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RESEARCH

Target weight at discharge for children receiving their first inpatient treatment for an eating disorder

Kazumi Kurata[1] · Yuta Inagawa[1] · Tatsuhiko Yagihashi[1] · Takahiro Nakamura[1] · Seiji Obi[1] · Shiro Suda[1]

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Abstract

Purpose There is no consensus regarding the optimal target weight for discharge during the hospitalization of children with eating disorders (EDs). We attempted to identify the ideal discharge weight for children receiving their first inpatient treatment for anorexia nervosa (AN) or avoidant/restrictive food intake disorder (ARFID).

Patients and methods Sixty children (mean age: 12.8 years) diagnosed with either AN (49 children) or ARFID (11 children) were followed for 1 year after discharge from a psychiatric ward. We analyzed the percent of ideal body weight (%IBW) at discharge, along with physical and social factors, to predict weight outcomes and rehospitalization risk during the first year after discharge. Longitudinal weight trends were assessed, and Cox proportional hazards modeling was used to analyze the time to rehospitalization.

Results Single and multiple regression analyses identified the %IBW at discharge as the sole significant predictor of %IBW at 1 year. A receiver operating characteristic curve determined that 86.4%IBW at discharge was the optimal predictor of achieving 90%IBW by 1-year post-discharge. Patients who had achieved ≥ 86.4%IBW at discharge showed better weight trajectories compared with those discharged at < 86.4%IBW. A higher discharge %IBW was associated with prolonged time to rehospitalization, indicating a reduced risk of readmission.

Conclusions Discharging pediatric patients at a higher weight is associated with improved weight recovery and a reduced risk of rehospitalization. A target discharge weight of 86.4%IBW may serve as an effective criterion for children with EDs.

Level of evidence III, case–control analytic studies.

Keywords Feeding disorder · Eating disorder · Child · Adolescent · Weight gain · Inpatient · Follow-up study

Introduction

Anorexia nervosa (AN) and avoidant/restrictive food intake disorder (ARFID) are eating disorders (EDs) [1] that affect mainly adolescents/young adults and are often associated with long-lasting physical/psychological symptoms. AN is characterized by extremely low body weight concomitant with fear of gaining weight and body image disturbance [1], with a mean age of onset at 12–15 years [2]. Patients with ARFID also exhibit extremely low body weight, but they lack fear of gaining weight and body image disturbance [1]. The mean onset age of ARFID is younger than that of AN patients at < 12 years [3], and some patients who are initially diagnosed with ARFID later develop obesity fears and body image disturbances during the course of the disorder, and their diagnoses thus change to AN [4]. In both AN and ARFID, undernutrition and low body weight lead to many physical complications in the acute phase [2, 5]. It has been

✉ Yuta Inagawa
d07sm011@gmail.com

Kazumi Kurata
kuratakazumi@gmail.com

Tatsuhiko Yagihashi
yagihashi.tatsuhiko@jichi.ac.jp

Takahiro Nakamura
hirotaka19901206@gmail.com

Seiji Obi
r2011os@jichi.ac.jp

Shiro Suda
sudash@jichi.ac.jp

[1] Department of Psychiatry, Jichi Medical University, 3311-1 Yakushiji, Shimotsuke-Shi, Tochigi 329-0498, Japan

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estimated that the symptoms of 7–35% of patients with AN persist for > 5 years [6–8]. ARFID sometimes involves a longer duration of illness and a more severe course compared to AN [9]. Prolonged undernutrition and low body weight can lead to long-term physical sequelae such as osteoporosis and short stature [10] as well as psychological sequelae including depression, bipolar disorder, anxiety disorders, substance-related disorders, and avoidant personality disorder [2]. Early treatment is essential to reduce these risks and support recovery.

Weight restoration as early as possible after the onset of an ED can prevent a prolonged illness duration and late sequelae. A shorter illness duration with early weight restoration improves the risk of recurrence [11], psychological symptoms including fear of gaining weight and body image disturbances, and later psychiatric comorbidities [12]. As bone metabolism abnormalities due to low body weight normalize at 16.4–18.5 kg/m^2 body mass index (BMI) [13], early weight recovery to an appropriate level can prevent future osteoporosis. Among individuals who are still growing, a final short stature can be prevented by shortening the period of low body weight during the height spurt [14]. Cognitive impairment has been reported in patients with amenorrhea and irregular menstruation [15], and it has been suggested to be caused by low estrogen levels [16]. Weight loss in AN has been linked to alterations in GABA receptors and astrocytes, which may be involved in anxiety, loss of adherence, and learning deficits [17]. Shortening the period of low body weight as much as possible may, therefore, contribute to the improvement of not only physical/physiological functions but also psychological/cognitive functions.

Inpatient treatment is effective for re-nutrition and weight restoration in patients with severely low body weight [18]. Early weight gain during treatment can contribute to remission [19], whereas family problems such as divorce and single parenting can lead to difficulty in achieving remission [8]. Combined interventions by multiple professionals are possible in inpatient treatment which is recommended in various guidelines, including the British National Institute for Health and Care Excellence (NICE) guidelines [20–22]. Although inpatient treatment is a powerful treatment modality, 12.3% of patients with EDs drop out of treatment [7], and the relapse rate after discharge is reported to be high among patients whose treatment is insufficient: 9% after complete remission and 35% after partial remission [23]. Relapse is common within the first year of treatment [23], with a peak at 1 month after discharge [24].

A primary goal of inpatient treatment for EDs is to restore the patient to an appropriate weight within a short term from the ED onset. The consensus on the final target weight for ED treatment is 90% of the patient's ideal body weight (90% IBW), at which the resumption of menses (ROM) is expected in most female patients [16, 25–27]. However, if the target of inpatient treatment is to achieve ROM, hospitalization will be prolonged, resulting in significant losses to patients' social participation and healthcare economy. Despite the availability of various ED treatment guidelines [20–22], there is no description of how much weight should be restored during hospitalization. There has thus been a need for an appropriate target weight index at discharge that would encourage patients to continue treatment to achieve final recovery and prevent recurrence after discharge.

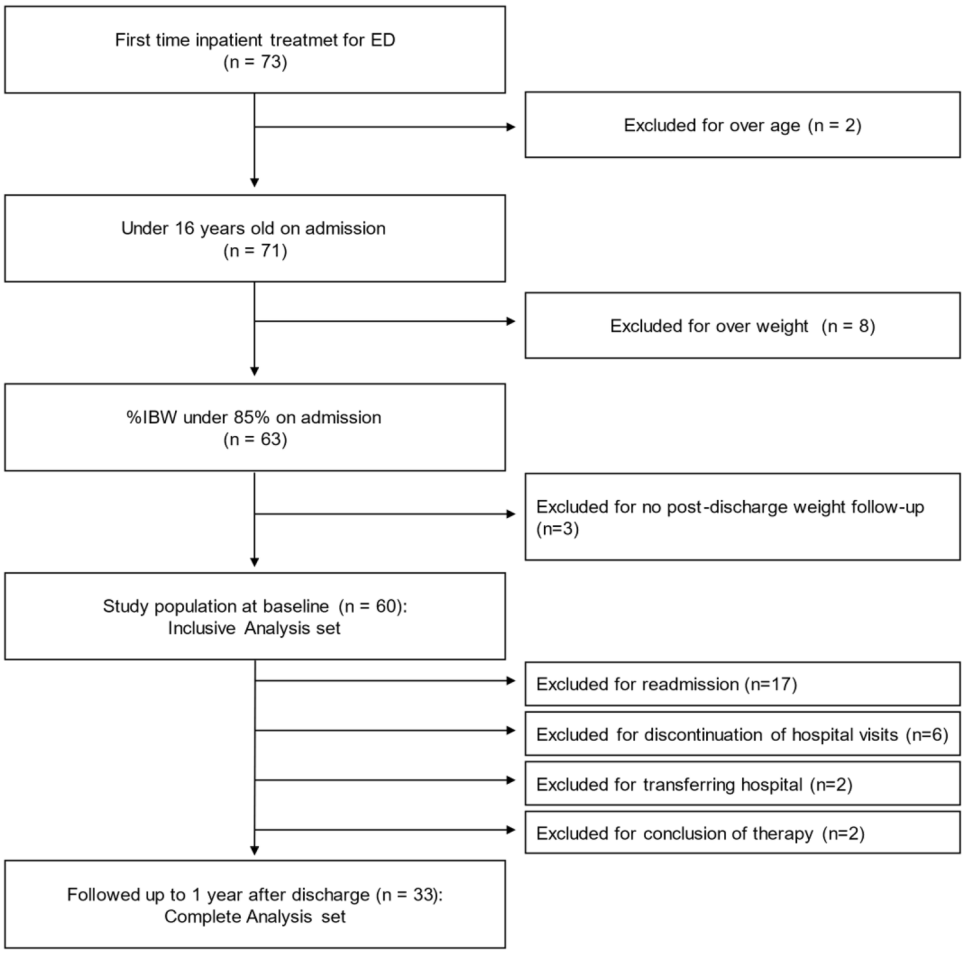
We conducted the present study to identify the optimal target weight at discharge for children receiving their first inpatient treatment for an ED. This retrospective analysis was conducted using clinical data on longitudinal weight trends and readmissions during the first year after discharge.

Patients and methods

We performed a retrospective chart review of all patients admitted to the psychiatric ward of Jichi Medical University Hospital Tochigi Children's Medical Center between January 1st 2015 and July 31st 2021. Since this Center has the only child psychiatric ward in Tochigi Prefecture and surrounding areas, most of the children with severe EDs in the region are referred to this facility. The children's diagnoses were based on the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria for AN or ARFID and were made by two trained child psychiatrists.

Patients

Since fear of obesity and body image disturbances are less prominent in the early stages of illness due to the underdeveloped verbal abilities of pediatric patients, we included both AN and ARFID patients in this study. We recruited children with AN or ARFID who received their first inpatient treatment for an ED at the Center. The first exclusion criteria were patients: (i) age > 16 years; (ii) admission weight > 85% ideal body weight (%IBW); and (iii) unable to continue follow-up due to loss of post-discharge weight measurement. The enrolled participants who completed inpatient treatment were analyzed as the 'inclusive analysis set' and were followed for 1 year after their discharge. The second exclusion criteria were patients who discontinued follow-up visits within 1 year after discharge due to: (i) readmission; (ii) interruption of hospital visits; (iii) transfer to a different hospital, or (iv) the conclusion of outpatient therapy. The enrolled participants were analyzed as the 'complete analysis set' (Fig. 1). To identify factors associated with the standard weight ratio 1-year post-discharge, we analyzed the complete analysis set first and the inclusive analysis set second.



ED: Eating Disorder, %IBW: % Ideal Body Weight,

Fig. 1 Consort flow diagram of the patients

Figure 1 shows a flow diagram of the patient selection. Seventy-three patients with an ED received first-time inpatient treatment for their EDs. The exclusion criteria eliminated 13 patients, including 2 who were > 16 years, 8 whose admission weights were > 85%IBW, and 3 who could not continue the post-discharge weight follow-up; 1 patient discontinued inpatient treatment, another was transferred to a different hospital on discharge, and the third declined the post-discharge weight measurement.

The remaining 60 patients who met the inclusion criteria were thus enrolled and analyzed as the inclusive analysis set. Among these patients, 27 discontinued the 1-year follow-up after discharge: 17 patients were readmitted to the hospital after discharge, 6 discontinued their hospital visits, 2 were transferred to a different hospital, 1 concluded outpatient therapy after achieving complete recovery, and 1 concluded outpatient therapy due to the family's request. The other 33 patients were enrolled and analyzed as the complete analysis set (Fig. 1).

Inpatient treatment

Inpatient treatment was provided in a closed unit of the Center's child psychiatry ward. The treatment team for a child consisted of two child psychiatrists, a psychologist, two/three nurses, a psychiatric social worker, and a dietician. A multidisciplinary approach [28, 29] was adopted by these professionals to establish a therapeutic relationship, diagnosis and assessment, psychoeducation, nutritional guidance, food records, re-nutritional therapy using behavioral restriction for overactive patients, and supportive psychotherapy. The psychiatrists met with patients twice weekly to discuss treatment plans and regularly interviewed family members to share the treatment process.

Nurses provided dietary and lifestyle care and explained the treatment progress to the patient and family members at least three times during each stage of treatment. Psychologists conducted both individual and group psychotherapy on a weekly basis. Psychiatric social workers collaborated

with patients' schoolteachers to provide social support for their return to school after discharge. The dietitians provided nutritional guidance on the ward. Re-nutritional therapy was based on the individual patient's oral nutrition, and tube feeding was used if oral intake was not possible.

Measurements

The primary outcome of this study was the change in the percentage of ideal body weight (%IBW) that had been achieved by the patients 1 year after their discharge (T0: discharge, T12: 12 month post-discharge). The secondary outcome was the monthly %IBW values from 1 to 12 month post-discharge (T1–T12). Given that ARFID and typical AN are considered fundamentally distinct pathologies, and that the sample size for ARFID was insufficient for statistically meaningful analyses, we conducted a subgroup analysis focusing exclusively on AN patients, excluding those with ARFID.

Sociodemographic and clinical characteristics

To identify potential confounding factors in our analyses, we examined the following sociodemographic and clinical characteristics of the patients: age at admission, gender, family environment (whether living with biological parents or not), classification of eating disorder (AN, ARFID), presence of psychiatric comorbidities, presence of binge eating, presence of excessive exercise, duration of hospital stay, %IBW on admission, %IBW at T0, %IBW at T12, rate of weight gain (kg/week), the use of gastric tube (GT) feeding, and rehospitalization. Psychiatric comorbidities were diagnosed based on the DSM-5 criteria, and the diagnosis was made by the psychiatrists in charge.

Percent of ideal body weight (%IBW)

The percent of IBW was calculated using the formula (100 × patient weight/standard weight), with standard weight based on the criteria issued by the Japan Pediatric Endocrine Society [30]. Patients were defined as having low body weight if their %IBW was < 85%, in accord with the Hirata method commonly used in Japan to evaluate pediatric physiques.

Statistical analyses

Single and multiple regression analyses, a two-way analysis of variance (ANOVA) in a mixed model, and a Cox proportional hazards model were performed using SPSS for Windows ver. 27.0 (IBM, Chicago, IL, USA). The analysis to determine the receiver operating characteristic (ROC) curve was performed using R software (ver. 4.4.1) and R Studio (2024.09.0 + 375) (The R Foundation, Vienna, Austria). All analyses were performed with the significance levels of $p < 0.05$, $p < 0.01$, $p < 0.001$.

Complete analysis set

Single and multiple regression analyses were performed to identify the factors associated with the standard weight ratio at T12. Twelve factors were used as explanatory variables: age, gender, family environment (whether living with biological parents or not), diagnosis of AN or ARFID, psychiatric comorbidities, presence of binge eating, presence of excessive exercise, duration of hospital stay (days), %IBW on admission and at T0, rate of weight gain (kg/week), the use of GT feeding during hospitalization. The ROC curve was used to determine the appropriate %IBW at T0 that predicted 90% of IBW at T12, which is the goal of ED treatment. In addition, we conducted the same analysis using a subgroup consisting solely of AN patients.

Inclusive analysis set

Based on the threshold of %IBW at discharge calculated by the ROC curve in the complete analysis set, we classified the patients into two groups: a low-weight group and a high-weight group. These two groups were compared by a two-way ANOVA in a mixed model to assess changes in the %IBW at each point of admission and T0–T12. The trend in %IBW per month from T0 to T12 was evaluated with the use of the estimated marginal means, calculated using a mixed model. This was performed to provide adjusted means for the two groups and to compare the groups with missing values. In addition, we conducted the same analysis using a subgroup consisting solely of AN patients.

We used a Cox proportional hazards model with variables selected by forward-stepwise selection to examine the predictors of time to readmission and the related confounding factors: age at admission, gender, family environment (whether living with biological parents), classification of eating disorders (AN, ARFID), presence of psychiatric comorbidities, presence of binge eating, presence of excessive exercise, duration of hospital stay, %IBW on admission and at T0, rate of weight gain, and the use of GT feeding.

Ethical considerations

This study was approved by the Ethics Review Committee of Jichi Medical University. The opt-out document was posted on the websites of the Department of Psychiatry and Department of Children's Mental Health at Jichi Medical University to notify and provide the opportunity to refuse permission for eligible patients to participate in the study.

Results

Table 1 summarizes the baseline clinical characteristics of the complete and inclusive analysis sets. Among the 60 patients in the inclusive analyses set, 95% were female, and 81.7% were diagnosed with AN. The average age at admission was 12.8 years, and the average duration of hospital stay was 90.8 days. The average %IBW values at admission and T0 were 72.5% and 84.9%, respectively.

Complete analysis set

Among the 33 patients in the complete analysis set (Table 1), 90.9% were female, and 78.8% were diagnosed with AN. The average %IBW increased from 72.4% at admission to 87.6% at T0 and to 91.6% at T12. In the single regression analysis conducted to identify factors associated with %IBW at T12, only the %IBW at T0 was significant ($p < 0.01$). In a stepwise selection, the multiple regression analysis demonstrated that only the %IBW at T0 was significantly predictive of %IBW at T12 ($p < 0.01$) (Table 2). In addition, even after adjusting for diagnosis, only %IBW at T0 remained a significant predictor of %IBW at T12 ($p < 0.001$).

Table 1 Baseline clinical characteristics of the patients with EDs after hospitalization

	Complete analysis set	Inclusive analysis set			
	Total $n=33$	Total $n=60$	Low-weight: %IBW < 86.4% $n=30$	High-weight: %IBW ≥ 86.4% $n=30$	p value (χ^2- or t test)
Female	30 (90.9)	57 (95.0)	27 (90.0)	30 (100.0)	0.12
Age at admission, years	11.8 ± 1.8 (8.0–15.0)	12.8 ± 1.8 (8.3–15.7)	13.2 ± 1.9 (8.3–15.7)	12.4 ± 1.6 (9.6–14.5)	0.49
Living with biological parents	27 (81.8)	46 (76.7)	23 (76.7)	23 (76.7)	1.00
Diagnosis, anorexia nervosa	26 (78.8)	49 (81.7)	22 (73.3)	27 (90.0)	0.10
Psychiatric comorbidity	15 (45.5)	21 (35.0)	9 (30.0)	12 (40.0)	0.42
ASD	12 (36.4)	15 (25.0)	5 (16.7)	10 (33.3)	0.14
ADHD	2 (6.1)	2 (3.3)	1 (3.3)	1 (3.3)	0.75
Other psychiatric comorbidities	12 [†](36.4)	16[#] (26.7)	6 (20.0)	10 (33.3)	0.24
Binge eating	1 (3.0)	2 (3.3)	1 (3.3)	1 (3.3)	0.75
Excessive exercise	14 (42.4)	23 (38.3)	8 (26.7)	15 (50.0)	0.06
Duration of hospital stay, days	92.0 ± 42.8 (14.0–175.0)	90.8 ± 56.3 (4.0–268.0)	58.7 ± 44.6 (4.0–173.0)	122.8 ± 48.3 (42.0–268.0)	< 0.001*
%IBW on admission	72.4 ± 6.1 (60.9–84.2)	72.5 ± 6.0 (54.8–84.2)	72.7 ± 6.1 (54.8–84.2)	72.3 ± 6.0 (60.9–83.2)	0.77
%IBW at discharge	87.6 ± 10.5 (65.4–117.4)	84.9 ± 10.7 (54.3–117.4)	76.5 ± 6.8 (54.3–85.1)	93.4 ± 6.1 (87.2–117.4)	< 0.001*
%IBW at 1-year follow up	91.6 ± 13.4 (68.3–133.1)	91.6 ± 13.4 (68.3–133.1) ($n=33$)	83.6 ± 8.9 (68.3–100.8) ($n=13$)	96.9 ± 13.5 (75.0–133.1) ($n=20$)	< 0.01*
Rate of weight gain, kg/week	0.46 ± 0.28 (− 0.15 to 0.93)	0.39 ± 0.4 (− 1.23 to 1.53)	0.23 ± 0.5 (− 1.22 to 1.53)	0.54 ± 0.18 (0.13–0.92)	< 0.01*
Gastric tube feeding treatment	12 (36.4)	23 (38.3)	9 (30.0)	14 (46.7)	0.18
Readmission		17(28.3)	10 (33.3)	7 (23.3)	0.39
Interruption of hospital visits		6 (10.0)	4 (13.3)	2 (6.7)	0.34
Transfer of hospital or conclusion of therapy		4 (6.7)	3 (10.0)	1 (3.3)	0.31

The data are n (%) or mean ± SD (range)

†Includes adjustment disorder ($n=9$), mental retardation ($n=1$), selective mutism ($n=2$). [#]Includes adjustment disorder ($n=13$), mental retardation ($n=1$), selective mutism ($n=2$). *Statistically significant at $p < 0.05$

%IBW percentage of ideal body weight (body weight/expected ideal body weight), *ADHD* attention deficit/hyperactivity disorder, *ASD* autistic spectrum disorder, *EDs* eating disorders

Table 2 Single and multiple regression analyses of the complete analysis set (33 patients) to identify factors associated with the %IBW at 1 year after discharge

Simple regression analysis Objective variable: the %IBW at 1 yr after discharge		
	B (95%CI)	*p* value
Age	−0.88 (−3.54 to 1.78)	0.51
Female	6.00 (−10.75 to 22.69)	0.47
Diagnosis, anorexia nervosa	1.18 (−10.67 to 13.03)	0.84
Psychiatric comorbidities†	1.74 (−7.98 to 11.45)	0.72
Binge eating	−8.07 (−36.19 to 20.06)	0.56
Excessive exercise	5.38 (−4.23 to 14.99)	0.26
Duration of hospital stay, days	0.07 (−0.04 to 0.19)	0.19
%IBW on admission	0.74 (−0.03–1.51)	0.06
%IBW at discharge	0.67 (0.26–1.07)	<0.01*
Rate of weight gain, kg/week	9.30 (−8.06 to 26.65)	0.28
Gastric tube treatment	0.21 (−9.87 to 10.28)	0.97
Living with biological parents	1.03 (−11.53 to 13.59)	0.87
Multiple regression analysis (stepwise method) Objective variable: the %IBW at 1 yr after discharge		
	B (95%CI)	*p* value
%IBW at discharge	0.67 (0.26–1.07)	<0.01*

†Includes autistic spectrum disorder, attention deficit/hyperactivity disorder, adjustment disorder, mental retardation, and selective mutism. *Statistically significant at $p < 0.05$

%IBW Percentage of ideal body weight (body weight/expected ideal body weight), *B* partial regression coefficient

To determine the %IBW at T0 that surpassed 90%IBW at T12, we plotted the ROC curve using the %IBW at T0. The demarcation value for the %IBW at T0 was 86.40% (sensitivity, 82.4%; specificity, 62.5%) (Fig. 2). In the ROC curve analysis conducted on the subgroup of AN patients within the complete analysis set, the demarcation value was 86.41 (sensitivity, 100%; specificity, 53.8%), which closely matched the results obtained for the entire complete analysis set.

Inclusive analysis set

Based on the 86.4%IBW at T0 value that predicted 90% of IBW at T12 in the ROC curve, we divided patients into low- and high-weight groups at T0. As shown in Table 1, 30 patients were classified into each group. There were no significant differences in gender, age, family environment, diagnosis, psychiatric comorbidity, binge eating, excessive exercise, GT feeding, or %IBW at admission between groups. The %IBW at T12 was significantly different: 96.9 ± 13.5% in the high-weight group and 83.6 ± 8.9% in the low-weight group ($p < 0.01$). The duration of hospital stay was approx. 2 months in the low-weight group and 4 months in the high-weight group, which was also a significant difference ($p < 0.001$). The rate of weight gain differed significantly

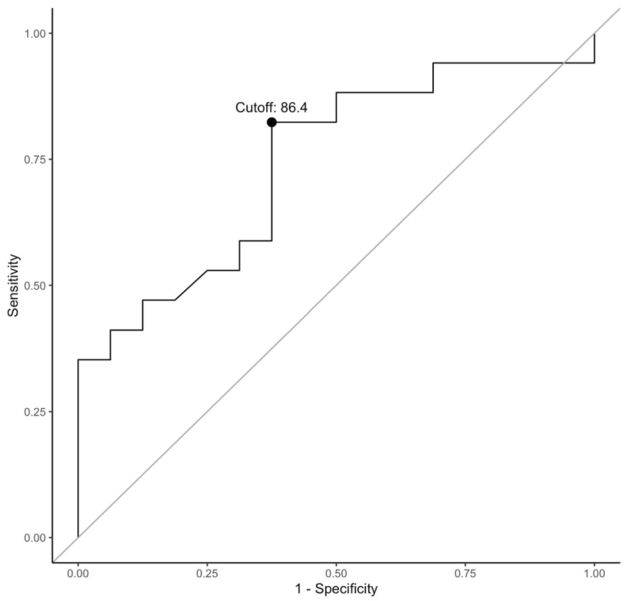


Fig. 2 Receiver operating characteristic curve to determine the percent of ideal body weight (%IBW) at discharge that surpasses 90%IBW at 1 year after discharge

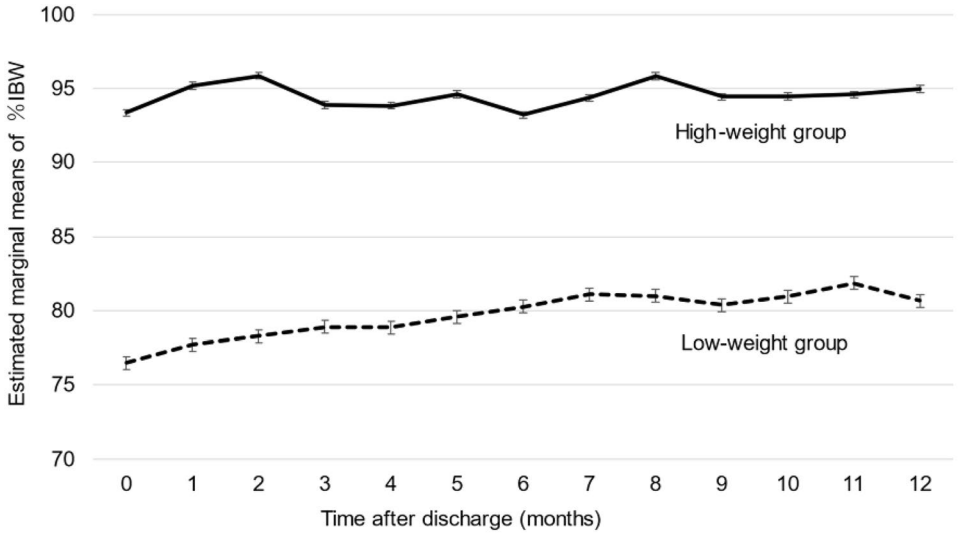
between the high-weight (0.54 ± 0.18 kg/week) and low-weight (0.23 ± 0.5 kg/week) groups ($p < 0.01$).

Figure 3 shows %IBW trends for both groups. Two-way ANOVA with a mixed model revealed significantly greater %IBW change in the high-weight group ($p < 0.001$). No significant time effects on %IBW from T0 to T12 were found in either group ($p > 0.05$), and no interaction between groups over time ($p > 0.05$). %IBW was maintained in both groups from T0 to T12. In the low-weight group, estimated marginal mean %IBW never exceeded 85% throughout T0 to T12. The results were consistent in the analysis conducted on the subgroup of AN patients (group, $p < 0.001$; time, $p > 0.05$; interaction, $p > 0.05$). Readmission in both groups occurred within 5 months after discharge. We used a Cox proportional hazards model to estimate the hazard ratio (HR) and 95% confidence interval (CI) for time to readmission. By forward-stepwise selection, the %IBW at T0 ($p < 0.001$, HR 0.877, 95%CI 0.822–0.936) and duration of hospital stay ($p < 0.001$, HR 1.017, 95%CI 1.007–1.027) were selected as significant predictors of rehospitalization. In addition, even after adjusting for the diagnosis, only %IBW at T0 and duration of hospital stay remained significant predictors (%IBW at T0, $p < 0.001$; duration of hospital stay, $p < 0.001$).

Discussion

This study focused on the association between weight gain during inpatient treatment and prognosis in patients with childhood-onset and first-episode EDs. The 1-year follow-up of weight and recurrence after inpatient treatment revealed that their weight at discharge was a factor influencing the 1-year prognosis. A previous study in adolescents showed that early weight gain predicts remission [19]. Similarly, in this study, no factor other than weight at discharge was associated with the %IBW at 1-year after discharge. A 1% IBW increase in weight at discharge predicted a 0.67% IBW increase in weight at 1-year post-discharge (Table 2). Although a high rate of weight gain (0.8 kg/week [12], 1.05 kg/week [31]) has been associated with better prognosis, in our patient series, where the weight gain rate was slower (0.46 ± 0.28 kg/week), the final weight at discharge had a greater impact on 1-year prognosis than the rate of weight gain. Our findings indicate that even if a patient's hospitalization is prolonged, sufficient weight gain contributes to a better prognosis.

The results of this study suggest that an IBW ≥ 86.4% is an appropriate indicator of the target weight at discharge. By performing an ROC curve analysis, we estimated that the weight at discharge to reach 90%IBW at 1 year after discharge (the final target weight at which ROM was obtained) is 86.4% (Fig. 2). The trend of the estimated marginal mean %IBW revealed that the %IBW at discharge was maintained at the 1-year follow-up in both the high- and low-weight groups. In the low-weight group (discharge weight < 86.4%IBW), the estimated marginal mean %IBW increased by only 4.6% in the first year after discharge and did not exceed 85% throughout the year (Fig. 3). As previously reported, failure to achieve weight gain during inpatient treatment increases the risk of rehospitalization [31]. The Cox proportional hazards model showed that the time to readmission was significantly correlated with the %IBW



	Group	Time	Group*Time
F	153.8	1.1	0.9
P	<0.001*	0.36	0.53

Fig. 3 Estimated marginal means of %IBW for the high- and low-weight groups calculated using a mixed model. Statistical significance was determined at $p < 0.05$

at discharge. The cumulative readmission rates for the low- and high-weight groups were 33.3% and 23.3%, respectively, indicating that the risk of readmission was approximately 1.4 times higher in the low-weight group. When converted to BMI percentiles for each age group, the proposed target weight of 86.4%IBW corresponded approximately to the 20th percentile for 12 years, the 22nd percentile for 13 years, and the 15th percentile for 14 years.

Several research groups have discussed the neurophysiological and neuropsychological aspects of the process of recovery from EDs. Waples noted that > 85%IBW weight gain in the treatment of AN improved cognitive function, depression, and anxiety [32]. It is known clinically that patients discharged at < 90%IBW tend to relapse easily because of a lack of improvement in cognitive impairment, such as fear of gaining weight and body image disturbance [33]. The final target weight for individuals with an ED is 90%IBW; at that level, female hormones reach a normal dynamic state, the patients thus reach ROM [16, 25–27] and cognitive impairments may normalize as a result of normalized estrogen [15, 16]. In summary, it is suggested that when the %IBW is around 85%, several neurophysiological and neuropsychological functions can recover, whereas when the %IBW achieved is > 90%, most functions recover. Based on our findings, we propose 86.4%IBW as the discharge target weight, which represents an optimal goal for supporting full recovery. In the low-weight group (discharge weight < 86.4%IBW), most patients had insufficient neurophysiological and neuropsychological recovery, which may have led to the failure of weight recovery by the 1-year follow-up and a high readmission rate.

Our low-weight group had a higher frequency of readmission, and the readmissions occurred earlier than in the high-weight group. Readmissions in both groups occurred within 5 months of discharge. This is consistent with a systematic review which showed that the risk of recurrence of EDs is especially high within 3–12 months after discharge [23]. On the other hand, Walsh et al. reported that the rate of relapse peaked within 2 month post-discharge and progressively decreased over time [24]. In the present study, the readmission rate in the low-weight group peaked at 2 months after discharge, whereas the readmissions in the high-weight group occurred later and without making a peak, suggesting that early phase readmission was avoided in these patients.

Although sufficient weight gain during inpatient treatment improved the patients' prognoses at 1-year post-discharge, a longer hospital stay was required. The patients in the high-weight group needed to stay approx. 2 months longer in the hospital compared to those in the low-weight group (Table 1). Prolonged hospitalization leads to a loss of social life experiences which has an impact on school-aged patients, and it also increases medical expenses. However, given that insufficient weight gain is associated with later psychosocial and healthcare economy losses due to readmission, the amount of these total losses might be diminished by a longer initial hospitalization.

Study strengths and limits

This study has several strengths. The most significant is that it provides a target discharge weight for inpatient care. It is also notable for focusing on young patients (8.3–15.7 years) and the first inpatient treatment conducted shortly after the onset of illness, offering new insight into the initial treatment of children with EDs. In addition, we compared weight changes each month after hospital discharge between two groups: a low-weight group and a high-weight group.

Although our results concerning the prognosis during the first year after discharge provide guidance about the ideal target weight at discharge, this study has several methodological limitations. First, this study focused solely on weight as an outcome measure and did not include direct assessments of psychiatric or cognitive symptoms. This may limit our ability to comprehensively evaluate recovery from eating disorders, as we could not assess psychological improvements independently. However, given that previous studies have suggested a link between weight restoration and neuropsychological improvement, our findings may still provide indirect insights into these aspects of recovery. Second, selection bias is possible. Because the low-weight group had a lower rate of weight gain (0.23 kg/week) than the high-weight group (0.54 kg/week), it is possible that the low-weight group included more refractory and/or less motivated subjects who might have been discharged without adequate recovery. Third, we did not include cases in which the follow-up was discontinued, and it is thus possible that the readmission rate calculated could have been underestimated. Fourth, the Cox proportional hazards analysis considered only readmission as a poor prognosis without considering other outcomes. Fifth, the analysis limited to ARFID was insufficient, indicating the need for further investigation. Sixth, only half of the patients underwent follow-up evaluation, making it difficult to generalize the findings from the complete analysis set to the inclusive analysis set. A prospective randomized study on the target discharge weight, incorporating psychopathological assessments, is required to validate our findings.

What is already known on this subject?

- Restoring weight as soon as possible after the onset of EDs can prevent prolonged duration of illness and late sequelae.
- Inpatient treatment is effective for re-nutrition and weight restoration in patients with severely low body weight,

but it was reported that many patients do not achieve full remission, drop out of treatment, or experience a relapse despite receiving treatment.
- There is a consensus that the final target weight in ED treatment is 90%IBW, at which ROM is expected in most patients. This study was necessary, because there is no consensus on the optimal target weight for discharge during the hospitalization of pediatric patients with EDs.

What does this study add?

This study provides insights into the first inpatient treatment after the onset of eating disorders in children. Our analyses revealed that discharging patients at a higher weight is associated with improved weight recovery and a reduced risk of rehospitalization. In addition, a target discharge weight of 86.4%IBW may serve as an effective criterion for children with EDs. These findings may help prevent prolonged and recurrent undernutrition, low body weight, and subsequent physical and mental complications in children experiencing their first episode of an ED.

Conclusion

The results of this investigation demonstrated that (*i*) high weight at discharge leads to more weight gain and reduced rehospitalization risks after discharge and (*ii*) 86.4%IBW may be an appropriate target weight at discharge for ED inpatient treatment. In children with a first-episode ED, recovery to an appropriate target weight in the initial inpatient treatment may prevent prolonged and recurrent undernutrition and low body weight and prevent subsequent physical and mental late complications.

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Data availability No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate The study was approved by the Ethics Review Committee of Jichi Medical University. An opt-out document was posted on the websites of the Department of Psychiatry and the Department of Children's Mental Health at Jichi Medical University to notify and provide the opportunity to refuse permission for eligible patients to participate in the study and to publish the manuscript.

Competing interests The authors declare no competing interests.

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