

Grip strength data for individuals with severe anorexia nervosa

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Abstract

Objective. This retrospective study compiled grip strength data of patients with severe anorexia nervosa to assess associations among grip strength, anorexia nervosa severity, depression, and physiological comorbidities.

Design. 475 patients with severe anorexia nervosa admitted to an inpatient hospital and completed a grip strength assessment at admission and discharge. Depression was diagnosed via clinical interview. Independent sample *t*-tests and Mann-Whitney *U* tests compared difference in grip strength and anthropometric measures between anorexia nervosa subtypes. Linear and logistic regressions assessed associations among grip strength, depression, and physiological measures.

Results. The cohort was 91.8% female (M age: 31.8 ± 11.7 years). At admission, patients had an average body mass index of 13.8 ± 2.4 kg/m² with 97.7% exhibiting impaired right-hand grip strength for their sex and age. Weaker right grip strength was associated with admission lower body mass index, worsening bone mineral density z-scores, and lower serum prealbumin (all *p*'s < .05) for both sexes. Patients with binge-purge anorexia nervosa had significantly stronger right grip strength (M: 19.0 ± 7.8 kg) compared to patients with restricting anorexia nervosa (M: 16.9 ± 7.9 kg), *p* = 0.003.

Conclusion. Severe malnutrition from anorexia nervosa was associated with profound deficits in grip strength, medical comorbidities and disease severity, but was not associated with depression.

Keywords: Grip strength, Anorexia nervosa, Malnourished, Functional mobility

Contribution of the Paper

- Grip strength is an easily administered and replicable assessment tool. Decreased grip strength has been associated with impairments in quality of life, functional abilities, fall risk, depression, and all-cause mortality [1-8].
- Currently, there are no consistent guidelines for outcome measures recommended for use in patients with anorexia nervosa.
- This study provided initial data for individuals with anorexia nervosa, demonstrating extreme deficits in grip strength.
- This data may assist in identifying the need for assessment and treatment for individuals with severe AN to increase strength, functional mobility level, and quality of life.

Introduction

Anorexia nervosa (AN) is a severe and persistent mental illness with a psychiatric mortality rate second only to opioid overdose [9]. Individuals with both subtypes of AN – the restricting subtype (AN-R) and the binge-purge subtype (AN-BP) – share the behavior of restricting their food intake which leads to a significantly low body weight, in addition to having an intense fear of gaining

weight and disturbance in their body image [10]. Individuals with AN-BP also engage in recurrent episodes of binge eating and/or purging behaviors, including self-induced vomiting or abuse of laxatives or diuretics. AN has high rates of psychiatric comorbidities, with approximately 42% of patients likely to experience a mood disorder [11]. Individuals who are living with AN may experience a poor quality of life [12] and serious medical complications that can adversely impact every system of the body [13]. One of the systems of the body upon which AN has its deleterious effects is the musculoskeletal system, which is impacted by the energy deficit caused by severe malnutrition.

Primary sarcopenia refers to the loss of skeletal muscle strength, quality, and consequential impaired functional mobility that is typically associated with the body's natural aging process [14]. This is further defined by Type II muscle fiber atrophy, proximal weakness, and decreased force and endurance production; these changes have also been found with AN [15,16]. Abnormal accumulation of glycogen, reduced serum carnosinase activity, and altered lactate response to ischemic types of exercise are other adverse changes to muscle physiology caused by AN [15,16].

Grip strength, an easily administered, affordable, and reliable measure of hand and arm muscle strength, has been deemed a biomarker of current and future medical status [1]. Studies have found decreased grip strength correlated with an increased level of disability, medical burden and all-cause mortality, along with decreased quality of life, and decreased independence [1-4]. Grip strength has also been found to be an important determinant of future fall risk, with grip strength at or below the 25th percentile predicting fall risk 12 months later [5]. Meta-analytic and other studies have shown a relationship between grip strength and depression, with lower hand-grip strength associated with higher odds of having depression [2,6].

Grip strength is also associated with overall nutritional status [7]. As malnutrition initially causes proximal weakness, it stands to reason that the presence of distal weakness is a sign of increased disease severity; thus, this test can potentially be used to perform an efficient and inexpensive global physical assessment of a patient. Grip strength has not been used to assess global strength and functioning in malnourished patients as a result of severe AN. The objectives of this retrospective analysis were to: 1) compile grip strength data of patients with severe AN-R and AN-BP and 2) to assess associations among grip strength with eating disorder disease severity, admission serum laboratory values, depression, and physiological comorbidities.

Methods

Participants and Procedures

In this retrospective study, 475 patients with severe AN [mean body mass index (BMI) < 13.8 ± 2.4 kg/m²] were admitted to a medical stabilization unit that specializes in the care of medically compromised patients with eating disorders and malnutrition between July 1, 2016—July 31, 2021.

Patients were eligible for inclusion if they were at least 18 years old, diagnosed with AN-R or AN-BP by a psychologist or psychiatrist according to Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5) criteria [9], had participated in a grip strength assessment on admission, and their hospitalization stay was greater than three days to ensure adequate data collection. Patients were

excluded if they were diagnosed with any other type of eating disorder or malnutrition. This study was evaluated and approved by the Colorado Multiple Institutional Review Board (COMIRB). The research was reviewed by a COMIRB member and determined to meet criteria for exemption under Category 4. All criteria for a waiver of HIPAA.

Measures

Clinical, demographic, and anthropometric measurements were retrospectively obtained from review of the patients' electronic medical record. Laboratory serum samples were collected on admission. Dual-energy X-ray absorptiometry (DXA) scans were performed using the Hologic QDR Series model Discovery-W. Bone mineral density (BMD) was assessed using the lowest z-score or t-score (if patient was 50 years old or older) from the lumbar spine, femoral neck or the total hip region. If the patient was less than 50 years old, a bone mineral density (BMD) z-score ≤ -2.0 from the patient's DXA lumbar spine (L1-L4), the femoral neck, or the total hip region was defined as "below the expected range for age," and a BMD z-score above -2.0 was defined as "within the expected range for age" [17]. Osteoporosis was diagnosed in postmenopausal patients aged 50 and older if the t-score was less than -2.5. Duration of the patient's eating disorder was obtained through self-report as documented in the medical record. Percent of ideal body weight (%IBW) was calculated using the Hamwi method [18].

Grip strength

Grip strength is tested on the unit using the Jamar hand dynamometer, an evaluation tool that measures isometric grip force. Grip strength dynamometry consists of three averaged measurements per upper extremity with the tester providing encouragement to the patient to squeeze with as much force as they possibly can. The patient sits in a standard chair with shoulder adducted to trunk, elbow flexed to 90 degrees, and forearm and wrist neutral. For the purposes of this study, a licensed physical therapist administered the grip strength measurements in the patient's room or in the unit's rehabilitation office. The American Society of Hand Therapists has recognized the Jamar Hand Dynamometer as the gold standard device for measuring grip strength [19-21].

Depression

The diagnosis of depression was obtained by chart review of the patients' DSM-5 diagnosis as previously diagnosed via clinical interview by the unit's psychologist or psychiatrist. Diagnoses that met criteria to be designated depression were: Major depressive disorder, recurrent (mild, moderate, severe with or without psychotic features, or unspecified); or major depressive disorder, single episode (mild, moderate, severe with or without psychotic features, or unspecified).

Statistical analyses

Descriptive statistics using means (M), medians (Mdn) and interquartile range (IQR) and box plots to assess for normality, were computed for all variables of interest. Independent sample *t*-tests and Mann-Whitney *U* tests were used to compare the difference in grip strength, laboratory results, and anthropometric measures between AN subtypes, when appropriate. Degrees of freedom are shown in parentheses after the test statistic. Linear and logistic regressions were conducted to assess associations among grip strength and admission BMI/%IBW, BMD z-scores, depression, fall risk, and

admission serum prealbumin levels. The results are represented as regression coefficients (Coeff) for linear regression or odds ratios (ORs) for logistic regression, along with 95% confidence intervals (CI). P values of <0.05 were considered statistically significant, and all analyses were completed using SAS Enterprise Guide software version 7.1 (SAS Institute, Cary, NC).

Results

Participant characteristics

The majority of the cohort were female (91.8%) with an average age of 31.8 ± 11.7 years (range: 18-64 years), and an average %IBW and BMI on admission of 66.1% ± 11.0 (range: 34.8-127.6) and 13.8 ± 2.4 kg/m² (range: 7.5-26.4), respectively (Table 1). Nineteen percent of the cohort were direct transports from an outside medical hospital and 16.4% required air ambulance for transfer to the unit. The remaining patients admitted from a residential eating disorder treatment center or from home.

Grip strength

Table 2 shows the average grip strength, by sex and age group, in our cohort of patients with the JAMAR data. At the time of admission, only 2.3% of enrolled patients exhibited normal grip strength for their sex and age in the right hand, and 15.4% in the left hand. An average of 20.6 ± 12.9 days elapsed between the admission

and discharge assessments. During this time, between admission and discharge, there was a modest improvement in grip strength, with 15% (n=334) exhibiting improvement from their baseline in the right hand and 30% (n=328) in the left hand.

Associations with grip strength

Stronger right grip strength, at admission, was associated with decreased odds of experiencing a fall (OR: 0.87, 95% CI: 0.81, 0.94, *p*=0.0004). For the female cohort, weaker right grip strength at admission, was associated with increasing age (Coeff: -0.07, 95% CI: -0.13, -0.02, *p*=0.006), lower BMI (Coeff: 0.91, 95% CI: 0.65, 1.17, *p*<0.0001), worsening BMD z-scores (Coeff: 1.04, 95% CI: 0.41, 1.68, *p*=0.001), and lower admission serum prealbumin (Coeff: 0.33, 95%CI: 0.24, 0.42, *p*<0.0001). For the male cohort, similar associations were found. Weaker right grip strength, at admission was associated with lower BMI (Coeff: 1.72, 95% CI: 0.34, 3.12, *p*=0.02), worsening BMD z-scores (Coeff: 6.05, 95% CI: 2.68, 9.42, *p*=0.001) and lower admission serum prealbumin (Coeff: 0.83, 95% CI: 0.26, 1.41, *p*=0.006). These associations found in the right hand were similar in the left hand.

There were no significant associations for either sexes, on admission, for right or left grip strength and depression. Additionally, admission right or left grip strength was not significantly associated with serum testosterone levels in males.

	Total Cohort			
	n (%)			
Demographics				
Sex				
Female	436 (92)			
Male	39 (8)			
AN Subtype				
AN-R	248 (52)			
AN-BP	227 (48)			
	Female	Male	AN-R	AN-BP
	n (%)	n (%)	n (%)	n (%)
Diagnosed with Depression (n=312)	287 (60)	25 (5)	151 (32)	161 (34)
Low BMD for age (n=186)†	165 (58)	21 (7)	108 (38)	78 (28)
Clinical Characteristics				
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Age (yrs)	32.2 ± 11.9	26.9 ± 9.1	31.4 ± 12.7	32.2 ± 10.7
Admission BMI (kg/m ²)	13.7 ± 2.3	15.9 ± 2.4	13.3 ± 2.1	14.4 ± 2.5
Admission % IBW	65.9 ± 11.0	67.7 ± 10.4	63.5 ± 9.7	68.9 ± 11.6
Length of hospitalization (days)‡	21 (14-30)	21 (13-28)	23 (16-35)	18 (13-27)
Duration of Eating Disorder (yrs)‡	11 (6-20)	5 (2-14)	9 (5-17)	14 (8-22)
Lowest BMD z-score	-2.4 ± 0.2	-2.3 ± 1.1	-2.5 ± 1.3	-2.3 ± 1.1
†BMD data was only available for 283 patients				
‡Median and interquartile range for non-normally distributed variables				
AN: Anorexia Nervosa; AN-R: Anorexia Nervosa, Restricting; AN-BP: Anorexia Nervosa, Binge-Purge; BMD: Bone Mineral Density; BMI: Body Mass Index; % IBW: Percent of Ideal Body Weight				

Table 2. JAMAR normative grip strength and average grip strength of patients diagnosed with anorexia nervosa on admission and discharge, sorted by age and stratified by sex.

		JAMAR (Females)		Anorexia nervosa (Females)					
				Admission			Discharge		
Age (yrs)	Hand	Mean (kg)	SD	n	Mean (kg)	SD	n	Mean (kg)	SD
18 to 19	R	32.5	5.6	39	16.5	6.3	25	18.8	6.6
	L	28	5.7	38	15.8	6	33	22.2	8.7
20 to 24	R	31.9	6.6	107	17.9	6.7	74	20.9	5.5
	L	27.7	5.9	107	16.6	6.6	65	18.9	6.2
25 to 29	R	33.8	6.3	78	16.6	6.7	57	19.1	5.4
	L	28.8	5.5	78	14.8	6.6	57	19.4	6.5
30 to 34	R	35.7	8.7	68	17.5	6.4	50	21	5.3
	L	30.8	8	68	16.3	6.1	45	20.5	6.2
35 to 39	R	33.6	4.9	36	18.3	6.6	25	20	7.5
	L	30.1	5.3	36	16.9	6.6	25	17.4	6.4
40 to 44	R	31.9	6.1	23	16.4	7	14	19.1	6.4
	L	28.3	6.3	23	15	6.5	14	18.4	6.2
45 to 49	R	28.2	6.8	32	15.4	6.7	22	17.8	3.9
	L	25.4	5.8	32	14.6	6.1	22	15.8	4.6
50 to 54	R	29.8	5.3	28	15.7	7.6	18	16.9	6.9
	L	26	4.9	28	15.7	7.4	19	15.6	6.3
55 to 59	R	26	5.7	12	13.8	4.6	9	16.2	4.4
	L	21.5	5.4	12	13.9	4.3	8	17.5	8.3
60 to 64	R	25	4.6	13	13.4	5.5	12	15.9	4.2
	L	20.7	4.6	13	13.4	3.6	12	14.9	4.3
		JAMAR Males		Anorexia nervosa Males					
				Admission			Discharge		
Age (yrs)	Hand	Mean (kg)	SD	n	Mean (kg)	SD	n	Mean (kg)	SD
18 to 19	R	49	11.2	9	30.5	7	9	34.6	6.7
	L	42.2	12.6	9	28.7	6.2	9	30	6.3
20 to 24	R	54.9	9.3	8	34.6	12.2	6	37.3	9.8
	L	47.4	9.9	8	33.4	10.8	6	34.8	10.7
25 to 29	R	54.7	10.4	10	28.9	12	6	31.2	8.6
	L	50.1	7.3	10	28.1	12	6	29.7	8.2
30 to 34	R	55.2	10.1	7	28.1	9.5	2	29.7	6.1
	L	50	9.8	7	26.9	10.8	2	27	1.4
35 to 39	R	54.3	10.9	1	39.3		1	41	
	L	51.2	9.8	1	36.7		1	40.7	
40 to 44	R	53	9.4	1	8.3		1	25	
	L	51.2	8.5	1	6		1	28.3	
45 to 49	R	49.8	10.4	2	15.8	13.9	2	23.3	15.1
	L	45.7	10.3	2	15.5	14.8	2	22.3	14.6
50 to 54	R	51.5	8.2						
	L	46.2	7.7						

55 to 59	R	45.9	12.1	1	32.3		1	35.3	
	L	37.7	10.6	1	34.7		1	36	
60 to 64	R	40.7	9.3						
	L	34.8	9.2						

R: Right; L: Left

Patients diagnosed with AN-BP had significantly stronger right grip strength (M:19.0 ± 7.8 kg) on admission, compared to patients diagnosed with AN-R (M:16.9 ± 7.9 kg), $t(473)=2.96, p=0.003$. **Table 3** shows the average grip strength by AN subtype and sex. Patients with AN-BP had their eating disorder (Mdn:14 yrs; IQR:8-22) significantly longer compared to patients diagnosed with AN-R (Mdn:9; IQR:5-17), ($U=37,113, p<0.0001$). Serum prealbumin was significantly higher, on admission, in patients diagnosed with AN-BP (M:21.6 ± 7.6 mg/dL), compared to patients diagnosed with AN-R (M:19.2 ± 5.7 mg/dL), $t(461)=3.77, p=0.0002$. Of the study cohort, 60% (n=283) of the patients received a DXA scan while on the unit; 252 of those patients were under the age of 50 years old, and of those, 152 patients (60%) had BMD z-score results below the

expected range for age. Of the 31 patients over the age of 50 years with DXA results, 58% were diagnosed with osteoporosis. A lower BMD z-score was significantly associated with depression (OR: 1.25, 95% CI: 1.02, 1.53, $p=.03$); however, admission grip strength was not significantly associated with depression.

Grip strength improved by at least 5 kg in one hand in 34% of patients by time of discharge after refeeding and some weight restoration. Patients demonstrated an average weight gain of 1.9 ± 0.9 kg/wk which equated to an average of a 2.9 ± 1.8 point increase in BMI. Only 5% of patients did not display any improvement in grip strength in either hand by the time of discharge, although their rate of weight gain was not different from the rest of the cohort.

Table 3. Average grip strength broken down by anorexia nervosa subtype on admission and discharge, sorted by sex and age.

		Females AN-R						Females AN-BP					
		Admission			Discharge			Admission			Discharge		
Age (yrs)	Hand	n	Mean (kg)	SD	n	Mean (kg)	SD	n	Mean (kg)	SD	n	Mean (kg)	SD
18 to 19	R	28	16.9	6.7	21	19.2	6.8	11	15.7	5.2	4	16.5	5.8
	L	27	15.8	6.6	22	22.1	6.9	11	15.6	4.8	11	15.6	4.8
20 to 24	R	59	17.3	6.9	44	20.9	5.4	48	18.6	6.4	30	21	6
	L	59	15.8	6.5	38	18.4	5.2	48	17.5	6.6	27	19.7	7.4
25 to 29	R	40	15.7	7	29	19.1	5.2	38	17.4	6.5	38	15.9	6.2
	L	40	13.7	6.9	27	18.5	7.1	38	15.9	6.2	30	20.2	6.1
30 to 34	R	27	15.2	6	23	19.1	5.3	41	19.1	6.3	27	22.7	4.9
	L	27	13.4	5.2	18	21.9	7.1	41	18.2	5.9	27	19.6	5.5
35 to 39	R	14	16.8	6.7	10	18.7	6.2	22	19.3	6.4	15	20.8	8.3
	L	14	15.4	6.2	8	19.5	5.1	22	17.9	6.7	17	16.4	6.9
40 to 44	R	7	12.8	6.8	7	16.5	4.5	16	18	6.7	7	21.6	7.3
	L	7	10.3	6.2	6	20.5	6.9	16	17.1	5.6	8	16.9	5.5
45 to 49	R	16	14.1	6.4	11	17.3	4	16	16.6	6.9	11	18.2	4
	L	16	13.8	4.8	14	14.4	4.6	16	15.4	7.2	8	18.4	3.5
50 to 54	R	13	14.9	7.2	7	15.9	4.7	15	16.3	8.2	11	17.5	7.5
	L	13	14.1	6.6	9	13.7	6.3	15	17	8	10	17.3	6
55 to 59	R	9	12.8	3.6	7	15.8	3.9	3	16.9	6.7	2	17.7	7.5
	L	9	12.5	3.2	5	14.1	4.2	3	18.2	5	3	23.2	11.2
60 to 64	R	10	12.5	5.5	9	15.1	4.5	3	16.2	5.7	3	18.4	1.3
	L	10	13.1	3	9	14	4.3	3	14.4	5.8	3	17.7	3.2
		Males AN-R						Males AN-BP					
		Admission			Discharge			Admission			Discharge		
Age (yrs)	Hand	n	Mean (kg)	SD	n	Mean (kg)	SD	n	Mean (kg)	SD	n	Mean (kg)	SD
18 to 19	R	6	29.2	7	6	32.4	5.5	3	33	7.5	3	39	7.9
	L	6	28.1	6.2	6	29.2	4.4	3	29.9	7.5	3	31.7	10.3

20 to 24	R	4	35.7	11.5	3	38	14.7	4	33.6	14.6	3	36.7	4.8
	L	4	35.5	11	3	37.4	13.9	4	31.3	11.7	3	32.2	8.5
25 to 29	R	6	22.1	9.4	4	28.6	9.2	4	39.2	7	2	36.3	6.1
	L	6	22.8	10.9	4	27.5	9.6	4	36.1	7.8	2	34	1.9
30 to 34	R	5	25.7	9.8	2	29.7	6.1	2	34.2	7.8			
	L	5	23.8	10.9	2	27	1.4	2	34.5	7.4			
35 to 39	R	1	39.3		1	41							
	L	1	36.7		1	40.7							
40 to 44	R	1	8.3		1	25							
	L	1	6		1	23.3							
45 to 49	R	1	6		1	12.7		1	25.7		1	34	
	L	1	5		1	12		1	26		1	32.7	
50 to 54	R												
	L												
55 to 59	R	32.3			1	35.3							
	L	34.7			1	36							
60 to 64	R												
	L												

AN-R: Anorexia Nervosa, Restricting; AN-BP: Anorexia Nervosa, Binge-Purge; R: Right; L: Left

Discussion

This paper demonstrates that patients who experience severe malnutrition secondary to AN demonstrate significant impairments in grip strength. The average age of females in this study was 32.2 ± 11.9 years; however, they presented with the average grip-strength of a 10–11-year-old female. Given the known associations of grip strength data, this indicates that patients who are severely malnourished from AN also likely have weakness in daily functioning due to muscle mass loss and muscle weakness, a higher number of medical comorbidities, increased hospital admission length of stay, and are at increased risk for all-cause-mortality [14]. Serum prealbumin levels, and severity of AN illness, as defined by BMI and %IBW, were associated with grip strength, suggesting that increased loss in grip strength is indicative of more severe eating disorder-related malnutrition and functional impairments. Patients with AN-R presented with decreased grip strength as compared to patients with AN-BP, suggesting a relationship between disease subtype and strength loss. A possible cause for this difference in grip strength between disease subtypes may reflect consistent starvation versus interspersed periods of binge eating which may provide increased fuel and energy to the body systems in patients with AN-BP, impacting muscle strength and function. The patients with AN-R in this study presented with a shorter average disease duration, further adding to the notable difference between subtypes.

A validated standard in the literature for a clinically important minimal difference in grip strength between admission and discharge has not yet been established, although a 2018 review conducted by Wang et al., suggests changes of 5.0 – 6.5 kg as a working guideline [22]. Only 34% of our patients met this threshold by discharge, congruent with the patient's need for ongoing eating disorder care to continue weight restoration after discharge from their initial medical stabilization hospitalization, and also logical, given that the average BMI/% IBW for our female patients at the time of discharge was still

only $15.8 \pm 1.6 \text{ kg/m}^2/76.2\% \pm 8.1$ and $76.1\% \pm 9.5$ for males. Most complications of AN are reversible with weight restoration, with the notable exception of BMD and perhaps cognitive functioning [23]. Given this, one would expect grip strength to continue to improve, but the findings of severely reduced grip strength are particularly telling given the young age of this sample, which is similar to the age of most individuals with AN who present for treatment. Future research should examine whether a patient with AN and impaired grip strength returns to normal after said patient has fully weight-restored and returned to community level outpatient programming. Future research should also assess the relationship between weight restoration, grip strength, and level of BMD accrual. Dependent on the level of improvement seen with grip strength, actions such as referral to outpatient physical therapy may need to be taken with patients due to fall risk, decreased BMD, and thus increased risk for fragility fractures and overall weakness.

The lack of correlation between reduced grip strength and depression was unexpected given that this relationship has been demonstrated in other populations [2]. A potential reason and a limitation of this study include the lack of a standardized assessment for depression, instead relying on clinical interview to define these diagnoses; it is also possible that the depressive symptoms of these patients could be the result of malnutrition [24] and thus may be a different clinical picture than previous research in primary depression. Moreover, when malnutrition is as profound as it was in our study population, it is conceivable that depression is muted by the overall weakness and loss of weight.

To our knowledge, this is the largest aggregate of grip strength data in a malnourished eating disorder population to date. Given our results of profound weakness, notwithstanding the relatively young age of our study population, these data can be used to encourage measurement of grip strength as a bedside tool, across many clinical and community eating disorder settings, to further

assess for nutritional state, fall risk, function, safety with daily activities, BMD estimate, and overall eating disorder disease severity classification. This may also be a useful screening tool for primary care physicians, and other members of an outpatient eating disorder treatment team, to help define a recommendation for higher levels of eating disorder treatment by objectively and quickly demonstrating to the patient and their team that their muscle strength is severely impaired, indicative of severe malnutrition. It is also an objective measure to assist in helping the patient with an eating disorder accept the severity of their illness. It has been the experience of these authors that patients can compensate for weakness through impaired motor patterns and body mechanics, use of assistive devices, and compensatory strategies, but cannot ignore objective measurements. It is not unusual for a patient to be unable to assume the testing position due to significant weakness in anti-gravity musculature. This level of weakness impacts all aspects of functional mobility and significantly increases fall risk, risk of disability, and further medical intervention. Additionally, grip strength may be used as a measurement of change in nutritional status across levels of the eating disorder care continuum, warranting referrals for higher levels of eating disorder care with more profound weakness. Another possible use of grip strength measurement is as a low-cost and easily accessible tool in rural and non-hospital settings as a surrogate of a patient's possible bone density loss and the need for more formal testing via a DXA scan.

Limitations

There are inherent limitations to any retrospective study that need to be considered for this study. First, this study is a convenience sample assessed at a single hospital and may be subject to a selection bias. Second, while the number of males in this study is proportionate to the rate of eating disorders in males for the overall population, the number is low, and this may impact correlations. Third, some eating disorder patients may have a desire to appear sicker than they truly are due to the psychology of eating disorders and may not put forth full effort with testing to achieve this aim. Finally, the data were obtained retrospectively and some data such as length of illness were obtained through self-report.

Conclusion

Grip strength is a global assessment of a person's muscle strength and functional ability that is easy and affordable to administer. This study demonstrated that severe malnutrition from AN was associated with an average grip strength similar to that of a pre-pubescent child, demonstrating marked impairment. Moreover, our study demonstrated a significant loss of grip strength that indicates a need for close observation for safety along with intense medical and nutritional intervention for this severe AN population to prevent medical complications, death, and loss of physical function. This study only examined patients with AN severe enough to warrant hospitalization at a specialized inpatient eating disorder unit, thus future research should obtain follow-up data to determine whether patients with AN normalize their grip strength when fully weight-restored, or whether it remains permanently weakened. This may provide further prognostic guidance in the treatment of patients with severe AN.

Author Disclosures

Competing interests

The authors declare no conflicts of interest.

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