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BRIEF REPORT

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Seasonal and subtype differences in body mass index at admission in inpatients with anorexia nervosa

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Abstract

Objective: In the general population, body weight is—on average—higher in the winter than in the summer. In patients with anorexia nervosa (AN), however, the opposite pattern has been reported. Yet, only a handful of studies exist to date that suffer from small sample sizes and inconsistent results. Therefore, the current study examined seasonal effects on body weight in a large sample of patients with AN to dissolve previous inconsistencies.

Method: Clinical records of N = 606 inpatients (95.4% female) who received AN treatment at the Schoen Clinic Roseneck (Prien am Chiemsee, Germany) between 2014 and 2019 were analyzed.

Results: Patients with restrictive type AN had lower body mass index at admission in the winter than in the summer. This difference was not found for patients with binge/purge type AN and patients with atypical AN.

Discussion: Individuals with restrictive type AN show seasonal variations in body weight that are opposite to seasonal variations in body weight in individuals without AN. These seasonal effects are specific to the restrictive subtype and cannot be found for the binge/purge or atypical subtypes. Future studies that replicate this effect in other cultures or latitudes and that examine the mediating mechanisms are needed.

KEYWORDS

anorexia nervosa, atypical anorexia nervosa, binge/purge subtype, body mass index, restrictive subtype, seasonality

1 | INTRODUCTION

Seasonal variations in body weight have been consistently reported. In European and North American countries, body mass index (BMI) is on average higher in the winter than in the summer (Mehrang, Helander, Chieh, & Korhonen, 2016). This pattern has been found both in the general population (Visscher & Seidell, 2004) and in overweight adults participating in a behavioral weight loss intervention (Fahey, Klesges, Kocak, Talcott, & Krukowski, in press). Possible mechanisms that explain increases in body weight during the winter include a reduction in physical activity and increased consumption of high-calorie foods compared to the summer period (Lloyd & Miller, 2013; Ma et al., 2006; Sabbağ, 2012; Sturm, Patel, Alexander, & Paramanund, 2016; Westerterp, in press).

In a small sample of 37 adolescents with anorexia nervosa (AN; 68% restrictive type) from the Netherlands, Carrera et al. (2012) reported the peculiar finding that participants during the cold season (October to April) had lower BMI than participants in the warm season, suggesting that seasonal changes in body weight in individuals with AN may be opposite to the seasonal changes found in persons without AN. Two later studies extended this finding, suggesting that seasonal variations in BMI in individuals with AN depend on AN subtype. Specifically, in a study from Spain, Fraga et al. (2015) found that BMI at admission in the cold season (November to April) was lower in adolescent inpatients with restrictive type AN than in binge/purge type AN, whereas subtypes did not differ in BMI in the warm season. Similarly, in a study from Germany, Born et al. (2015) found that BMI at admission during autumn and winter was lower in adult inpatients with restrictive AN than in binge/purge type AN, whereas subtypes did not differ in BMI during spring and summer. Both studies, however, were based on small sample sizes ($n = 86$ and $n = 68$) with particularly small groups of patients with binge/purge type AN.

To overcome these limitations, Kolar et al. (2018) examined clinical records of 304 adolescent inpatients from a multi-centric database in Germany. Although they indeed found an interactive effect between season and AN subtype on BMI at admission, the nature of this interaction indicated higher body weight during the cold than the warm season in patients with restrictive type AN. Hence, the current state of affairs is that the study with the largest sample size to date found seasonal differences in BMI in patients with restrictive type AN that are opposite to the seasonal differences found in three small-scale studies and, therefore, no clear conclusions can be drawn about the existence and the direction of seasonal BMI variations in AN. Thus, we examined clinical records of more than 600 patients with AN with the aim of dissolving previous inconsistent findings.

2 | METHOD

Clinical records of individuals with AN who received inpatient treatment at the Schoen Clinic Roseneck (Prien am Chiemsee, Germany) between 2014 and 2019 were analyzed. Data of $N = 606$ inpatients (95.4% female, $n = 578$) were available for the current analyses. Mean age was 22.7 years ($SD = 9.76$, range: 12–69). The majority of patients were diagnosed as restrictive type AN (F50.00; 61.6%); 22.4% were diagnosed as binge/purge type AN (F50.01); and 16.0% were diagnosed as atypical AN (F50.1; Table 1), according to the German version of the International Classification of Diseases (ICD-10-GM, https://www.dimdi.de/static/de/klassifikationen/icd/icd-10-gm/kode-suche/htmlgm2020/block-f50-f59.htm). These groups did not differ in age ($F_{[2,603]} = 2.87$, $p = 0.057$, $\eta^2_p = 0.009$) but differed in sex distribution ($\chi^2_{[2]} = 6.53$, $p = 0.038$, $\phi = 0.104$) with patients with atypical AN having a higher proportion of men (9.3%) than patients with binge/purge subtype (5.1%) and restrictive subtype (3.2%).

Previous studies applied different categorizations of warm versus cold season (e.g., differing in the assignment of October and April; Carrera et al., 2012; Fraga et al., 2015; Kolar et al., 2018). Thus, we decided to follow the classification of meteorological seasons (similar to Born et al., 2015): spring (March to May), summer (June to August), autumn (September to November), and winter (December to February) based on the patients' admission date. A univariate analysis of variance was run with IBM SPSS Statistics Version 24, entering subtype and season as between-subjects factors and BMI at admission as dependent variable. Significant effects ($p < 0.05$) were followed up with independent samples *t*-tests. The data that support the findings of this study are available in the Supplementary Material of this article.

3 | RESULTS

The main effect of season was not significant ($F_{[3,594]} = 0.28$, $p = 0.838$, $\eta^2_p = 0.001$). A significant main effect of subtype ($F_{[2,594]} = 14.4$, $p < 0.001$, $\eta^2_p = 0.046$) indicated that both the patients with restrictive type AN ($M = 14.7$ kg/m^2, $SD = 1.88$, $t_{[468]} = 5.72$, $p < 0.001$, $d = 0.652$) and the patients with binge/purge type AN ($M = 15.1$ kg/m^2, $SD = 2.06$, $t_{[231]} = 3.36$, $p = 0.001$, $d = 0.447$) had lower BMI than the patients with atypical AN ($M = 16.0$ kg/m^2, $SD = 1.92$). A significant interaction season × subtype ($F_{[6,594]} = 2.63$, $p = 0.016$, $\eta^2_p = 0.026$), however, qualified this effect. This interaction was also significant when age and sex were included as covariates ($F_{[6,592]} = 2.39$, $p = 0.027$, $\eta^2_p = 0.024$). Given the large number of possible group comparisons, we focused on the summer and winter seasons as these can be most clearly differentiated in terms of outside temperature. In the summer, the three subtypes did not differ from each other (all *p*s > 0.733). In the winter, the patients with restrictive type AN had lower BMI than both the patients with binge/purge type AN ($t_{[144]} = 2.93$, $p = 0.004$, $d = 0.580$) and the patients with atypical AN ($t_{[136]} = 3.30$, $p = 0.001$, $d = 0.730$). The patients with binge/purge type AN and the patients with atypical AN did not differ in BMI ($t_{[56]} = 0.62$, $p = 0.539$, $d = 0.164$). Furthermore, the patients with restrictive type AN had lower BMI in the winter than in the summer ($t_{[202]} = 2.89$, $p = 0.004$, $d = 0.407$), whereas BMI did not differ

TABLE 1 Descriptive statistics of body mass index (kg/m^2) at admission as a function of subtype and season

	Subtype								
N = 606	**Restrictive (*n* = 373)**			**Binge/purge (*n* = 136)**			**Atypical (*n* = 97)**		
	n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
Spring (*n* = 178)	101	14.5	1.92	48	14.8	2.12	29	16.4	1.64
Summer (*n* = 150)	91	15.2	1.85	36	15.3	1.94	23	15.4	2.22
Autumn (*n* = 107)	68	14.8	1.75	19	14.3	2.32	20	16.1	1.61
Winter (*n* = 171)	113	14.5	1.89	33	15.5	1.83	25	15.9	2.11

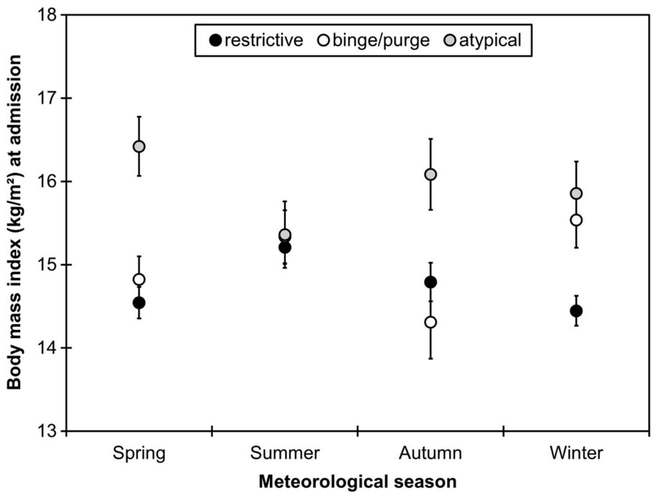

FIGURE 1 Mean body mass index at admission as a function of subtype and season. Error bars represent the standard error of the mean

between winter and summer in the other two subtypes (both *ps* > 0.431; Table 1; Figure 1).

4 | DISCUSSION

Previous studies have reported inconsistent and, in fact, opposing seasonal differences in body weight in inpatients with restrictive type AN. The current study reports the largest sample of patients with AN to date in which seasonal variations in BMI at admission were examined as a function of AN subtypes. In line with the findings by Fraga et al. (2015) and Born et al. (2015), inpatients with restrictive type AN had lower BMI at admission in the winter than in the summer, and this difference was not observed for binge/purge type and atypical AN.

Several possible mechanisms for this effect have been proposed. For example, seasonality effects on BMI might be mediated by increased physical activity in individuals with AN. Specifically, as individuals with AN have lower body surface temperature and self-perceived warmth than individuals without AN in most body parts (Belizer & Vagedes, 2019), they may increase physical activity at cold ambient temperatures as a thermoregulatory behavior (Carrera et al., 2012). In line with this, preliminary evidence based on case reports suggests that heat treatment results in a reduction of hyperactivity, anxiety, and depression in patients with AN (Gutierrez & Vazquez, 2001), although results from randomized controlled trials have been mixed (Carrera & Gutiérrez, 2018). Another explanation posits that individuals with AN have deficient insulation due to reduced subcutaneous fat, and thus, the body expends more energy for thermoregulation at cold ambient temperatures (Fraga et al., 2015). Hypothetically, this process may be mediated by brown adipose tissue, which is activated by hypothermia, dissipates energy, and generates heat (Freemark & Collins, 2018). Finally, it has also been suggested that reduced exposure to sunlight in the winter and lower vitamin D concentrations may also influence body weight, for example, through increased depressiveness (Kolar et al., 2018).

At least two methodological aspects need to be considered when interpreting findings from the current and from the previous studies. One aspect refers to the definition of AN subtypes. In the current study, this differentiation was based on the ICD-10-GM, whereas other studies referred to the criteria in the fourth (Carrera et al., 2012; Fraga et al., 2015) or fifth (Kolar et al., 2018) version of the Diagnostic and Statistical Manual of Mental Disorders (DSM) or did not specify the definition criteria (Born et al., 2015). Similarly, prevalence of patients being classified as binge/purge-type AN differed across studies between 4% (Kolar et al., 2018) and 53% (Born et al., 2015), which might be due to different subtype definitions. A crucial aspect may be the presence of excessive exercise, which would not represent a purging behavior according to the DSM but which is not explicitly excluded in the definition of binge/purge-subtype AN in the ICD-10-GM. Another aspect refers to the definition of the warm and cold seasons. In the current study, we differentiated between the four meteorological seasons (as the large sample size allowed us to do so), whereas previous studies combined autumn/winter and spring/summer (Born et al., 2015) or differentiated between warm and cold season based on outside temperature, but with different definitions (Carrera et al., 2012; Fraga et al., 2015; Kolar et al., 2018). Thus, these methodological differences may partly explain inconsistent findings about seasonal effects on body weight in AN.

Although the current study cannot answer the question about the mediating mechanisms, it offers robust support for the counterintuitive seasonal variations in body weight in a large, heterogeneous sample of patients with AN that includes both adolescents and adults as well as both males and females. Furthermore, it highlights the crucial role of differentiating between AN subtypes. In addition to examining possible mediators that drive reductions of body weight in persons with restrictive AN in the winter, future studies also need to examine possible moderators of this effect, for example, whether it replicates in cultures and latitudes outside of Europe as well.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available in the supplementary material of this article.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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