

## High-calorie refeeding in adolescents with anorexia nervosa: a narrative review

C. Roman<sup>1</sup>, R. Aglave<sup>2</sup>, S. Farine<sup>2</sup>, C. Joris<sup>1</sup>, L. Lefebvre<sup>2</sup>, F. Vermeulen<sup>1</sup>

(1) Hôpital Erasme, Hôpital Universitaire de Bruxelles (HUB), Université Libre de Bruxelles (ULB), Brussels, Belgium; (2) Department of Dietetic, Hôpital Erasme, Hôpital Universitaire de Bruxelles (HUB), Université Libre de Bruxelles (ULB), Brussels, Belgium.

### Abstract

**Background and objectives:** Recent studies about refeeding in anorexia nervosa (AN) suggest starting with a high calorie diet. This narrative review aims to understand the initial refeeding management in hospitalized children and adolescents with AN and to develop a practical protocol.

**Methods:** We performed a comprehensive database search in June 2023 for abstracts published between January 2010 and May 2023 in different databases: Pubmed, The Cochrane Library and Embase with the terms refeeding syndrome, energy intake, diet therapy, weight restoration, hypophosphatemia, nutritional rehabilitation, anorexia nervosa, restrictive eating disorders, child, adolescent and young adult.

**Results:** Fifteen papers were included in this review. Twelve studies were retrospective or observational. Only 3 randomized controlled trials were found. Initial energy intake varies within a wide range between 500 and 2800 kcal per day but generally begins with higher calories than current recommendations. Only hypophosphatemia was often described without clinical refeeding syndrome. Initial weight restoration was better with high calorie refeeding (HCR). Length of stay was shorter with HCR in some studies. Long term outcomes were unknown. Only two studied severely malnourished patients (< 70 % mBMI).

**Conclusion:** In adolescents with AN and with a low risk of RS, high calorie refeeding is possible under close medical monitoring and with prompt electrolyte correction. Robust studies with a unified protocol are needed to confirm the safety of high calorie refeeding especially in severely malnourished adolescents with AN. (*Acta gastroenterol. belg.*, 2024, 87, 287-293).

**Keywords:** Anorexia nervosa, adolescent, refeeding syndrome, hypophosphatemia.

**Abbreviations:** NGF: Nasogastric Feeding; RS: Refeeding Syndrome; ONS: Oral Nutritional Supplements.

### Introduction

Anorexia nervosa (AN) is characterized by a self-inflicted energy restriction, an intense fear of weight gain or a disturbed body image resulting in weight loss and malnutrition. It is considered the most severe mental illness. Mortality rates in patients suffering from eating disorders are estimated at 3-6%, the highest of all psychiatric disorders. Eating disorders, in particular anorexia nervosa, are associated with a significant suicide risk (1). Nutritional rehabilitation is complex and essential in treatment.

The goals of refeeding are weight restoration, correction of malnutrition complication and cognitive function recovery to allow patients to be actors in their psychotherapy. Early weight gain is an important outcome at 1-year follow-up (2). This refeeding is based on “best

practice” or on experience rather than on robust evidence with a clear lack of global consensus. Consequently, the approach to weight restoration is very different between and within countries (3). Until recently, the most common practice, based on international guidelines such as those of the American Dietetic Association (ADA), was to begin with 1,000-1,200 kcal/day intake (30-40 kcal/kg/day), or even less (until 10-20 kcal/kg/day) in severely malnourished patients, with a progressive increase of 100-200 kcal/day (4). In Europe, low-calorie levels of 500-600 kcal/day (5-10 kcal/kg/day) were recommended (5). This method called “Conservative refeeding” consists of starting with a low-calorie diet to limit the risks of refeeding syndrome.

Refeeding syndrome (RS) describes the clinical and metabolic disorders that can occur during refeeding (orally, enterally, or parenterally) of a malnourished patient. Starvation causes electrolyte and vitamin depletion that may go unnoticed due to a metabolism compensation. During refeeding, the increased insulin level drives phosphorus and potassium intracellularly and glucose-dependent metabolic pathways use thiamine as a co-factor to produce fat and proteins or to stimulate glycogen. In the case of refeeding syndrome (RS), hypophosphatemia, hypokalemia, hypomagnesemia and thiamine deficiency can occur even if serum levels are normal initially and result in a wide range of clinical manifestations mild to severe. Severe and rapid electrolytes depletion in RS can result in life-threatening outcomes, particularly with cardiac complications (arrhythmias, heart failure) and neurological complications (altered mental status, seizures). The American Society for Parenteral and Enteral Nutrition (ASPEN) has proposed a new clinical definition of RS in 2020, a decrease in serum phosphorus, and/or potassium, and/or magnesium levels by 10-20% (mild RS), 20-30% (moderate), or > 30% and/or organ dysfunction resulting from a decrease in any of these and/or due to thiamine deficiency (severe RS), occurring within 5 days of reintroduction of calories (6). Hypophosphatemia is used as a sensitive marker for the RS. Therefore, the approach of refeeding in adolescents

Correspondence to: Roman Céline, Paediatrics Department, Hôpital Erasme, HUB, Route de Lennik 808, 1070 Anderlecht, Belgium. Phone: 02 555 49 44. Email: celine.roman@hubruxelles.be

Submission date: 19/01/2024  
Acceptance date: 11/04/2024

with AN is always to minimize or prevent refeeding syndrome from occurring (7). Conversely, being underfed can also lead to severe complications, including death. The “underfeeding syndrome” is now described. For 10 years, many studies have been published on high calorie refeeding (HCR) in AN. In 2011, the Royal College of Psychiatry published Junior MARSIPAN (focus on patients under 18) guidelines to standardize care in the United Kingdom, but they mainly relied on experts’ opinions due to limited evidence (8).

This literature review is performed to understand the initial refeeding management of hospitalized children and adolescents with AN. This review also aims to present a practical protocol for the management of intrahospital refeeding in young anorexic patients.

## Methods

We performed a comprehensive database search in June 2023 for abstracts published between January 2010 and May 2023 in different databases: Pubmed, The Cochrane Library and Embase. Search strategies combined controlled vocabulary terms (MeSH) with keywords for the following concepts: refeeding syndrome, energy intake, diet therapy, weight restoration, hypophosphatemia, nutritional rehabilitation, anorexia nervosa, restrictive eating disorders, child and adolescent.

Inclusion criteria were all relevant studies (randomized controlled trials, cohort studies and case-control studies) of a refeeding protocol in children, adolescents and young adults with AN where feeding protocol is defined and outcomes are related to short and/or long-term restoration of medical stability (including vital signs, length of stay, weight recovery) or cognitive improvements (including

neurocognitive functioning and/or long-term eating disorder cognitions and behaviors) or psychological well-being (decreased psychiatric symptoms such as obsessive ideation, guilt after meals, and suicidal ideation) or safety of HCR (including refeeding syndrome, refeeding hypophosphatemia, hypokalemia, hypomagnesemia).

Exclusion criteria were reviews, case reports or studies without descriptive feeding protocol, studies about adults  $\geq 25$  years old or studies about other eating disorders (bulimia, Avoidant/Restrictive Food Intake Disorder (ARFID)).

Of the 233 articles identified in databases, we excluded 164 papers after screening the titles and abstracts. Sixty-nine full-text articles were screened and only 15 were included (Figure 1).

No formal quality of assessment was performed to evaluate quality of studies included. Nonetheless, study designs were discussed in results and limitations (e.g. bias, sample size).

## Results

We found fifteen articles discussing refeeding in adolescents and young adults with AN. Only three of these studies were randomized controlled trials (RCT). Eleven were retrospective and/or observational studies. Data are respectively summarized in Table 1 and Table 2.

Patients included in those studies were adolescents but also young adults. Age at inclusion varied between 9 and 24 years old. Six studies involved adolescents only. Three quarters of these studies concerned AN or atypical anorexia clearly defined by Diagnostic and Statistical Manual of Mental Disorder, Fourth and Fifth edition (DSM-4 and DSM-5). Other studies included restrictive eating disorder.

Severely malnourished adolescents with AN defined by ADA (4)/ ASPEN (6) by a percentage of median body mass index (% mBMI) inferior to 70 % were most of the time not represented. Thirteen studies concerned moderately malnourished patients with  $\geq 70\%$  mBMI. Only Dalenbrook *et al.* (23) studied adolescents with low BMI around a 60% mBMI and Golden *et al.* (16) had a small group of patients with an mBMI  $< 70\%$ .

Initial energy intake varies in a very large range between 500 (9) and 2800 (19,20) kcal per day. Oral intake is preferred with three meals and three snacks under the supervision of a nurse. When energy intake is not enough, liquid oral supplementation at 1 kcal or 1.5 kcal/mL is often recommended. Nasogastric feeding (NGF) is rarely used when calorie intake was not adequate in four studies. Two studies recommended the NGF initially in unstable patients (19) or to compare bolus feed and continuous NGF (15).

Clinical refeeding syndrome was not always clearly defined but biochemical abnormalities like hypophosphatemia, hypomagnesemia and hypokalemia were defined in all studies searching RS. Hypophosphatemia

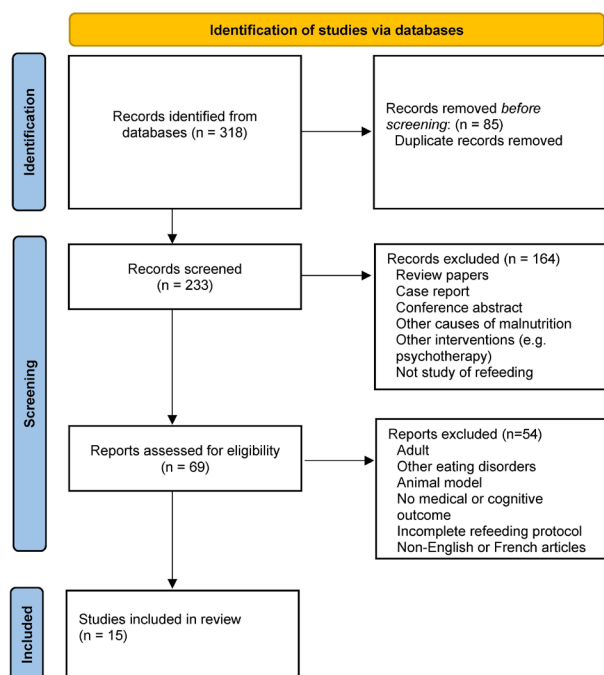


Figure 1. — Flowchart of studies selection.

Table 1. — Randomized controlled trial (RCT) studies of refeeding protocol in adolescent and young adult with AN

Author, years	Total	Population			Refeeding protocol		Conclusion
		Age (y) (mean)	% Body weight	Eating disorder	Initial intake (kcal)	Feeding Route	
O'Connor <i>et al.</i> 2016 (9)	36 (18HCR/ 18LCR)	10-16 (13,8)	70 % mBMI	AN and AAN	LCR 500 + 200/d HCR 1200 + 200/d	Oral or NG if needed	HCR (38kcal/kg/d) was associated with greater weight gain than LCR (16 kCal/kg/d) without adverse cardiovascular outcome or increasing of RS.
Garber <i>et al.</i> 2021 (10)	120	12-24 (16,4)	> 60 % mBMI	AN and AAN	LCR 1400 + 200/d HCR 2000 + 200/d	Meals + liquid ONS	HCR restored medical stability significantly earlier than lower-calorie refeeding. Electrolyte abnormalities and other adverse events did not differ by group. Hospital stay was 4.0 days shorter among the group receiving HCR
Golden <i>et al.</i> 2021 (11)	111 (60HCR/ 51LCR)	12-24 (16,4)	84,9% mBMI (± 11,7)	AN and AAN	LCR 1400 + 200/d HCR 2000 + 200/d	Meals + liquid ONS	No difference between HCR and LCR in rates of clinical remission, medical rehospitalization, number of readmission or number of days hospitalized one year post discharged

AAN : Atypical Anorexia Nervosa, AN : Anorexia Nervosa, HCR : High-Calorie Refeeding, LCR : Low-Calorie Refeeding; mBMI : median Body Mass Index, NG : Nasogastric, ONS : Oral Nutritional Supplements.

was classified as mild, moderate, and severe, with different reference ranges. Electrolytes were monitored in 12 studies. Most of the time, a blood test was performed once or twice daily during the first week of refeeding (9,12-19,21), except in one study, every one or two days (10). Dalenbrook *et al.* (23) controlled electrolytes abnormalities weekly and Smith *et al.* (21) twice weekly. Pettersson *et al.* (20) did not perform any analysis of serum phosphate. All studies monitored electrolytes for any clinical signs of RS.

Nobody described a clinical refeeding syndrome. Only mild hypophosphatemia was described in five studies (12,17,21-23) with an incidence between 3.5% (17) and 46% (21, 22). Three studies started a prophylactic phosphate supplementation during the first week of refeeding (15,18,19). In Agostino *et al.* (15) and Madden *et al.* (18), mild hypophosphatemia was absent. In Parker *et al.* (19), it occurred in 1.1% of patients. In other studies, phosphate supplementation was prescribed, if necessary, except in Dalenbrook (23) where it was systematic with a significant underweight below BMI 13 kg/m<sup>2</sup>.

Four studies performed systematic multivitamins or calcium supplementation (10,13,18,19).

High calorie refeeding (HCR) is associated with a better gain of weight in one RCT (9) and initially in two observational studies (14,15) compared to low calorie refeeding (LCR). HCR is associated with a rapid gain weight from 1.3 kg/week (12) to 2.1 kg/week (19). Conservative refeeding is often associated with a loss of weight during the first week (13).

Length of stay (LOS) was compared in one RCT (10) and was shorter in the HCR than in the LCR and in three

observational studies (14-16). In Davis *et al.* (21), this difference was not significant.

The Golden's RCT didn't find any difference between HCR and LCR in rates of clinical remissions, medical rehospitalization, number of readmissions or number of days hospitalized one year post discharge (11).

Follow-up in these studies depends on the outcome between 4 weeks for the risk of RS (9,12,18,21,23) and 1 year for the risk of readmission (11). Correction of complications of malnutrition or cognitive function recovery was never an outcome. In none of these studies, was it possible to investigate long term recovery.

## Discussion

### Refeeding protocol

This last decade, many studies have researched the balance between the benefits of HCR and the risk of refeeding syndrome. RS is a potentially lethal disease occurring in malnourished patients who have been rapidly refeed with a fluid and electrolytes instability. The risk of RS is the highest in the first 5 days of nutritional rehabilitation. In mildly or moderately malnourished patients with AN, HCR provides a quicker weight restoration, a faster medical stability and a shorter LOS without an increase of RS (10,15,18,19). No difference has been shown in terms of clinical remission, medical rehospitalization, number of readmissions at 1 year in comparison with lower calories (11). The impact of different refeeding methods on long-term outcomes is unknown because the longest follow-up described is one

Table 2. — Retrospective and prospective observational studies of refeeding protocol in adolescent and young adult with AN

Author, Year	Study design	Total	Population			Refeeding protocol		Conclusion
			Age (y) (mean)	% Body weight	Eating disorder	Initial intake (kcal)	Feeding Route	
Whitelaw et al. 2010 (12)	Retrospective chart review	46	12-18 (15,7)	72,9% IBW ( $\pm$ 9.1)	AN and restrictive eating disorder	Min 1900 +100 -300/d High risk RS: 1400 + 100-300/d	Oral + NG if needed	38% of patients with mild hypo-phosphatemia. No clinical RS. Low IBW (<68%) are at greater risk to develop hypophosphatemia. 37% of phosphorus supplementation. Weight gain 1.3kg/week
Garber et al. 2012 (13)	Prospective observational	35	9-20 (16,2)	80,1% mBMI ( $\pm$ 2.3)	AN	800-2200 + 200/d	Meals + liquid ONS	94% started $\leq$ 1400 kcal/d (~28 kcal/kg/d) 83% of patients initially lost weight. No RS. 20% supplementation phosphorus
Garber et al. 2013 (14)	Prospective quasi-experimental	56	9-20 (16,2)	79,2 % mBMI ( $\pm$ 1,5)	AN	LCR: 1100 +100/d HCR: 1800 +120/d	Meals + liquid ONS	No RS; 36% supplementation of phosphate. Rate of weight gain higher in the HCR. Shorter LOS in the HCR group (40,6 kcal/kg) versus LCR group (27kcal/kg).
Agostino et al. 2013 (15)	Retrospective cohort study	165 (134LCR/ 31 HCR)	10-18 (14,9)	82-85% mBMI ( $\pm$ 10-13)	restrictive eating disorder	LCR: 1000-1200 + 150/d HCR: 1500-1800 + 200/d	NG + oral (HCR) versus oral (LCR)	Reduced LOS, better weight gain initially in HCR nasogastric feeding group. No complication including or electrolyte abnormalities use of phosphate supplements
Golden et al. 2013 (16)	Retrospective cohort study	310 (88LCR/ 222 HCR)	10-21 (16,1)	78,5% mBMI ( $\pm$ 8,3)	AN	LCR: 720-1320 + 200/d or 2d HCR: 1400-2800 + 200/d or 2d	Meals and snack + high-energy liquid ONS	LOS significantly shorter in HCR. No difference in between groups in terms of hypophosphatemia, hypomagnesemia, and hypokalemia, including in a subanalysis of severely malnourished group
Leclerc et al. 2013 (17)	Retrospective chart review	29	12-18 (14,5)	75,8% IBW (min 70%)	AN and restrictive eating disorder	1500 + 250 on D2 and D3, 250/2d	Oral	3,5% of hypophosphatemia. No clinical refeeding syndrome. Mean weight gain 0.240 kg/d
Madden et al. 2015 (18)	Cohort study	52	12-18 (14,8)	78.3% EBW	AN	2400 until 2400-3000 in 7 days	Continuous NG 24-72h then cycling + oral	Immediate weight gain. No refeeding syndrome observed.
Parker et al. 2016 (19)	Retrospective cohort study	162	14-19 (16,7)	80,1% mBMI ( $\pm$ 10.2)	restrictive eating disorder	2400-2800 (mean 2611.7)	Continuous NG or cycling NG and oral or oral only	HCR protocol (started 58.4 kcal/kg/d) with phosphate supplements provided rapid weight gain (+2kg/weeks). No severe hypophosphatemia or RS observed.
Pettersson et al. 2016 (20)	Observational	21	16-24 (19,9)	BMI 15.5 $\pm$ 0.94	AN	3264 $\pm$ 196 First week	Meals + high-energy liquid ONS	The intensive nutrition therapy (74 kcal/kg/d) produced weight gain, increased fat and muscle mass and decreased food related anxiety, without any clinical side effects.
Smith et al. 2016 (21)	Retrospective cohort study	129	10-22 (15,8)	79,4% mBMI ( $\pm$ 8,4)	AN and AAN	1500 + 500 for gain weight 130-200g/day	Meals + high-energy liquid ONS	Weight gain 1,4 kg/ weeks with increasing calories by 164 kcal/day. No full refeeding syndrome but 47% of hypophosphatemia. Medical stabilization in 15 days
Davis et al. 2021 (22)	Retrospective case control	125 (61 HCR/64 LCR)	< 20 (14,0)	73.2% mBMI ( $\pm$ 6.9)	AN	LCR: 1400-1500 +200-300/3d HCR: 1600-1800 +200-300 kcal/d	Meals and high-energy liquid ONS or NG	No cases of severe hypophosphatemia or refeeding syndrome. Higher incidence of mild hypophosphatemia in the HCR group (46%HCR/22%LCR). In severe malnourished patient is the same (42%HCR/20%LCR). No difference in LOS
Dalenbrook et al. 2022 (23)	Retrospective Chart review	120	12 - 20 (17,3)	62,1 % mBMI ( $\pm$ 6)	AN	2000 kcal/day (Individual caloric increases in accordance with body weight development)	Meals only or NG (rare)	No refeeding syndrome observed, 7,5% hypophosphatemia; severely malnourished youth met the recommended weight gain targets between 0.5 and 1 kg/ week with initial calorie intake à 57 kcal/kg/d

AAN : Atypical Anorexia Nervosa, AN : Anorexia Nervosa, EBW : Expect Body Weight, HCR : High-Calorie Refeeding, IBW : Ideal Body Weight, LCR : Low-Calorie Refeeding, LOS: Length of stay, mBMI : median Body Mass Index, NG : Nasogastric, ONS: Oral Nutritional Supplements.

year. Conservative refeeding proposed by the different guidelines seems to result in “underfeeding syndrome” with especially an initial loss of weight in the first week of refeeding (13). Although, there appears to be a wide range of HCR (1200-2800 kcal/d; 16-74 kcal/kg/d) offered in these studies. In conclusion of the Garber’s RCT, HCR with more than 1400 calories of initial intake with a daily increase of 200 kcal can be proposed in adolescent with mildly or moderately malnourished patients (10).

In severely malnourished patients, especially with a percentage of mBMI  $\leq$  70%, Dalenbrook *et al.* does not observe any clinical RS in 120 adolescents with a high calorie intake of 2000 kcal/d (~57 kcal/kg/d) (23). Only 7.5% of hypophosphatemia has been described but a blood sample was taken only once a week. Golden *et al.* observes no difference between HCR and LCR in terms of hypophosphatemia, hypomagnesemia, and hypokalemia in a subanalysis of severely malnourished adolescents (16). In literature with a larger inclusion of patients with AN, ARFID, bulimia nervosa and eating disorder not otherwise specified (EDNOS), Maginot *et al.* and Schlapfer *et al.* reported a decreased LOS and no risk of refeeding syndrome or hypophosphatemia, hypomagnesemia or hypokalemia when starting nutritional rehabilitation with higher calories (> 1500 kcal) in severely malnourished adolescent (24,25). Although, there is a clear lack of RCT in severely malnourished adolescent with AN, the most recent guidelines replacing Junior MARSIPAN in the United Kingdom, Medical Emergencies in Eating Disorders (MEED) still recommends an initial intake calorie between 10-20 kcal/kg/d (26). As of 2020, in Europe, the National Institute for Health and Care Excellence guidelines on eating disorders recommend to use a standard procedure for refeeding to avoid under-nutrition and refeeding syndrome (27). Further RCT are needed to expand the calorie initially intake.

In practice, recent studies have demonstrated that HCR is well tolerated by patients without increasing anxiety compared to LCR. The acceptability from HCR does not differ from LCR in adolescents and young adults with AN and AAN (28,29).

### Route to refeeding

The two main routes to refeeding are oral and nasogastric. For the moment, there is no evidence to recommend one over the other (30). Most of the studies in our review recommend nutritional liquid supplementation containing 1 to 1.5 kcal/mL to complete the calories if the food cannot cover the energy intake (10,11,13,14,16,17,19-21). Nasogastric feeding is not used routinely in most of the studies. It is even a reason for exclusion in Leclerc (17). In this review, Agostino *et al.* and Madden *et al.* recommend initially NGF to provide a better weight gain or to provide a reduced LOS without refeeding complication and electrolyte abnormalities (15,18). In our practice, we found that

it is complicated to cover all the energy intake by oral diet alone in adolescent with hospitalized AN. Two recent studies confirm that 30% of young people with hospitalized AN specially with lower BMI on admission require NGF during hospitalization to complete the oral intake (31,32). Another potential benefit of nasogastric refeeding is the continuous feeding in patients at high risk of RS, it could limit postprandial insulin peaks and so the risk of RS (32). Another recent study confirms that the combination of natural diet, oral nutritional supplementation (ONS) and NGF is the most effective in restoring weight (33). Recent guidelines, from the American Academy of Pediatrics 2021, indicate that the systematic use of nasogastric feeding at the beginning (exclusive or not) allows a faster weight gain and medical stabilization, as well as a reduction of length of stay but there is insufficient evidence to recommend one approach over another (34). Indeed, in 2022, MEED recommends starting with an oral administration and using NGF for patients with life-threatening weight loss or unable to achieve sufficient nutritional intake (26).

### Phosphate and other supplementations

Given the wide range of symptoms, electrolytes levels monitoring can be used to identify RS. Hypophosphatemia (< 1 mmol/L) is often an initial sign of RS (7). In this review, only three studies recommend routine phosphate supplementation at the start of refeeding (first two weeks) with a lower incidence of mild hypophosphatemia than in the other studies (15,18,19). Five other studies reported up to 1/3 (one up to 45%) of patients with mild hypophosphatemia without systematic supplementation. However, there is no RS with regular blood tests and rapid supplementation in mild hypophosphatemia (12-14,21,22). Two studies recommend routine phosphate supplementation in high risk of RS (12,23). In this review, the risk of RS is more correlated with the % mBMI than with the level of calorie intake (12). This is consistent with what we found in the literature with a high risk of RS in patients with < 70% mBMI (7,35). Other criteria of risk of RS are no nutritional intake for more than a few (3-4) days, weight loss of over 15% in the past 3 months, and abnormal electrolytes before refeeding (26). ASPEN and MEED do not recommend routine phosphate supplementation but a careful daily monitoring of electrolytes and clinical signs of RS for the first week of refeeding and a reactive supplementation if needed (5,26). In high risk of RS, a closer monitoring of electrolytes up to twice daily and a preemptive phosphorus supplementation can be made (5). In case of moderate hypophosphatemia (0.35-1 mmol/L), oral intake is recommended. In severe hypophosphatemia (<0.35 mmol/L), an intravenous route under cardiac monitoring is recommended (7). In all cases, if electrolytes become difficult to correct or drop abruptly during the initiation of nutrition, calories cannot be increased. Decreased calories or cessation of nutrition

support may be an option based on practitioner judgment and clinical presentation (5).

Thiamin can decrease during the nutritional rehabilitation, potentially leading to Wernicke encephalopathy, a neurologic complication (5). In adults with AN, the use of thiamin supplements, multivitamins and minerals is recommended during nutritional rehabilitation (36). In this review, thiamin supplementation is not discussed in any study. ASPEN and MEED recommend thiamin supplementation for 5 to 10 days in pediatric patients (5).

Multivitamins are routinely administered in four studies (10,11,15,19). Published recommendations from ASPEN, MEED and AAP also support the use of multivitamins in addition to encouraging a varied diet (5,26,33). Calcium and vitamin D supplements can be dosed to target recommended daily amounts (33).

Based on this review and our intrahospital experience, we have developed an algorithm that is practical, straightforward, and prudent for all patients with AN hospitalized in pediatrics or child psychiatry. This protocol is not available for patients with comorbidities or in intensive care or with severe complication of AN (severe bradycardia for example). The ASPEN criteria are used to define the risk of RS. Thiamine, phosphorus, and multivitamins are given systematically to all patients in the first ten days. The initial intake is 35 kcal/kg/d in case of low and moderate risk of RS and 15 kcal/kg/d in case of high risk. Intakes increase by 5 kcal/kg every day in low and moderate risk and every two days in high risk to obtain a gain of weight of 0.5 to 1 kg per

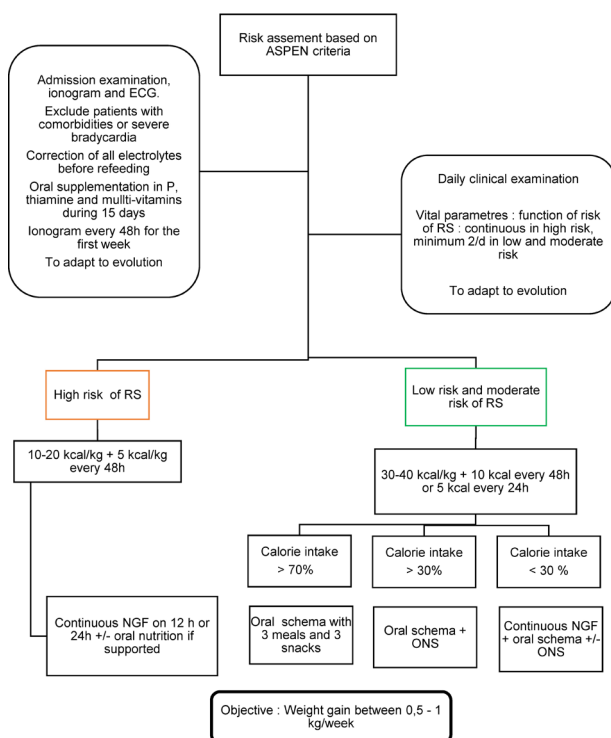


Figure 2. — Practical protocol for the nutritional management of adolescents and young adults hospitalized with AN in pediatrics or child psychiatry, based on the recommendations of NICE, MEED and this review.

week. Electrolytes (P, K, Mg) are monitored every 24-48 hours for 7 days to detect RS. The NG tube is commonly used with continuous feeding in patients with severe malnutrition (Figure 2).

### Limitations

This review is a narrative review made with a methodological rigor but this is not a systematic review. Quality assessment tools were not used due to the heterogeneity and small number of studies included. Several studies included are retrospective and/or observational, with small sample size and bias selection or loss of follow-up. As the studies included in this review use very diverse protocols, it can be difficult to compare them and establish common guidelines. We performed this review specifically for adolescents. Due to this choice, some pertaining studies could have been overlooked.

### Strengths

This study has resulted in aggregating every pertaining study about refeeding of adolescents suffering from AN. This review has led to the production of a specific protocol based on recent and up to date data. This protocol is now used as a reference in the treatment of patient with AN in our institution

### Conclusion

In patients with a low risk of RS, high-calorie refeeding (> 1400 kcal) under close medical supervision can be proposed supported. In severely malnourished patients, careful calorie intake at baseline is recommended. There is a clear lack of randomized controlled trials to support higher calorie intake. There is also insufficient evidence to recommend a nasogastric tube over oral feeding. Reactive phosphate supplementation is still preferred to routine supplementation but is discussed in high risk of RS. Nutritional rehabilitation in adolescents with AN remains complex with an obvious lack of evidence and uniformity of care. Strong studies with a unified protocol are needed to confirm the safety of HCR especially in severe AN adolescents.

### Conflict of interest

None.

### Acknowledgement

The authors would like to acknowledge Pr. Patrick Bontems and Dr. Marie Delhaye for their support.

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