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JOURNAL OF
ADOLESCENT
HEALTHwww.jahonline.org

Original article

Evaluation of a Nutrition Rehabilitation Protocol in Hospitalized Adolescents With Restrictive Eating Disorders

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Article history: Received April 11, 2013; Accepted June 1, 2013

Keywords: Anorexia nervosa; Adolescents; Nutrition; Nutrition rehabilitation protocol; Refeeding syndrome; Nutritional analysis

ABSTRACT

Purpose: Nutritional rehabilitation is an essential part of inpatient treatment for adolescents with restrictive eating disorders (ED). The purpose of this study was to examine weight gain, prevalence of refeeding syndrome, and nutritional composition of the diet in hospitalized adolescents with anorexia nervosa (AN) and eating disorder not otherwise specified (EDNOS), restrictive type, on a structured nutrition rehabilitation protocol (NRP).

Methods: An evidence-based NRP was implemented on the inpatient eating disorders unit at the Hospital for Sick Children in June 2011. Adolescents 12–18 years of age with AN or EDNOS, an ideal body weight (IBW) of 70% or greater, no clinical or metabolic signs of refeeding syndrome, and on their first admission were assigned to the NRP. A retrospective chart review between June 2011 and June 2012 was completed. A repeated measures analysis was used to determine the mean rate of weight gain. Mean cumulative % change in body mass index (BMI) was plotted against days to assess daily weight trajectory.

Results: Twenty-nine patients, mean age of 14.7 (SD ± 1.5) years, were included in the study. A total of 3.5% developed hypophosphatemia on day 1. Mean weight gain was .24 kg/day ($p < .0001$) and 1.7 kg/week. An increase in mean cumulative % change in BMI was observed from days 2–14. Actual caloric intake was 98%–113% of the prescribed intake. Macronutrient distribution was within acceptable limits based on dietary reference intakes.

Conclusions: The NRP is considered effective, efficient, and safe. Further research is needed to explore the effectiveness and safety of NRPs in other populations.

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IMPLICATIONS AND CONTRIBUTION

This study evaluated a newly developed nutrition rehabilitation protocol in 29 hospitalized adolescents with anorexia nervosa and eating disorder not otherwise specified, restrictive type, and demonstrated a mean weight gain of 1.7 kg/week with minimal adverse events. The study supports an efficient, effective, and safe approach to oral nutritional rehabilitation in this population.

The authors of this manuscript have no potential, perceived, or real conflict of interest. All authors were involved in writing the first draft of the manuscript. There was no honorarium, grant, or other form of payment given to anyone to produce the manuscript.

Poster presentation at Eating Disorders Association of Canada 3rd Biennial Conference in Halifax, Nova Scotia, Canada, October 11–12, 2012.

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Nutritional rehabilitation is an essential component of inpatient treatment for underweight or medically compromised adolescents with anorexia nervosa (AN) [1]. The goals of nutritional rehabilitation are to restore weight, normalize eating patterns, and correct the physical and psychological complications of malnutrition [1–7]. However, one of the medical complications that can occur when reintroducing nutrition for severely malnourished patients is refeeding syndrome. Refeeding

syndrome is described as the potentially life-threatening shift in fluid and electrolytes (particularly phosphate) from the extracellular to intracellular spaces upon refeeding [8]. Therefore, one of the main concerns when initiating nutrition for adolescents with AN and eating disorder not otherwise specified (EDNOS), restrictive type, is to minimize or prevent refeeding syndrome from occurring.

There are currently no published data on the most effective inpatient method of refeeding adolescents with AN or EDNOS, restrictive type. Current practice for nutritional rehabilitation in adolescents is based primarily on experience and general consensus [9,10]. Nutritional guidelines are based on the premise of starting nutrition at a low caloric level and increasing slowly to avoid refeeding syndrome. However, there is recent evidence to suggest that if patients' nutrition is started at a low-energy intake and advanced too slowly, they may develop "underfeeding syndrome," which can also result in severe complications, including death [9]. Further, refeeding slowly also delays medical stabilization and lengthens hospital stay [11].

Because of this lack of scientific evidence and risks of under- and overfeeding, researchers have started to investigate feeding regimes in hospitalized adolescents with AN. Garber et al. [11] used a conservative oral refeeding protocol with 35 subjects and found a weight loss trend in the first week of admission. Eighty-three percent of patients initially lost weight on the protocol and weight gain was not seen until protocol day 8. Nutrition was initiated at a mean intake of 1,205 kcal/d (range of 800–2200 kcal/day) depending on the 24-hour recall and advanced by 200 kcal every other day. Twenty percent of patients had low serum phosphorus and received supplementation. Garber et al. [11] concluded that more aggressive feeding protocols are required for adolescents with AN to encourage faster and more consistent weight gain to stabilize patients as well as shorten hospital stays.

In contrast, a retrospective chart review by Whitelaw et al. [12] demonstrated that using an aggressive oral refeeding approach, initiating nutrition at a minimum of 1,900 kcal/d and increasing up to 2,200 kcal on day 3 and 2,700 kcal on day 5 (with further increments of 300 kcal as required) resulted in appropriate weight gain, but 37% of patients required phosphate supplementation for hypophosphatemia.

Based on the current literature, the Eating Disorders Program at the Hospital for Sick Children (SickKids) developed and evaluated an oral nutrition rehabilitation protocol (NRP) (Figure 1) [1–12]. The purpose of this study was to examine the rate of weight gain, the prevalence of refeeding syndrome, and nutritionally analyze the prescribed oral diet in hospitalized adolescents with AN and EDNOS, restrictive type, on a structured NRP during the first 2 weeks of hospitalization on a specialized pediatric eating disorder ward.

Methods

Study setting and design

The NRP was implemented in June 2011 on the eating disorders inpatient unit at SickKids. A retrospective chart review was completed on all inpatients who were started on the NRP between June 2011 and June 2012. Initial descriptive data were collected from their first full day of admission (day 1).

Subjects

Subjects included adolescents between 12 and 18 years of age who met the strict Diagnostic and Statistical Manual for Mental Disorders, Fourth Edition (DSM-IV) criteria for AN or EDNOS (restrictive type), were medically unstable as defined by the criteria outlined in the Society for Adolescent Health and Medicine position paper on adolescent eating disorders [1] and were on their first hospital admission. Patients were excluded from the NRP if they were below 70% of their ideal body weight (IBW) or had any clinical or metabolic signs of refeeding syndrome on admission. IBW was determined for each patient using the patient's history of weight and height plotted on the Centers for Disease Control and Prevention (CDC) growth curves, 50th percentile body mass index (BMI)-for-age using the CDC growth curves, menstrual threshold weight, and body composition values.

A total of 98 patients were admitted to the inpatient eating disorders program between June 2011 and June 2012. Of these patients, 29 participated in this study. The remaining patients were excluded because they were under the age of 12 ($n = 21$); were below 70% of their IBW ($n = 11$); had a previous hospital admission ($n = 23$); did not meet the DSM-IV criteria for AN or EDNOS, restrictive type ($n = 3$); were mistakenly not started on the NRP ($n = 6$); or the clinicians did not correctly follow the NRP as delineated ($n = 5$).

This study was reviewed and approved by the Research Ethics Board at SickKids.

Inpatient nutrition rehabilitation protocol

An evidence-based NRP was developed and implemented on the inpatient eating disorders unit at SickKids in June 2011 [1–12]. The NRP was initiated on the first full day of admission at 1,500 kcal, with three meals and three snacks, each 250 kcal. All meals and snacks were provided as food and taken orally. The prescribed nutrition was advanced 250 kcal on days 2 and 3 and 250 kcal every other day up until day 7 when the patient was receiving 2,500 kcal per day (Figure 1). Thereafter, nutrition was increased as required based on a minimum weight gain of 1.0 kg per week; nutritional increases were given for maintenance of weight or weight loss in increments of 250 kcal. Inpatients were supported through all meals and snacks by parents with the support of frontline staff or by frontline staff alone. An oral nutritionally complete liquid supplement was given to replace a food item that was refused (total caloric equivalent replacement). The protocol required that any subject needing nasogastric supplementation was to be removed from the study.

Patients were placed on set nonselective menus during the first 2 weeks of admission. Nonselect menus are predetermined menus based on energy (kcal) and food group requirements. These set menus were analyzed for macronutrient composition using Computrition Hospitality Suite NCM Select software v.17.5 (Computrition, Inc, Chatsworth, CA). Calcium, vitamin D, and a multivitamin were provided to all patients as part of standard treatment (Figure 1).

During the first 2 weeks of hospitalization, patients were either on bed rest or participated in minimal activity, which included walking to and from meals and therapeutic groups on the inpatient unit.

Data collection

Data were collected from a retrospective review of patients' medical records. Dietitians (A.L., T.T., and K.S.) reviewed the charts

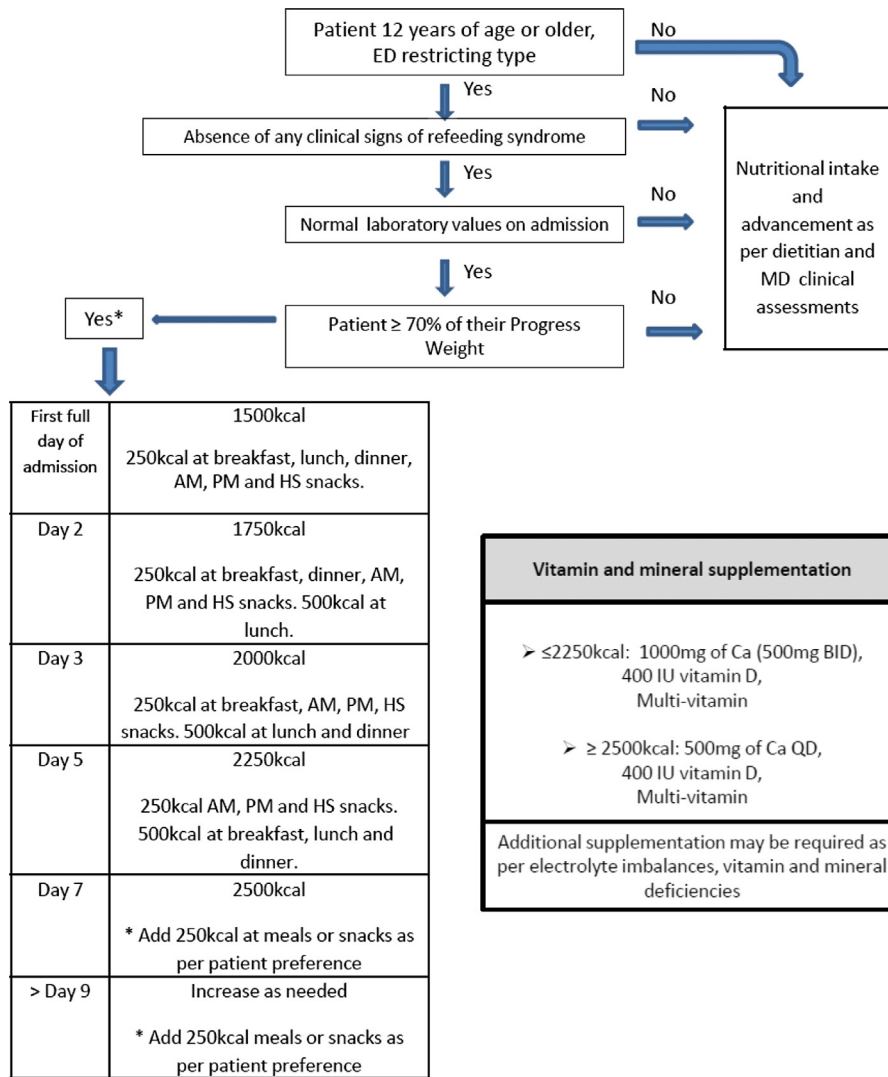


Figure 1. Nutrition rehabilitation protocol (developed June 2011). AM = morning; BID = twice daily; Ca = calcium; ED = eating disorder; EKG = electrocardiogram; HS = evening; IU = international units; kcal = kilocalories; MD = pediatrician; PM = afternoon; QD = once daily. *This protocol assumes that there will be a daily medical assessment with laboratory evaluation and EKGs as clinically indicated. If there are any signs of refeeding syndrome, the medical team (in consultation with the dietitian) will make daily nutritional recommendations.

to retrieve data on relevant demographic, diagnostic, clinical, and anthropometric variables for the first 2 weeks of admission. Descriptive data included age, gender, diagnosis, weight, height, BMI, reason for admission, length of admission, and menstrual status (Table 1).

A patient's weight was measured in a gown each morning after voiding and before consuming any food or liquids. Weight was measured in kilograms using an electronic scale (Health o meter Bridgeview, IL; model 592KLS). Height was measured at admission in centimeters using a wall-mounted stadiometer (SECA, Hanover, MD; model 216 1814009). Vital signs (orthostatic blood pressure and heart rate) were recorded daily for the duration of the admission (every 4 hours when medically unstable [1] and every 12 hours when medically stable). Blood work (serum electrolytes, blood urea nitrogen, and creatinine) was monitored daily for the first week of refeeding. Fluid intake and output were measured daily during admission.

Assessing interrater agreement was an important component of chart abstraction to ensure the precision of data collected. Each of the three dietitians (A.L., T.T., and K.S.) reviewed 9–10 charts. A different dietitian did a second review of the 9–10 charts. The second abstraction of the identified variables was compared for agreement. There was 95% agreement.

Statistical methods

Statistical analysis included repeated measures analysis, with time (days) as a linear continuous variable using mixed analysis procedure in SAS version 9.3 to determine the mean rate of weight gain. Mean cumulative % change in BMI was plotted against days to assess daily weight trajectory. Fluid balance was defined as total input minus total output in milliliters over each 24-hour period and plotted on a box plot. Nutritional analysis of the prescribed diets from day 1 to day 7 (1,500–2,500 kcal) was

Table 1

Clinical data on patient population (N = 29)

Clinical data	Mean or percent (SD)
Age (y)	14.7 (1.5)
Female	75.9%
BMI on admission (kg/m ²)	16.4 (1.7)
BMI range on admission (kg/m ²)	13.7–20.3
% IBW on admission	75.8 (5.4)
Diagnosis	
AN-R	79.3%
AN-BP	3.4%
EDNOS-R	17.2%
Reason for admission ^a	
Bradycardia	58%
Significant weight loss	48%
Hypotension	7%
Rehydration	7%
Amenorrhea (N = 16)	
1°	12.5%
2°	87.5%
Length of admission (days)	35.8 (13.0)

AN-BP = anorexia nervosa, binge-purge type; AN-R = anorexia nervosa, restrictive type; BMI = body mass index; EDNOS-R = eating disorder not otherwise specified, restrictive type; IBW = ideal body weight; SD = standard deviation.

^a Subjects may have had more than one reason for admission.

completed using the Computrition Hospitality Suite NCM Select software. Mean daily intakes of macronutrients were tabulated.

Results

Twenty-nine patients with a mean (SD) age of 14.7 (1.5) years were put on the NRP between June 2011 and June 2012. Baseline demographic and clinical data are found in Table 1.

Medical stability

Subjects (n = 28) were hospitalized for a mean (SD) duration of 35.8 (13.0) days and medical stability was achieved on mean (SD) day 14.3 (9.7). Medical stabilization was defined according to the Society for Adolescent Health and Medicine position paper [1]. None of the subjects required nasogastric feedings. One patient was excluded from analysis because she left the hospital before becoming medically stable. Of the 29 participants, only one had a low serum phosphate that required oral supplementation on day 1 of the protocol. No further electrolyte imbalances or clinical signs or symptoms of refeeding syndrome were observed [8].

Rate of weight gain and mean percent change in BMI trajectory

Patients showed significant weight gain, at a rate of .24 kg/day ($p < .0001$) while on the NRP. Cumulative percentage change in BMI over 14 days demonstrated sustained daily weight gain from day 2 to day 14, with average weight restoration of 1.7 kg per week (Figure 2).

Fluid balance

Fluid balance in milliliters was calculated each day for the first 14 days of admission using documented fluid intake and urinary output (n = 27). Two of the patients did not have accurate recordings and were therefore excluded from this specific analysis. Because the patients were found to be euvoletic, weight gain was not thought to be due to fluid shifts (Figure 3).

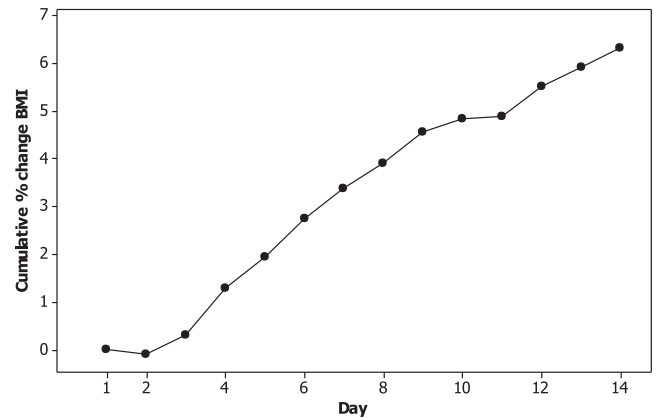


Figure 2. Mean cumulative % change in body mass index (BMI) per day (N = 29). Cumulative weight gain from day 1 (considered first full day of admission) was observed from day 2 onward.

Nutritional analysis

The nutritional analysis revealed that the prescribed diets (1,500–2,500 kcal) compared with the actual caloric intake ranged from 1,698 kcal (113.2%) to 2,444 kcal (97.8%). Furthermore, the average macronutrient distribution of the nonselective meals and snack system was found to be in accordance with the Dietary Reference Intakes recommendations [13] for Acceptable Macronutrient Distribution Ranges (AMDR) for children ages 4–18 (Table 2).

Discussion

Hospitalized euvoletic adolescents with AN and EDNOS, restricting type, demonstrated steady and sustained weight gain from day 2 through day 14 of their hospital admission while on a standardized NRP that started at 1,500 kcal/day, advanced 250 kcal on days 2 and 3, and 250 kcal every other day up until day 7. On average, weight increased by .24 kg per day or 1.7 kg per week. These findings suggest that this NRP is efficient and effective at weight restoration in hospitalized adolescents with AN and EDNOS, restricting subtype, who are age 12 years or older, whose body weight is 70% of IBW or greater, and who does not have any clinical or laboratory signs of refeeding on admission.

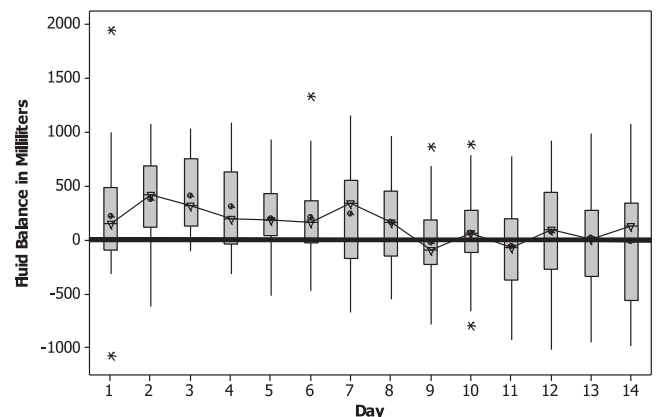


Figure 3. Daily fluid balance over 14 days (N = 27). Circle = mean; triangle = median.

Table 2
Nutritional analysis of meals and snacks

Energy intake			Macronutrient distribution (% kcal)		
Prescribed diet (kcal)	Actual kcal received	% prescribed vs. received	Protein (10%–30%) ^a	Fat (25%–35%) ^b	Carbohydrate (45%–65%) ^c
1,500	1,698	113.2	16.0	31.0	53.0
1,750	1,862	106.4	15.0	29.2	56.0
2,000	2,077	104.0	16.0	29.0	55.0
2,250	2,270	101.0	15.5	28.0	56.5
2,500	2,444	97.8	15.0	29.0	56.0

^a Recommended percentage of total daily energy (kcal) for protein as defined by the Acceptable Macronutrient Distribution Ranges (AMDR) [12].

^b Recommended percentage of total daily energy (kcal) for fat as defined by the AMDR [12].

^c Recommended percentage of total daily energy (kcal) for carbohydrate as defined by the AMDR [12].

Only one patient (3.5%) developed hypophosphatemia requiring supplementation while on the NRP. No other clinical or metabolic signs of refeeding syndrome were observed. In contrast, Garber et al. [11] concluded that initiating nutrition at 1,200 kcal was too conservative to produce a rapid significant weight gain, and 20% of the patients required phosphate supplementation. Further, Whitelaw et al. [12] demonstrated that initiating nutrition at 1,900 kcal and attaining 2,400 kcal by day 5 was effective for weight restoration; however, 37% required phosphate supplementation. The NRP in this study demonstrated effective and safe weight gain with only 3.5% of the study population requiring minimal supplementation.

This is the first study to use a NRP with advancing kcal using food alone and to also examine the macronutrient distribution of patients' daily intake. The NRP started at 1,500 kcal/d as food and increased at regular, rapid intervals producing a safe rate of weight gain in our patients with restrictive eating disorders. A challenge with using all food to refeed patients, however, is that the exact amount of calories and the percentage of macronutrients are not always known. To examine this issue, we analyzed the calorie content and percent of macronutrients in the nonselect menu cycle from 1,500- to 2,500-kcal diets. The caloric analysis of the nonselect menus fell between 97.8% and 113.2% of the predicted set menu calories. The nutritional analysis of the NRP revealed that the percentage of carbohydrates, fat, and protein fell within the AMDR appropriate for age, supporting the safety and efficacy of this macronutrient distribution when refeeding this population (Table 2). According to the National Academy of Sciences [13], the AMDR is associated with reduced risk for chronic diseases, while providing essential vitamins and minerals.

The benefits of using all food to refeed inpatients with eating disorders not only includes balancing the macronutrient intake, but helps to acclimatize individuals to eating at regular intervals with variations in quantity and quality of food. We were able to introduce challenging foods earlier and help patients with fears around food items and food selection.

A limitation of the NRP was that a relatively small number of patients met the criteria for this study. Over the course of 12 months, 29 patients were put on the protocol and followed it as outlined. Eleven additional patients met the inclusion criteria for the study, but five of these patients were started on the NRP and not advanced according to the protocol and six of these patients were mistakenly not started on the NRP. More consistent clinician education and monitoring when implementing a new protocol could have resulted in a larger sample size.

This study supports a more aggressive approach to nutritional rehabilitation with macronutrients in keeping with ADMR for hospitalized adolescents in patients who are 12–18 years of age with restrictive eating disorders and who are greater than 70% of their IBW. The NRP resulted in a consistent and safe increase in weight with negligible adverse effects observed. Efficient, effective, and safe NRP has the potential to result in shorter hospital stays and the initiation of evidence-based treatments sooner. Further, decreased length of stay can also result in less disruption to the adolescent's family, education, and social life and reduced costly inpatient stays.

Further research is required into the effectiveness of nutritional rehabilitation in adolescents with eating disorders to establish an evidence base for best practice. Clinical trials that explore other NRPs that maximize safe weight gain in this population, in younger children and adolescents, and in those whose IBW is less than 70% are needed. Dietary composition, including both macronutrient and micronutrient distribution, its impact on refeeding, and the safety and efficacy with which refeeding occurs in hospitalized adolescents with eating disorders also need to be studied. Other refeeding techniques such as enteral or parenteral nutrition used alone or as adjunctive methods also need to be compared with oral nutritional rehabilitation for safety, efficacy, and tolerability.

Acknowledgments

We acknowledge Derek Stephens, M.Sc., Deirdre Snelgrove, M.A., Susan Dello, R.D., and the patients and staff in the eating disorders program at SickKids for their contributions to this project.

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