence successful interventions during childhood or adolescence are of great importance in regards to potential long-term health benefits.

Although several outpatient treatments may be available to children and adolescents with overweight and obesity[8-9], success of such treatments is significantly hampered by early dropout. Dropout rates vary significantly between studies, but are generally above 25% within 4-6 months of starting a treatment program[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 (i.e. socioeconomic status, age and ethnicity)[12,14], logistical reasons[11], perceived failure of treatment[10], and psychosocial issues (i.e. lower self-concept and depression)[12]. Results regarding the influence of weight status and metabolic risk factors were however inconsistent[10-11]. To optimize effectiveness, it is important to develop strategies to minimize 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 programs, 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 with overweight and obesity seeking ambulatory treatment. Based on previous research, we expected dropout to be related to both weight, family and psychosocial variables. More specifically, we expected weight status, family affluence, psychosocial variables and weight change to affect dropout such that youth with higher starting weight, youth from less affluent families, youth experiencing psychosocial adjustment problems and youth that perceived less weight change would be more likely to discontinue participation.

METHODS

Participants

One-hundred-ninety-one Caucasian children and adolescents (53% female), aged 7-17 years (Mean= 12.07, SD = 2.47), who visited a paediatric clinic for weight management advise 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 Pediatric Clinic in order to lose weight to take part in the study, whereby only youth 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 into the effect of treatment programs on outcome in youth with overweight and obesity[15,16]. Using computer software, participants were randomly assigned to either an multidisciplinary group (n=92) or individual therapy (n=99), based on age, gender and weight status. 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 organized theoretical and practical educational sessions on nutrition; a psychologist organized sessions focused on improving the children´s self-esteem; and a sport teacher organized 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 dietician, 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 dietician 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 11 years and over, and may cause some difficulties for the younger children based on their level of depending on their level of understanding and literacy, health care staff was available to provide support if necessary. Adherence (i.e. persisting in following the treatment program[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 adolescent were either classified as dropout or adherent.

The study was approved by the National Medical Ethical 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 was 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 4 items reflective of the family's material conditions (e.g. family car ownership). Total scores below 3 reflect low affluence, scores between 3 and 5 medium affluence and scores of 6 and above high affluence[22].

Health indicators

Anthropometric characteristics

Participants' BMI was computed using height and weight measures and transferred to Z scores using the free LMS Growth software

(http://www.healthforallchildren.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 adults of overweight (25 kg/m^2) and obesity (30 kg/m^2)[23]. We did use Dutch L, M and S scores[24], as national LMS data are 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 old. The 99th BMI percentile are equivalent to the extrapolation, according to age and gender, of the BMI cut-off point of 30 kg/m^2 at 18 years old 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 cardio-metabolic 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 4-point Likert scale (1 "excellent" to 4 "poor"). Subjective health complaints reflect the extent to which participants have experienced symptoms in 8 domains the last six months: headache, stomach ache, backache, dizziness, feeling low, feeling irritability or bad tempered, feeling nervous or having difficulty sleeping. Items are scored on a 5-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 5 sub-scale 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 sub-scale scores. A test-retest reliability coefficient (intraclass correlation) of .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 5-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 4-point response format ranging from 1 “no, nothing” to 4 “yes, almost everything”. For these three items, scores less than 2 were considered to reflect content, scores equal or greater than 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

Chi-square analyses were used 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. The 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 power of 80% given the sample of N=191.[32] A post hoc power analysis revealed that for each binary predictor

variable odds ratio of 2.0 could be detected with a power of .75 given a dropout percentage of 37% (α=.05, N=191).[32]

RESULTS

Of the 191 participants enrolled in the ambulatory treatment programs, 69 were categorized as overweight (36%) and 122 as obese (64%) in accordance with the IOTF 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% already dropped out after 4 months. Attrition was unrelated to therapy module (see Table 1) hence further analyses were conducted considering the sample as a whole.

Table 1: Results of Chi-square Test and Descriptive Statistics for attrition by treatment module (N=191)

	Attrition 4 months[a]			Attrition 1 year[b]		
	Continued attendance	Dropout	Total	Continued attendance	dropout	Total
Individual therapy	85 (85.9%)[c]	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

[a] $\chi^2 = 0.04$, df = 1, $p = .83$; Cramer´s $V = .02$

[b] $\chi^2 = 0.05$, df = 1, $p = .83$; Cramer´s $V = .02$

[c] Percentage reflect percentage of cases within treatment module

Results of the Chi-square analyses revealed that although gender and family affluence were unrelated to attrition ($\chi^2(1, N=191)= 0.62$, $p=.43$, and $\chi^2(2, N=190)= 2.51$, $p=.29$, respectively), participants with obesity were more likely to dropout than participants with overweight ($\chi^2(1, N=191)= 6.71$, $p=.01$). For all other variables, descriptive statistics and *t*-test results are presented in Table 2.

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

	Continued attendance (n = 121)		Dropout (n = 70)				
Variable	Mean	SD	Mean	SD	*p*	*t*	*d*
Demographics							
Age in years	11.77	2.39	12.59	2.53	.03	2.24	0.33
Anthropometrics & Metabolism							
BMI-Z Score	2.43	0.55	2.73	0.55	<.001	3.60	0.55
Change in BMI-Z score after 4 months*	.10	.20	.10	.21	.81	.24	.04
Glucose in mg/dl	86.42	6.85	86.63	6.23	.83	0.21	0.03
Insulin in mIU/l	14.11	7.07	20.20	9.78	<.001	4.94	0.71
Cholesterol in mg/dl							
HDL	54.91	13.33	52.00	11.09	.13	1.54	0.24
LDL	93.23	27.24	92.81	32.42	.92	0.10	0.01
Triglycerides in mg/dl	88.38	43.59	110.10	70.46	.01	2.62	0.37
HOMA-IR	3.04	1.64	4.37	2.22	<.001	4.69	0.68
Psychosocial parameters (self-report)							
SDQ[a]-conduct	2.23	1.45	2.69	1.59	.04	2.06	0.30
SDQ[a]-peer relations	2.49	1.93	2.57	1.90	.78	0.28	0.04
SDQ[a]-hyperactivity	4.10	1.87	4.33	2.13	.43	0.79	0.11
SDQ[a]-emotional symptoms	3.61	2.30	3.64	2.39	.94	0.08	0.01
HBSC-perceived health 1 excellent – 4 poor	2.31	0.80	2.57	0.89	.04	2.06	0.31
HBSC-Subjective health[b]							
-Somatic	16.87	3.02	16.61	3.24	.58	0.56	0.08
-Psychological	15.07	3.52	14.30	3.99	.17	1.36	0.21
HBSC-self confidence 1 confident – 5 not confident	2.18	1.08	2.22	1.07	.84	0.20	0.04
HBSC-self perception 1 content – 5 not content	2.31	1.21	2.74	1.28	.02	2.29	0.35

HBSC-body satisfaction 1 satisfied - 4 not satisfied	2.52	0.81	2.93	0.89	.001	3.26	0.48
HBSC-life satisfaction 1 satisfied – 5 not satisfied	7.14	1.97	6.75	1.90	.19	1.31	0.20

[a] Subscale scores ranging from 0-10 with higher scores reflecting more problems

[b] Subscale score ranging from 4-20, with Higher scores reflecting fewer symptoms

[*]N=163 as for the 28 children that already dropped out by 4 months no weight data is available

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, 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, subjective health, self-confidence or general quality of life.

In the first regression model we included predictor variables that could be acquired using screening methods (i.e. questionnaire and anthropometric data). These variables included age (7-12 vs. 13-17 years), weight status (overweight vs. obese), conduct problems (normal vs. abnormal range), perceived health (good/excellent vs. fair/poor), self-perception (content vs. discontent) and body satisfaction (content vs. discontent). The therapy module was also included in the model as a covariate. A 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 program and those who dropped out (χ^2 (7, N=187) = 26.44, p < .001). Although Nagelkerke's R^2 of .18 indicated a weak relationship between prediction and grouping, overall prediction success was 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 ranges between .01

and .03), whereas conduct problems, self-perception and perceived health did not predict dropout. Participants aged 13-17 years were twice as likely to drop-out of treatment than 7-12-year-old participants. Similarly, odds ratios indicated that participants with obesity and participants who were discontent with their body were 2.17 and 2.24 times more likely to dropout than other participants. Although participants with conduct problems were 2.32 times as likely to dropout, this odds ratio failed to reach significance (see Table 3).

Table 3: Predictors of attrition Screening measures

		95% CI for Exp(B)			
	Odds ratio	Low	High	*Wald*	*p*-value
Type of therapy Individual vs. Group	0.94	0.33	1.79	0.05	.83
Demographic parameters					
Age 7-12 vs. 13-17 years	2.02	1.03	3.95	4.22	.04
Anthropometric parameters					
Weight status Overweight vs. obese	2.17	1.06	4.41	4.56	.03
Psychosocial parameters					
SDQ-Conduct problems Normal vs. abnormal range	2.32	0.85	6.29	2.71	.10
Perceived health status Good/excellent vs. fair/poor	1.34	0.68	2.63	0.73	.39
Self-perception Content vs. discontent	0.97	0.48	1.96	0.06	.94
Body satisfaction Content vs. discontent	2.24	1.13	4.46	5.34	.02
Constant	3.93			5.67	.02
Nagelkerke R^2 = 0.18					

Reference group: dropout

In the second model we replaced the weight status variable by other correlates of obesity (i.e. HOMA-IR and triglyceride levels). A blood sample is needed to acquire these measures. As youth may perceive taking the 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 the HOMA-IR levels, only HOMA-IR was used as a surrogate marker for insulin resistance. Again, the Chi-square analysis indicated that the set of predictors (i.e. therapy module, age, HOMA-IR, triglycerides, conduct problems and body satisfaction) were able to reliably distinguish between participants who continued attending the treatment program and those who dropped out (χ^2 (6, N=186) = 29.99, $p < .001$) and overall prediction success was 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 (see Table 4).

Table 4: Predictors of attritions – Screening measures and biological markers

		95% CI for Exp(B)			
	Odds Ratio	Low	High	Wald	*p*-value
Therapy Individual vs. Group	0.86	0.45	1.66	0.21	.65
Demographic parameters					
Age 7-12 vs. 13-17 years	2.08	1.06	4.05	4.56	.03
Biological markers					
HOMA-IR Normal vs. at risk	2.30	1.18	4.48	6.02	.01
Triclycerides Normal vs. elevated	2.03	0.75	5.53	1.93	.17

Psychosocial parameters					
SDQ-Conduct problems Normal vs. abnormal range	2.81	0.96	8.20	3.58	.06
Body satisfaction Content vs. discontent	2.28	1.17	4.44	5.85	.02
Constant	8.70			8.10	.01
Nagelkerke R^2 = 0.20					

Reference group: dropout

The odds ratios indicated that participants with elevated HOMA-IR levels, participants aged 13-17 years, 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 program than other participants. Although participants with conduct problems were 2.81 times as likely to dropout, this odds ratio failed to reach significance (see Table 4).

DISCUSSION

Results of this study show that any combination of risk factors increases the likelihood of dropout and that youth in the low risk groups are most likely to continue participation to ambulatory treatment. The risk factors we identified were either directly related to the weight problem (i.e. weight class, HOMA-IR levels or body satisfaction), or more or less independent (i.e. conduct problems and age). The results further show that participants who may benefit most from losing weight (i.e. whose health is most compromised), may be 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 the continued participation in treatment. This is an important finding, although it warrants replication, as 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 indicator of treatment success, however such change may not fully reflect youth´ perceptions of treatment success. For example, for one person the observed BMI change may match expectations, whilst for another the same change may be a disappointment. Future research could utilise measures of perceived treatment success in combination with observed changes in BMI-Z scores to investigate this relationship further. In line with the results of previous studies[12,35] our findings suggest younger children are more likely to continue to attend the program. The age groups in the current study reflect different developmental stages (i.e. 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 programs[36-38]. Therefore, future research could also include parental questionnaires as possible indicators of youth dropout.

The effect of body satisfaction confirms previous findings, i.e. 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 lead to unrealistic expectations

of treatment, which has been shown to contribute to dropout in adults[40] and adolescents[38].

Although both regression models are equally successful at explaining variance in attrition, the correct prediction of continued participation and dropout is slightly lower in the model including biological markers of the level of (un)healthy weight than in the model using weight status (i.e. 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, 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 percentages reported in other samples[10]. From our study, we can conclude that ambulatory treatment programs 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 programs aimed to prevent obesity may be most effective[41]. For teenagers with obesity, who are discontent with their bodies, other treatment programs (e.g. inpatient) may be more suitable, especially when behavioural conduct is an issue. This finding is in line with previous research indicating that especially older youth with psychosocial adjustment problems were most at risk to withdraw prematurely from a weight management program[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

eating disorder pathology, would have provided further information to why some youth continued participation whilst 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 (e.g. logistical difficulties, perceived failure of treatment). Another limitation is the fact that from our data we cannot determine to what extent continued attendance to treatment reflects the adherence to the treatment program. Furthermore, although the all-Caucasian sample may be representative of the Luxembourgish society (i.e. 89% of people living in Luxembourg in 2007 had a European/Caucasian background[42]), it may reduce the generalizability to other countries and settings.

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

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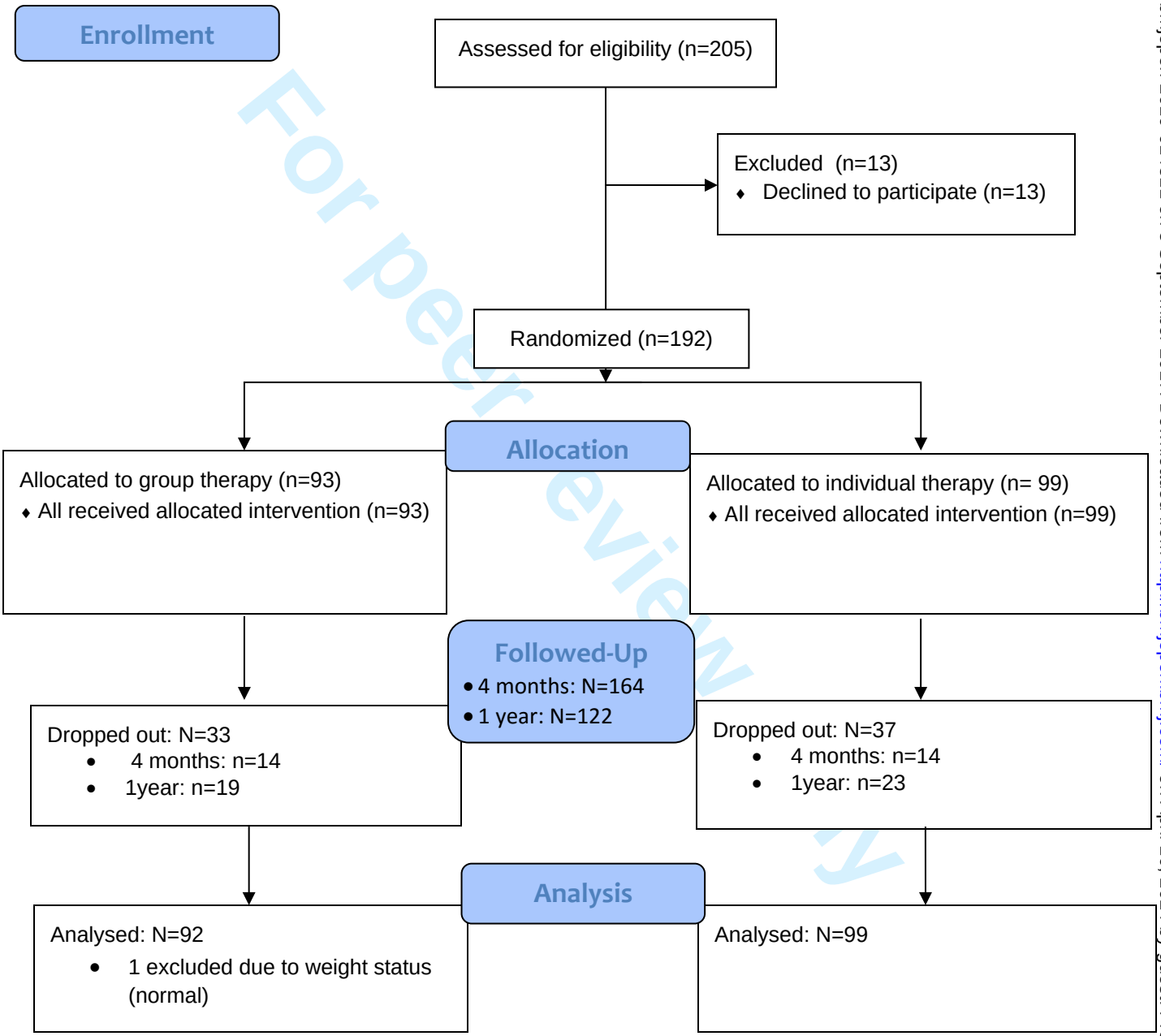
CONSORT Flow Diagram



STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported (page 5-6)
Objectives	3	State specific objectives, including any prespecified hypotheses (page 6)
Methods		
Study design	4	Present key elements of study design early in the paper (page 6-7)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection (page 6)
Participants	6	(*a*) *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants (page 6)
Variables	7	Clearly define all outcomes, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable (page 7-9)
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). (page 7-9)
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at (page 9; response letter)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why (page 7-9)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding (page 9)
		(*b*) Describe any methods used to examine subgroups and interactions (10-14)
		(*c*) Explain how missing data were addressed
		(*d*) *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy (page 6)

Continued on next page

Results		
Participants	13	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (page 6, page 10-13)
Descriptive data	14	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (page 6)
		(b) Indicate number of participants with missing data for each variable of interest (page 10-13)
Outcome data	15	*Cross-sectional study*—Report numbers of outcome events or summary measures (page 7-9)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (page 10-13)
		(*b*) Report category boundaries when continuous variables were categorized (page 10-13)
Other analyses	17	Report other analyses done (response letter)
Discussion		
Key results	18	Summarise key results with reference to study objectives (page 15-17)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. (page 18)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence (page 15-18)
Generalisability	21	Discuss the generalisability (external validity) of the study results (page 18)
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based (page 19)

BMJ Open

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

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

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Supplementary files:

1) Marked copy: “OSPEL_Maintext_BMJOpen_revised3” – indicates changes to revised manuscript following additional reviewers´ comments
2) Consort Flow diagram – for the original RCT, that provided data for the current study

Contributorship statement:

Ineke Pit-ten Cate: Dr Pit-ten Cate conceptualized the study, carried out the literature review and data-analyses, drafted the initial manuscript and approved the final manuscript as submitted.

Hanen Samouda: Dr Samouda conceptualized and designed the study, collated the research materialized, collected the data, reviewed the manuscript and approved the final manuscript as submitted.

Ulrike Schierloh: Dr Schierloh conceptualized the study, collected data, reviewed the manuscript and approved the final manuscript as submitted.

Julien Jacobs: Mr Jacobs, was involved in the conceptualization of the study, prepared the dataset and carried out the initial data analyses, reviewed the manuscript and approved the final manuscript as submitted.

Jean Francois Vervier: Dr Vervier was involved in the conceptualization of the study, collated the research materials, reviewed the manuscript and approved the final manuscript as submitted.

Saverio Stranges: Prof Stranges was involved in the conceptualization of the study, reviewed the manuscript and approved the final manuscript as submitted.

Marie Lise Lair: Ms Lair conceptualized and planned the study, reviewed the manuscript and approved the final manuscript as submitted.

Carine de Beaufort: Prof de Beaufort conceptualized and planned the study, collated research materials, collected data, reviewed the manuscript and approved the final manuscript as submitted.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Data sharing statement:

No additional data available

ABSTRACT

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

Design: retrospective longitudinal study

Setting: paediatric clinic: ambulatory treatment program

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

Results: Chi-square and t-test results showed both psychosocial and health indicators differentiated between participants who continued attending the treatment program and those that dropped out. More specifically, youth that dropped out of treatment were significantly older, had higher BMI-Z scores, higher levels of insulin, triglycerides and HOMA-IR, reported poorer health and 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 predict attrition (overall prediction success 73%; prediction success for continued attendance 90/91%; prediction success for dropout 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) in- or outpatient program may facilitate prolonged engagement of the patient and hence may be most effective in establishing weight loss.

Key words: Obesity; Attrition; Ambulatory treatment; Adolescents, Children

Strengths and limitations of this study:

Strengths:

- Successfully predicting continued attendance to treatment may contribute to more efficient and cost-effectiveness of 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.

Limitations:

- It remains unclear to what extent continued treatment attendance reflects compliance
- The all-Caucasian sample may reduce the generalizability 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 overweight and obesity among children and adolescents. Combined overweight and obesity estimates in different countries range from 5-25%[1,2] with a reported average prevalence of 16-22%. Despite efforts taken by national governments, health providers, and international organizations, such as the World Health Organization (WHO) and the European Association for the Study of Obesity (EASO), to promote awareness of weight problems and develop preventive measures, paediatric obesity prevalence 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 varying extent related to adult obesity[7], hence successful interventions during childhood or adolescence are of great importance in regards to potential long-term health benefits.

Although several outpatient treatments may be available to children and adolescents with overweight and obesity[8-9], success of such treatments is significantly hampered by early dropout. Dropout rates vary significantly between studies, but are generally above 25% within 4-6 months of starting a treatment program[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 (i.e. socioeconomic status, age and ethnicity)[12,14], logistical reasons[11], perceived failure of treatment[10], and psychosocial issues (i.e. lower self-concept and depression)[12]. Results regarding the influence of weight status and metabolic risk factors were however inconsistent[10-11]. To optimize effectiveness, it is important to develop strategies to minimize 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 programs, 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 with overweight and obesity seeking ambulatory treatment. Based on previous research, we expected dropout to be related to both weight, family and psychosocial variables. More specifically, we expected weight status, family affluence, psychosocial variables and weight change to affect dropout such that youth with higher starting weight, youth from less affluent families, youth experiencing psychosocial adjustment problems and youth that perceived less weight change would be more likely to discontinue participation.

METHODS

Participants

One-hundred-ninety-one Caucasian children and adolescents (53% female), aged 7-17 years (Mean= 12.07, SD = 2.47), who visited a paediatric clinic for weight management advise 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 Pediatric Clinic in order to lose weight to take part in the study, whereby only youth 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 into the effect of treatment programs on outcome in youth with overweight and obesity[15,16]. Using computer software, participants were randomly assigned to either an multidisciplinary group (n=92) or individual therapy (n=99), based on age, gender and weight status (see CONSORT flow diagram, suppl. 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 organized theoretical and practical educational sessions on nutrition; a psychologist organized sessions focused on improving the children´s self-esteem; and a sport teacher organized 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 dietician, 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 dietician 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 11 years and over, and may cause some difficulties for the younger children based on their level of depending on their level of understanding and literacy, health care staff was available to provide support if necessary. Adherence (i.e. persisting in following the treatment program[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 adolescent were either classified as dropout or adherent.

The study was approved by the National Medical Ethical 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 was 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 4 items reflective of the family's material conditions (e.g. family car ownership). Total scores below 3 reflect low affluence, scores between 3 and 5 medium affluence and scores of 6 and above high affluence[22].

Health indicators

Anthropometric characteristics

Participants' BMI was computed using height and weight measures and transferred to Z scores using the free LMS Growth software

(http://www.healthforallchildren.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 adults of overweight (25 kg/m^2) and obesity (30 kg/m^2)[23]. We did use Dutch L, M and S scores[24], as national LMS data are 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 old. The 99th BMI percentile are equivalent to the extrapolation, according to age and gender, of the BMI cut-off point of 30 kg/m^2 at 18 years old 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 cardio-metabolic 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 4-point Likert scale (1 "excellent" to 4 "poor"). Subjective health complaints reflect the extent to which participants have experienced symptoms in 8 domains the last six months: headache, stomach ache, backache, dizziness, feeling low, feeling irritability or bad tempered, feeling nervous or having difficulty sleeping. Items are scored on a 5-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 5 sub-scale 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 sub-scale scores. A test-retest reliability coefficient (intraclass correlation) of .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 5-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 4-point response format ranging from 1 “no, nothing” to 4 “yes, almost everything”. For these three items, scores less than 2 were considered to reflect content, scores equal or greater than 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

Chi-square analyses were used 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. The 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 power of 80% given the sample of N=191.[32] A post hoc power analysis revealed that for each binary predictor

variable odds ratio of 2.0 could be detected with a power of .75 given a dropout percentage of 37% (α=.05, N=191).[32]

RESULTS

Of the 191 participants enrolled in the ambulatory treatment programs, 69 were categorized as overweight (36%) and 122 as obese (64%) in accordance with the IOTF 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% already dropped out after 4 months. Attrition was unrelated to therapy module (see Table 1) hence further analyses were conducted considering the sample as a whole.

Table 1: Results of Chi-square Test and Descriptive Statistics for attrition by treatment module (N=191)

	Attrition 4 months[a]			Attrition 1 year[b]		
	Continued attendance	Dropout	Total	Continued attendance	dropout	Total
Individual therapy	85 (85.9%)[c]	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

[a] $\chi^2 = 0.04$, df = 1, $p = .83$; Cramer´s $V = .02$

[b] $\chi^2 = 0.05$, df = 1, $p = .83$; Cramer´s $V = .02$

[c] Percentage reflect percentage of cases within treatment module

Results of the Chi-square analyses revealed that although gender and family affluence were unrelated to attrition ($\chi^2(1, N=191)= 0.62$, $p=.43$, and $\chi^2(2, N=190)= 2.51$, $p=.29$, respectively), participants with obesity were more likely to dropout than participants with overweight ($\chi^2(1, N=191)= 6.71$, $p=.01$). For all other variables, descriptive statistics and *t*-test results are presented in Table 2.

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

	Continued attendance (n = 121)		Dropout (n = 70)				
Variable	Mean	SD	Mean	SD	*p*	*t*	*d*
Demographics							
Age in years	11.77	2.39	12.59	2.53	.03	2.24	0.33
Anthropometrics & Metabolism							
BMI-Z Score	2.43	0.55	2.73	0.55	<.001	3.60	0.55
Change in BMI-Z score after 4 months*	.10	.20	.10	.21	.81	.24	.04
Glucose in mg/dl	86.42	6.85	86.63	6.23	.83	0.21	0.03
Insulin in mIU/l	14.11	7.07	20.20	9.78	<.001	4.94	0.71
Cholesterol in mg/dl							
HDL	54.91	13.33	52.00	11.09	.13	1.54	0.24
LDL	93.23	27.24	92.81	32.42	.92	0.10	0.01
Triglycerides in mg/dl	88.38	43.59	110.10	70.46	.01	2.62	0.37
HOMA-IR	3.04	1.64	4.37	2.22	<.001	4.69	0.68
Psychosocial parameters (self-report)							
SDQ[a]-conduct	2.23	1.45	2.69	1.59	.04	2.06	0.30
SDQ[a]-peer relations	2.49	1.93	2.57	1.90	.78	0.28	0.04
SDQ[a]-hyperactivity	4.10	1.87	4.33	2.13	.43	0.79	0.11
SDQ[a]-emotional symptoms	3.61	2.30	3.64	2.39	.94	0.08	0.01
HBSC-perceived health 1 excellent – 4 poor	2.31	0.80	2.57	0.89	.04	2.06	0.31
HBSC-Subjective health[b]							
-Somatic	16.87	3.02	16.61	3.24	.58	0.56	0.08
-Psychological	15.07	3.52	14.30	3.99	.17	1.36	0.21
HBSC-self confidence 1 confident – 5 not confident	2.18	1.08	2.22	1.07	.84	0.20	0.04
HBSC-self perception 1 content – 5 not content	2.31	1.21	2.74	1.28	.02	2.29	0.35

HBSC-body satisfaction 1 satisfied - 4 not satisfied	2.52	0.81	2.93	0.89	.001	3.26	0.48
HBSC-life satisfaction 1 satisfied – 5 not satisfied	7.14	1.97	6.75	1.90	.19	1.31	0.20

[a] Subscale scores ranging from 0-10 with higher scores reflecting more problems

[b] Subscale score ranging from 4-20, with Higher scores reflecting fewer symptoms

[*]N=163 as for the 28 children that already dropped out by 4 months no weight data is available

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, 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, subjective health, self-confidence or general quality of life.

In the first regression model we included predictor variables that could be acquired using screening methods (i.e. 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 program and those who dropped out (χ^2 (7, N=177) = 29.60, $p < .001$). Although Nagelkerke's R^2 of .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 more likely to dropout than other participants (see Table 3).

Table 3: Predictors of attrition - Screening measures

		95% CI for Exp(B)			
	Odds ratio	Low	High	*Wald*	*p*-value
Type of therapy Individual vs. Group	1.21	0.60	2.46	0.28	.60
Demographic parameters					
Age	1.09	0.94	1.25	1.28	.26
Anthropometric parameters					
BMI-Zscore	2.84	1.49	5.41	10.10	.001
Psychosocial parameters					
SDQ-Conduct problems	1.13	0.88	1.44	0.93	.34
Perceived health status	1.03	0.97	1.09	0.77	.38
Self-perception	1.26	0.93	1.72	2.15	.14
Body satisfaction	1.69	1.11	2.57	5.94	.02
Constant	.001			15.50	.000
Nagelkerke R^2 = 0.21					

Reference group: dropout

In a second analysis we dichotomized 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 split the group based on a developmental change between pre-adolescence (7-12) and adolescence (13-17). 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 categorizations, which are generally used in health care settings, rather than consider 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 program and those who dropped out (χ^2 (7, N=187) = 26.44, $p < .001$), 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* ranges between .01 and .03), whereas conduct problems, self-perception and perceived health did not predict dropout. Participants aged 13-17 years were twice as likely to drop-out of treatment than 7-12-year-old participants. Similarly, odds ratios indicated that participants with obesity and participants who were discontent with their body were 2.17 and 2.24 times more likely to dropout than other participants. Although participants with conduct problems were 2.32 times as likely to dropout, this odds ratio failed to reach significance (see Table 4).

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

		95% CI for Exp(B)			
	Odds ratio	Low	High	*Wald*	*p*-value
Type of therapy Individual vs. Group	0.94	0.33	1.79	0.05	.83
Demographic parameters					
Age 7-12 vs. 13-17 years	2.02	1.03	3.95	4.22	.04
Anthropometric parameters					
Weight status Overweight vs. obese	2.17	1.06	4.41	4.56	.03
Psychosocial parameters					
SDQ-Conduct problems Normal vs. abnormal	2.32	0.85	6.29	2.71	.10

range					
Perceived health status Good/excellent vs. fair/poor	1.34	0.68	2.63	0.73	.39
Self-perception Content vs. discontent	0.97	0.48	1.96	0.06	.94
Body satisfaction Content vs. discontent	2.24	1.13	4.46	5.34	.02
Constant	3.93			5.67	.02
Nagelkerke R^2 = 0.18					

Reference group: dropout

In the second model we replaced the weight status variable by other correlates of obesity (i.e. HOMA-IR and triglyceride levels). A blood sample is needed to acquire these measures. As youth may perceive taking the 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 the HOMA-IR levels, only HOMA-IR was used as a surrogate marker for insulin resistance. Again, the Chi-square analysis indicated that the set of predictors (i.e. therapy module, age, HOMA-IR, triglycerides, conduct problems and body satisfaction) were able to reliably distinguish between participants who continued attending the treatment program and those who dropped out (χ^2 (6, N=188) = 28.30, $p < .001$) and overall prediction success was 69% (87% for continued attendance and 38% for dropout). The Wald criterion demonstrated that HOMA-IR levels and body satisfaction made significant contributions to predictions, whereas age, conduct problems and triglyceride levels did not (see Table 5). The odds ratios 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 (see Table 5).

Table 5: Predictors of attritions – Screening measures and biological markers

		95% CI for Exp(B)			
	Odds Ratio	Low	High	Wald	*p*-value
Therapy Individual vs. Group	1.22	0.63	2.35	0.34	.56
Demographic parameters					
Age	1.04	0.90	1.19	0.23	.63
Biological markers					
HOMA-IR	1.31	1.08	1.59	7.23	.007
Triclycerides	1.00	1.00	1.01	1.13	.29
Psychosocial parameters					
SDQ-Conduct problems	1.17	0.94	1.45	1.85	.17
Body satisfaction	1.48	1.01	2.16	4.00	.05
Constant	0.22			14.19	.000
Nagelkerke R^2 = 0.19					

Reference group: dropout

When repeating this analysis using dichotomised variables, the Chi-square analysis indicated again that the set of predictors were able to reliably distinguish between participants who continued attending the treatment program and those who dropped out (χ^2 (6, N=186) = 29.99, $p < .001$) 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 (see Table 6).

Table 6: Predictors of attritions – Screening measures and biological markers (dichotomised predictor variables)

		95% CI for Exp(B)			
	Odds Ratio	Low	High	Wald	*p*-value
Therapy	0.86	0.45	1.66	0.21	.65

Individual vs. Group					
Demographic parameters					
Age 7-12 vs. 13-17 years	2.08	1.06	4.05	4.56	.03
Biological markers					
HOMA-IR Normal vs. at risk	2.30	1.18	4.48	6.02	.01
Triclycerides Normal vs. elevated	2.03	0.75	5.53	1.93	.17
Psychosocial parameters					
SDQ-Conduct problems Normal vs. abnormal range	2.81	0.96	8.20	3.58	.06
Body satisfaction Content vs. discontent	2.28	1.17	4.44	5.85	.02
Constant	8.70			8.10	.01
Nagelkerke R^2 = 0.20					

Reference group: dropout

The odds ratios indicated that participants with elevated HOMA-IR levels, participants aged 13-17 years, 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 program than other participants. Although participants with conduct problems were 2.81 times as likely to dropout, this odds ratio failed to reach significance (see Table 6).

DISCUSSION

Results of this study show that any combination of risk factors increases the likelihood of dropout and that youth in the low risk groups are most likely to continue participation to ambulatory treatment. The risk factors we identified were either directly related to the weight problem (i.e. weight class, HOMA-IR levels or body satisfaction), or more or less independent (i.e. conduct problems and age). The results further show that participants who

may benefit most from losing weight (i.e. whose health is most compromised), may be 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 the continued participation in treatment. This is an important finding, although it warrants replication, as 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 indicator of treatment success, however such change may not fully reflect youth´ perceptions of treatment success. For example, for one person the observed BMI change may match expectations, whilst for another the same change may be a disappointment. Future research could utilise 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 variable in the regression analyses yielded differential results. More specifically, age as a continuous variable does not contribute significantly to the prediction of dropout whereas age as a dichotomous variable does. This could indicate that the linear component of the relationship between age and attrition is less important than the non-linear component. This further support 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, however 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 program. The age groups in the current

study reflect different developmental stages (i.e. 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 programs[36-38]. Therefore, future research could also include parental questionnaires as possible indicators of youth dropout.

The effect of body satisfaction confirms previous findings, i.e. 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 lead to unrealistic expectations of treatment, which has been shown to contribute to dropout in adults[40] and adolescents[38].

Although both regression models are equally successful at explaining variance in attrition, the correct prediction of continued participation and dropout is slightly lower in the model including biological markers of the level of (un)healthy weight than in the model using weight status (i.e. 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 percentages reported in other samples[10]. From our study, we can conclude that ambulatory treatment programs 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 programs aimed to prevent obesity may be most effective[41]. For teenagers with obesity, who are discontent with their bodies, other treatment programs (e.g. inpatient) may be more suitable, especially when behavioural conduct is an issue. This finding is in line with previous research indicating that especially older youth with psychosocial adjustment problems were most at risk to withdraw prematurely from a weight management program[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 eating disorder pathology, would have provided further information to why some youth continued participation whilst 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 (e.g. logistical difficulties, perceived failure of treatment). Another limitation is the fact that from our data we cannot determine to what extent continued attendance to treatment reflects the adherence to the treatment program. Furthermore, although the all-Caucasian sample may be representative of the Luxembourgish society (i.e. 89% of people living in Luxembourg in 2007 had a European/Caucasian background[42]), it may reduce the generalizability to other countries and settings.

In closing, the identification of patients who may be more likely to stay in an ambulatory program may be relatively easily determined based on a simple questionnaire,

combining the SDQ and items of the HBSC. Such questionnaire may not take longer than 10 minutes to complete and in combination with anthropometric and demographic information will provide valuable information to the specialist to guide his/her decision which treatment program may best suit the patient.

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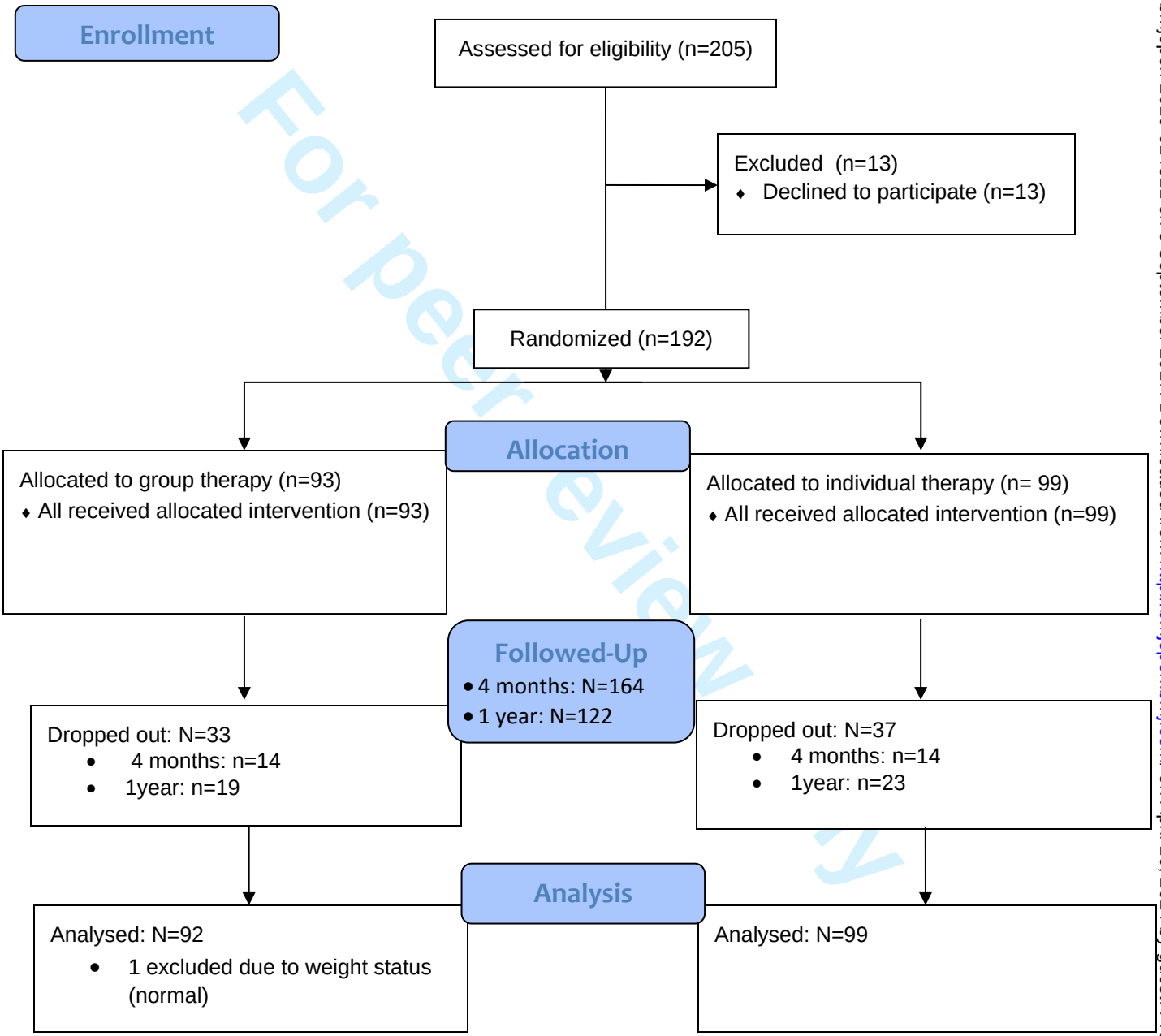
CONSORT Flow Diagram



STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract – we have indicated the study´s design in both Title and Abstract (page 3)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found – Abstract (page 3)
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported - page 5
Objectives	3	State specific objectives, including any prespecified hypotheses - page 6
Methods		
Study design	4	Present key elements of study design early in the paper - page 6-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection - page 6-7
Participants	6	(*a*) *Retrospective longitudinal study*—Give the eligibility criteria, and the sources and methods of selection of participants - page 6
Variables	7	Clearly define all outcomes, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable - page 7-9
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement) - page 7-9
Bias	9	Describe any efforts to address potential sources of bias – page 6
Study size	10	Explain how the study size was arrived at - page 9-10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why - page 7-9; page 13
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding - page 9
		(*b*) Describe any methods used to examine subgroups and interactions – page 10-17
		(*c*) Explain how missing data were addressed - N/A
		(*d*) *Retrospective longitudinal study* —If applicable, describe analytical methods taking account of sampling strategy - page 6

Continued on next page

Results		
Participants	13	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed - page 6; page 10-13
Descriptive data	14	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders - page 6
		(b) Indicate number of participants with missing data for each variable of interest - page 10-13
Outcome data	15	*Retrospective longitudinal study* —Report numbers of outcome events or summary measures - page 7-9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included - page 12-17
		(*b*) Report category boundaries when continuous variables were categorized - page 7-9; page 13
Other analyses	17	Report other analyses done (response letters)
Discussion		
Key results	18	Summarise key results with reference to study objectives - page 17-19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision - page 20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence - page 18-20
Generalisability	21	Discuss the generalisability (external validity) of the study results - page 20
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based - page 22