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ORIGINAL ARTICLE

Anorexia nervosa in adolescents: evolution of weight history and impact of excess premorbid weight

Klara Meierer[1] · Alexandre Hudon[1] · Marc Sznajder[2] · Marie-France Leduc[1] · Danielle Taddeo[1,3] · Olivier Jamoulle[1,3] · Jean-Yves Frappier[1,3] · Chantal Stheneur[1,3]

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Abstract

The purpose of our study is to establish if the proportion of patients diagnosed with anorexia nervosa that have a history of excess weight has increased over a 10-year period and to study how different premorbid weight groups vary in terms of clinical characteristics. We performed a single-center, retrospective cohort study of all new patients presenting with anorexia nervosa, restrictive and binge/purge subtypes, in 2004 and 2014 at the Adolescent Medicine Clinic of Sainte-Justine University Health Centre ($n = 172$). The prevalence of excess premorbid weight was similar in both cohorts (32% in 2004 versus 29.5% in 2014). The historically overweight subgroup had a lower heart rate at intake (64.77 versus 69.75, $p = 0.03$). Patients with excess premorbid weight lost an average of 1 kg more per month than their historically thinner counterparts (2.6 kg versus 1.6 kg/month, $p = 0.0011$). The total decrease in BMI was much greater in patients with a history of excess weight (7 BMI points versus 3.8, $p = 0.0001$).

Conclusion: Since overweight and obese patients present with significant weight suppression values, our study stresses the importance of screening for AN in all patients rather than in only the noticeably underweight.

What is Known:
- *More than one third of patients presenting with AN have a history of overweight or obesity, which is comparable to the general population.*
- *A delay between AN onset and diagnosis has been described in overweight adolescents.*

What is New:
- *Historically overweight patients presenting with AN demonstrate increased speed of weight loss, greater drop in BMI, and lower heart rate at presentation.*
- *For patients with a history of excess weight considered as having recovered from AN, the average BMI at discharge was within normal limits.*

Keywords Anorexia nervosa · Adolescents · Overweight · Obesity · Eating disorder

Klara Meierer and Alexandre Hudon contributed equally to this work.

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✉ Chantal Stheneur
chantal.stheneur@umontreal.ca

Klara Meierer
klara.meierer@mail.mcgill.ca

Alexandre Hudon
alexandre.hudon.1@umontreal.ca

Marc Sznajder
Marc.Sznajder@aphp.fr

Marie-France Leduc
Marie-France.leduc.3@umontreal.ca

Danielle Taddeo
danielle.taddeo@ssss.gouv.qc.ca

Olivier Jamoulle
olivier.jamoulle@umontreal.ca

Jean-Yves Frappier
jeanyves_frappier@ssss.gouv.qc.ca

[1] University of Montreal, 2900 Boulevard Edouard-Montpetit, Montreal, Quebec H3T 1J4, Canada

[2] Department of Pediatrics, Ambroise Paré Hospital, 9 Avenue Charles de Gaulle, 92100 Boulogne-Billancourt, France

[3] Department of Pediatrics, Division of Adolescent Medicine, CHU Sainte-Justine, 3175 CH Côte-Sainte-Catherine, Montreal, Quebec H3T 1C5, Canada

Abbreviations

AN Anorexia nervosa
BMI Body mass index
SD Standard deviation
NS Non-significant

Introduction

Anorexia nervosa (AN) is a complex medical condition affecting mainly adolescents and young adults. According to the National Survey of Anorexia Nervosa in the USA, the prevalence among adolescents is 0.3% [17]. The demographics of anorexia nervosa are in constant evolution. The average age of onset is between 15 and 19 years of age and described as steadily decreasing in recent generations [6]. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) criteria no longer include amenorrhea and a given BMI threshold for the diagnosis of AN [1]. This revised definition of the disorder allows for greater inclusion of the different sub-populations that may develop AN.

Obesity is a major adolescent health concern, leading to important short- and long-term complications [13]. Overweight and obesity rates are increasing in Canadian youth, which is representative of an international trend regarding excess weight in children (WHO). According to Statistics Canada, 16.9% of Canadian teenagers between 12 and 17 years of age are overweight, and 6.2% are obese [16]. Given the considerable importance of physical image and social media in the lives of teenagers, the pressure cast onto overweight youth to lose weight can be significant. Many public health campaigns target these children by establishing the achievement of a "healthy body weight" as a primordial goal [12]. Moreover, adolescents with excess weight are at greater risk of having weight and shape concerns when compared to normal weight peers [3]. AN must therefore be considered regardless of weight history or weight at presentation.

In a recent study conducted by Lebow et al. [10], the authors found a 36.7% prevalence of premorbid overweight or obesity in teenagers suffering from restrictive AN. This number is slightly higher to the combined prevalence of adolescent overweight and obesity in the USA (33.6% according to the National Institute of Diabetes and Digestive and Kidney Diseases) [15]. Initially, weight loss is encouraged and perceived as favorable by health care providers. Hence, a delay between disease onset and diagnosis has been described in overweight adolescents [10, 14]. Since early intervention is associated with recovery [20], it is imperative to identify AN symptoms early on and act promptly to halt disease progression. In addition to informing health care providers about the importance of considering AN in patients of all premorbid weight categories, there is a critical need for studies that specifically examine the influence of historical overweight or obesity on the course and treatment of AN in adolescents [9].

The primary goal of our study was to establish if the proportion of patients diagnosed with AN that have a history excess premorbid weight had increased over a 10-year interval (2004 and 2014). Motivation to study this topic stems from the clinical impression at the Adolescent Medicine Clinic of Sainte-Justine University Health Centre that an increasing number of patients presenting with AN have a history of excess weight. In addition, there is a growing body of literature analyzing the association between overweight and eating disorder development [5, 14, 19]. Our secondary objective was to analyze the characteristics of patients with excess premorbid weight and AN by comparing different premorbid weight categories in terms of delay between disease onset and diagnosis, clinical characteristics at first visit, number of hospitalizations, and follow-up outcomes. History of excess weight refers to either excess weight at presentation or excess weight at any time prior to disease onset.

Materials and methods

We performed a single-center, retrospective cohort study of all new patients presenting for an eating disorder in 2004 and 2014 at the Adolescent Medicine Clinic of Sainte-Justine University Health Centre, a tertiary pediatric hospital. The multidisciplinary team taking care of patients was composed of nurses, psychologists, social workers, pediatricians, psychiatrists, and nutritionists. The initial evaluation (i.e., intake) was performed by a pediatrician who decided whether or not it was necessary to involve other professionals.

The charts were reviewed in 2016 by two medical students (AH and KM). Patients were included if they were between 10 and 17 years old at intake and fulfilled DSM-5 diagnostic criteria for AN of restrictive or binge eating/purging type. Age, sex, maximal premorbid weight, weight at diagnosis, minimal weight, and menarche age were registered. Height at maximal premorbid weight was retrieved when available and was otherwise considered as equivalent to height at diagnosis. Anthropometric measurements (i.e., weight, height, and BMI) were expressed in z score, using the mean value expected for the patient's age and standard deviation, via the Pediatric Z-Score Calculator [4]. Overweight and obesity were defined as a BMI over the 85th and 95th percentiles respectively. Clinical signs and symptoms at presentation such as dizziness, fatigue, acrocyanosis, capillary refill time, heart rate, blood pressure, episodes of binge eating behavior, and duration of amenorrhea were recorded. Follow-up was studied for the 2004 cohort, through the number of hospitalizations before 18 years of age and through rates of discharge, transfer to adult care, transfer to psychiatry before adulthood, and drop-out. Patients were discharged when considered as having recovered from AN, as per the pediatrician's judgment that the patient's health status, both physical and psychological, no longer required follow-up at the AN clinic.

Continuous variables were expressed as the median [Q1, Q3]. The Student's *t* test was used to compare means, while the Pearson test was used to calculate the correlations. A *p* value of less than 0.05 was considered as statistically significant.

Results

Patients

In 2004, a total of 129 adolescents presented for an eating disorder, out of which 23 were excluded as they did not meet the diagnostic requirements for AN. The remaining 106 adolescents were divided into two groups: patients with a history of normal weight (weight under the 85th percentile) and patients with a history of excess weight (weight above the 85th percentile at any time prior to disease onset). Seventy-two (68%) patients were in the first group whereas 34 patients (32%) were in the second group.

In 2014, a total of 101 patients presented for an eating disorder, out of which 35 were excluded as they did not meet the AN diagnostic requirements. The remaining 66 adolescents were divided into the same two groups. Fifty patients (75.5%) had a normal weight history whereas 16 patients (24.5%) had a history of excess weight. The difference in prevalence of excess premorbid weight between 2004 and 2014 was found to be non-specific ($p = 0.3$). In the normal premorbid weight group, 30 patients (24.6%) were experiencing binge eating episodes versus 22 patients (44.0%) in the excess weight group ($p = 0.012$).

The characteristic profiles for each group are displayed in Table 1.

History of AN

Table 2 shows the evolution of AN characteristics prior to intake. The average patient age at presentation was 15.12 years, with no significant presentation age difference between the 2004 and 2014 groups. The median maximal BMI before disease onset values were 25.5 kg/m^2 (1.27 *z* score) for the group with a history of excess weight and 20.7 kg/m^2 (0.33 *z* score) for the normal premorbid weight group ($p < 0.001$). At presentation, the BMI values were respectively 19.4 kg/m^2 (− 0.075 *z* score) and 17.3 kg/m^2 (− 1.07 *z* score) ($p < 0.001$). The median durations of symptoms before coming to medical attention were 7.5 months for the excess premorbid weight groups and 8 months for the normal premorbid weight groups (non-specific (NS)). The speed values of weight loss were respectively 2.6 versus 1.6 kg/month ($p = 0.001$), demonstrating a significantly steeper drop in body weight in the excess premorbid weight group.

Before coming to our specialized clinic, 45 (36.9%) patients in the average premorbid weight group were already undergoing follow-up for another medical condition, versus 20 (40%) in the excess premorbid weight group (NS).

Clinical data at first visit

Among the selected clinical signs and symptoms at intake (see Fig. 1), two were significantly different between normal premorbid weight and excess premorbid weight groups. Blood pressure readings lower than 90/45 mmHg were more common in the normal premorbid weight group (20% versus 8%, $p = 0.037$). Moreover, heart rate was lower in the group, with a history of excess weight with an average of 65 versus 70 beats/min ($p = 0.03$).

Table 1 Characteristics of patients

	2004	2014	Average weight	Overweight	*p* value
N (%)	106	66	122 (71%)	50 (29%)	NS
Female/male	100/6	66/0	118/4	48/2	NS
Age at diagnosis (years) median [Q1, Q3]	15.46 [14.27, 16.38]	15.29 [13.52, 16.20]	15.5 [14.0, 16.4]	15.3 [13.9, 16.0]	NS
Age at menarche (years) median [Q1, Q3]	12.0 [11.0, 12.0]	12.0 [11.0, 12.1]	12.0 [11.0, 12.5]	12.0 [11.0, 12.0]	NS
Height at diagnosis (cm) median [Q1, Q3]	161.5 [157.5, 166.0]	159.7 [154.6, 165.0]	161.0 [155.2, 166.0]	160.2 [157.6, 164.4]	NS
Weight at diagnosis (kg) median [Q1, Q3]	47.6 [42.3, 53.7]	44.1 [39.4, 51.3]	45.5 [39.3, 51.3]	50.3 [45.5, 56.1]	$p < 0.001$
BMI SD max	0.65 [0.22, 1.18]	0.52 [− 0.37, 0.98]	0.33 [− 0.28, 0.71]	1.44 [1.19, 1.61]	$p < 0.001$
BMI SD diagnosis	− 0.65 [− 1.62, 0.01]	− 0.97 [− 1.71, − 0.058]	− 1.07 [− 1.92, − 0.26]	− 0.075 [− 1.07, − 0.495]	$p < 0.001$

Characteristics of patients with anorexia nervosa in 2004 and 2014 with respect to their premorbid weight history. SDs are interpreted as *z* score

Table 2 Evolution of AN symptoms before the first visit

	2004		2014		*p* value
	Average-weight history	Overweight history	Average weight history	Overweight history	
Duration of AN (months)	15.0 [7.0, 22.0]	17.5 [10.8, 24.5]	–	–	NS
Speed weight loss (kg/months)	1.02 [0.61, 2.05]	2.15 [1.08, 3.08]	1.13 [0.49, 2.06]	2.13 [1.46, 4.01]	$p = 0.001$
Δ BMI (max–min)	3.80 [2.85, 5.00]	6.85 [4.90, 9.18]	3.60 [2.30, 5.25]	6.65 [4.75, 8.05]	$p < 0.001$

Evolution of anorexia nervosa symptoms before the first visit in our tertiary hospital in patients with (≥ 85th percentile) or without overweight/obesity

Follow-up

During follow-up for the 2004 cohort, 42% of patients in the excess premorbid weight group were hospitalized versus 29% in the normal weight group ($p = 0.10$). The mean number of hospitalizations per patient was 0.42± 0.51 in the excess weight group versus 0.35± 0.65 (NS).

Figure 2 represents the outcome at the end of pediatric follow-up. At the end of follow-up in our pediatric center, 35% of patients in the normal premorbid weight group were considered as having recovered from AN versus 41% of patients in the excess premorbid weight group (NS). The average durations of amenorrhea were 7.8 versus 11.1 months ($p = 0.04$) respectively.

At the end of follow-up, for patients considered as having recovered from AN, the median weight values were 49.3 kg [43.7, 54.0] for the normal premorbid weight group and 57.7 kg [53.4, 66.7] for the excess premorbid weight group ($p = 0.0002$). Figure 3 represents the evolution of BMI for patients with and without excess premorbid weight. For the normal premorbid weight group, the difference between maximal historical weight and minimal weight (i.e., weight suppression) was 8.7 kg, versus 16.6 kg in the group excess premorbid weight group. The median BMI values were 19.53 [18.56, 20.88] for the normal premorbid weight group and 21.57 [20.35, 24.87] ($p = 0.0014$) for the excess premorbid weight group at the end of follow-up, which places both groups within the normal BMI range. 28.57% of patients in the historically overweight group were discharged with excess weight.

Among patients considered as having recovered from AN, the disease duration in the average premorbid weight group was 16.5 ± 0.89 months versus 20.3 ± 1.35 months in the excess premorbid weight group (NS).

Discussion

The goal of this study is to describe how premorbid weight history influences characteristics at intake and follow-up outcomes for adolescents suffering from AN.

Our initial hypothesis was that the percentage of adolescents with a history of excess weight in the AN population had increased in recent years. However, the prevalence of adolescents with excess premorbid weight in the 2004 cohort was 32% versus 24.5% in 2014. Overall, we found that 29% of patients presenting to our AN clinic in 2004 and 2014 had a history of excess weight. This percentage is slightly higher than the prevalence of excess weight in the Canadian adolescent population (19.4% in 2005 and 23.1% in 2014), according to Statistics Canada. Lebow et al. [10] had an equivalent finding in their population of

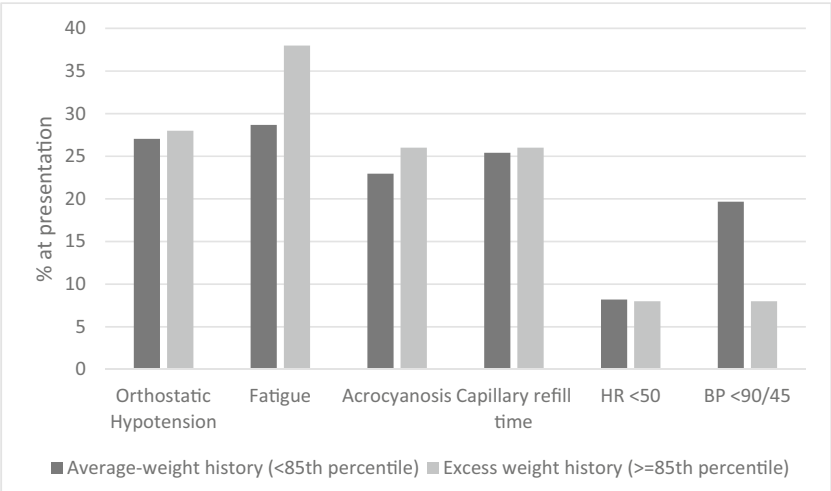

Fig. 1 Comparison of clinical signs and symptoms at intake in anorexia nervosa patients presenting with and without excess premorbid weight. Software used: MSOffice Excel

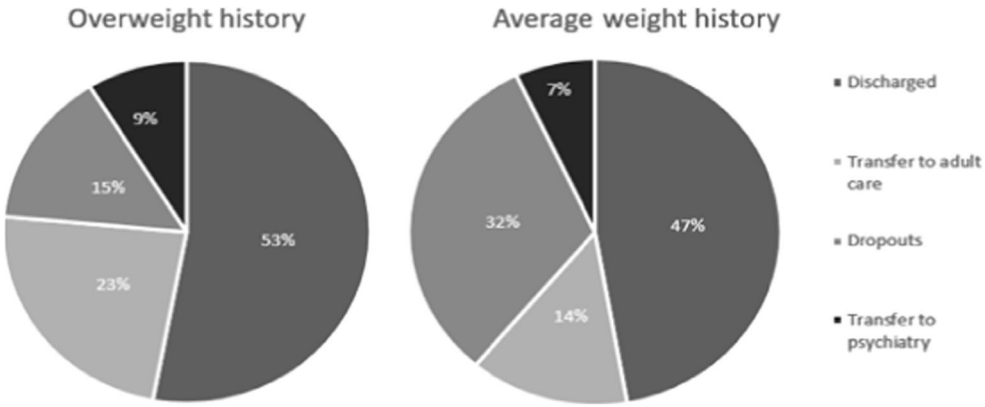

Fig. 2 Outcome of patients with (≥ 85th percentile, $N = 34$) and without (< 85th percentile, $N = 72$) previous overweight at the end of pediatric follow-up. Software used: MSOffice Excel

adolescents suffering from AN, with 36.7% of patients endorsing a history of excess weight, compared to a prevalence of 33.6% for adolescent excess weight in the general US youth population (according to the National Institute of Health).

Our results demonstrate significantly greater speed of weight loss during AN evolution in patients with a history of excess weight when compared to normal premorbid weight counterparts. This result echoes the findings of previous studies [10]. Moreover, weight suppression (expressed through BMI) was greater in the excess premorbid weight population, as per previous studies [5, 8–10, 18]. Heart rate under 50 BPM was significantly more prevalent in the excess premorbid weight group, whereas blood pressure under 90/45 was more frequently identified in the normal premorbid weight group. This is in agreement with Garber et al.'s [7] finding that heart rate at intake is lower in patients with excess premorbid weight and with Swenne's finding that blood pressure at intake is lower in patients with normal weight history [18]. Other signs and symptoms (fatigue, orthostatic hypotension, acrocyanosis, and capillary refill time) were not significantly different between the two premorbid weight groups, which may indicate that weight history does not influence these clinical features, or that our population is too small to identify a subtle difference.

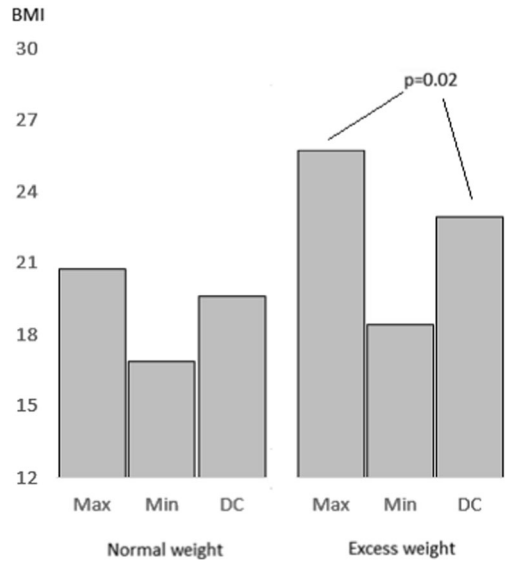

Fig. 3 Comparison of the evolution (max maximum, min minimum, dc discharged) in BMI for patients having recovered from AN for normal and excess premorbid weight groups (premorbid max weight < 85th percentile, $N = 25$; premorbid max weight ≥ 85th percentile, $N = 14$). Software used: MSOffice Excel

We observed that binge eating behavior was significantly more present in patients with a history of excess weight when compared to patients with normal premorbid weight (44.0% versus 24.6% respectively, $p = 0.012$). This corroborates the association between overweight and binge eating behavior in adolescents that has been previously established in literature [11].

At discharge, the average weight for patients with excess premorbid weight considered as having recovered from AN was 57.7 kg, with an average BMI of 22.92. Since this value is within a normal BMI range, this finding can help reassure previously overweight or obese patients who may be afraid of gaining significant weight when undergoing treatment for AN. Murray et al. found that weight seems to stabilize 5 years after clinical resolution of an eating disorder. However, important weight suppression has been linked to future weight gain [2]. Further research could help determine if the same is true for patients with excess premorbid weight suffering specifically from AN.

Total duration of illness as determined by the physician's opinion was not significantly different between the two premorbid weight groups. Our results are in accordance with Kennedy et al.'s recent findings [9], but they oppose Villarejo and Lebow [10, 19] who highlight a longer duration of illness in patients with excess premorbid weight when compared to normal premorbid weight counterparts. Total duration of illness may be similar in both groups due to the fact that patients with excess premorbid weight may return to a normal BMI faster, thus prompting clinicians to discharge these patients earlier than their normal premorbid weight peers.

This study has several limitations. Self-report of maximal weight can result in incorrect premorbid BMI. This bias may be more important in the group of patients with a history of excess weight, as these patients may be embarrassed to declare a very high maximal weight. Height at maximal historical weight was not systematically documented in the patient's chart, in which case height at diagnosis was used. This substitution can underestimate the maximal premorbid BMI for these patients, causing the change in BMI during AN evolution to appear as less than its true value. Another limitation was regarding the documentation of oral contraceptive pill usage, which was missing in certain charts, thus impacting findings concerning amenorrhea. Finally, patients who presented to our clinic may not be representative of all adolescents suffering from AN, but rather the subset of patients who seek care and obtain a referral to a university health center.

Conclusion

The prevalence of excess premorbid weight in patients presenting with AN was similar in the 2004 and 2014 cohorts. We have identified an increased speed of weight loss and total weight loss during AN evolution in the previously overweight and obese population when compared to the normal premorbid weight population. Since overweight and obese patients present with significant weight suppression values, our study stresses the importance of screening for AN in all patients rather than in only the noticeably underweight.

Authors' Contributions Klara Meierer M.D.:
Main author, data collection, manuscript writing, reviewer
Alexandre Hudon:
Main author, data collection, manuscript writing, reviewer
Marc Sznajder M.D.:
Data analysis, reviewer
Marie-France Leduc M.D.:
Data collection, reviewer
Danielle Taddeo M.D.:
Data collection, reviewer
Olivier Jamoulle M.D.:
Data collection, reviewer
Jean-Yves Frappier M.D.:
Data collection, reviewer
Chantal Stheneur M.D., PhD:
Supervision of data collection, supervision manuscript writing, reviewer

Compliance with ethical standards

Ethical approval was obtained from the Sainte-Justine's Hospital Research Ethics Board.

Conflict of interest The authors declare that they have no conflict of interest.

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

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