Associations between Muscular Strength and Digestive System Disorders in Older Adults

Bong Kil Song, Angelique Brellenthin, and Duck-chul Lee, FACSM

Iowa State University, Ames, Iowa

Purpose: To examine the associations of handgrip strength (HGS) with prevalence of digestive system disorders (DSD) in older adults.

Methods: This cross-sectional study included 511 older adults (57% women; mean age 72 years old) who were without heart attack, stroke, or cancer in the past 5 years. HGS was calculated as the sum of the maximal contractions from both hands. Participants were categorized into sex-specific tertiles (thirds) of HGS. DSD cases were identified via self-administered medical history questionnaire. The DSD were further categorized into disorders of the upper tracts (gastroesophageal reflux disease, ulcers), intestines (irritable bowel syndrome, inflammatory bowel disease, diverticulitis), or accessory organs (gallbladder, liver, pancreas). Logistic regression was used to calculate the odds ratios (ORs) and 95% confidence intervals (CI) of DSD among HGS thirds while adjusting for sex, age, smoking, heavy alcohol consumption, diet quality, cardiorespiratory fitness, and body mass index (BMI).

Results: There were 192 DSD cases. Compared with the lower third of HGS (least strong), the ORs (95% CIs) of having DSD were 0.58 (0.37-0.92) and 0.50 (0.31-0.81) among those in the middle and upper (strongest) thirds, respectively, after adjusting for the possible confounders. Similar trends were observed in the DSD of the upper tracts, intestines, and accessory organs. In a joint analysis of HGS and BMI (another strong risk factor of DSD), participants were dichotomized into weak (lower third) or strong (middle and upper thirds) and normal weight (<25.0 kg/m^2), overweight (25.0-29.9 kg/m^2), or obese (≥ 30.0 kg/m^2) based on BMI. Compared with the weak-obese group, ORs (95% CIs) were 0.60 (0.28-1.27), 0.27 (0.11-0.65), 0.43 (0.21-0.88), 0.41 (0.20-0.83) and 0.13 (0.06-0.30) for the weak-overweight, weak-normal weight, strong-obese, strong-overweight, and strong-normal, respectively, after adjusting for the possible confounders.

Conclusions: HGS was inversely associated with DSD in older adults. In addition, higher HGS appears to attenuate the increased prevalence of DSD in overweight and obese participants. Prospective studies are warranted.

Table 1. Characteristics by tertile of hand grip strength among the 551 participants

Characteristics	Tertile of Hand grip strength (kg)				
	All	1(Low)	2	3(High)	
N	551	170	170	171	*P* value
Women, n (%)	298 (56.5)	96 (56.4)	96 (56.4)	97 (56.7)	0.999
Age (yrs)	71.9 (5.6)	73.9 (6.5)	71.3 (5.1)	70.4 (4.6)	**<.0001**
Body mass index (kg/m^2)[a]	27.7 (4.7)	27.7 (4.4)	27.6 (5.3)	27.8 (4.4)	0.946
Hand grip strength (kg)	33.6 (11.7)	24.9 (7.5)	33.0 (8.1)	42.7 (11.3)	**<.0001**
Stepcount (stepcount/day)	5825 (3450)	5553 (2668)	6287 (3709)	5660 (3825)	0.108
Dietary screening tool_total (score)	65.2 (11.0)	65.5 (10.7)	65.4 (11.3)	64.8 (11.1)	0.821
Cardiorespiratory fitness (minute)[b]	4.5 (0.9)	4.8 (1.0)	4.5 (1.0)	4.2 (0.6)	**<.0001**
Current smoker, n (%)	6 (1.1)	3 (1.7)	2 (1.8)	1 (0.5)	0.600
Heavy alcohol drinking, n (%)[c]	39 (8.7)	11 (6.4)	13 (7.6)	15 (8.7)	0.726
Marital status, n (%)					0.134
Single	21 (4.1)	5 (2.9)	8 (4.7)	8 (4.6)	
Married	406 (79.4)	133 (78.2)	140 (82.3)	133 (77.7)	
Widowed	49 (9.5)	24 (14.12)	9 (5.2)	16 (9.3)	
Divorced	35 (6.8)	8 (4.7)	13 (7.6)	14 (8.1)	
Total digestive system disorders, n (%)	192 (37.5)	78 (45.8)	59 (34.7)	55 (32.1)	0.021
Digestive upper tracts disorders, n (%)	121 (23.6)	52 (30.59)	30 (17.6)	39 (22.8)	0.019
Digestive intestines disorders, n (%)	69 (13.5)	26 (15.2)	26 (15.2)	17 (9.9)	0.248
Digestive accessory organs disorders, n (%)	55 (10.7)	22 (12.9)	18 (10.5)	15 (8.7)	0.461

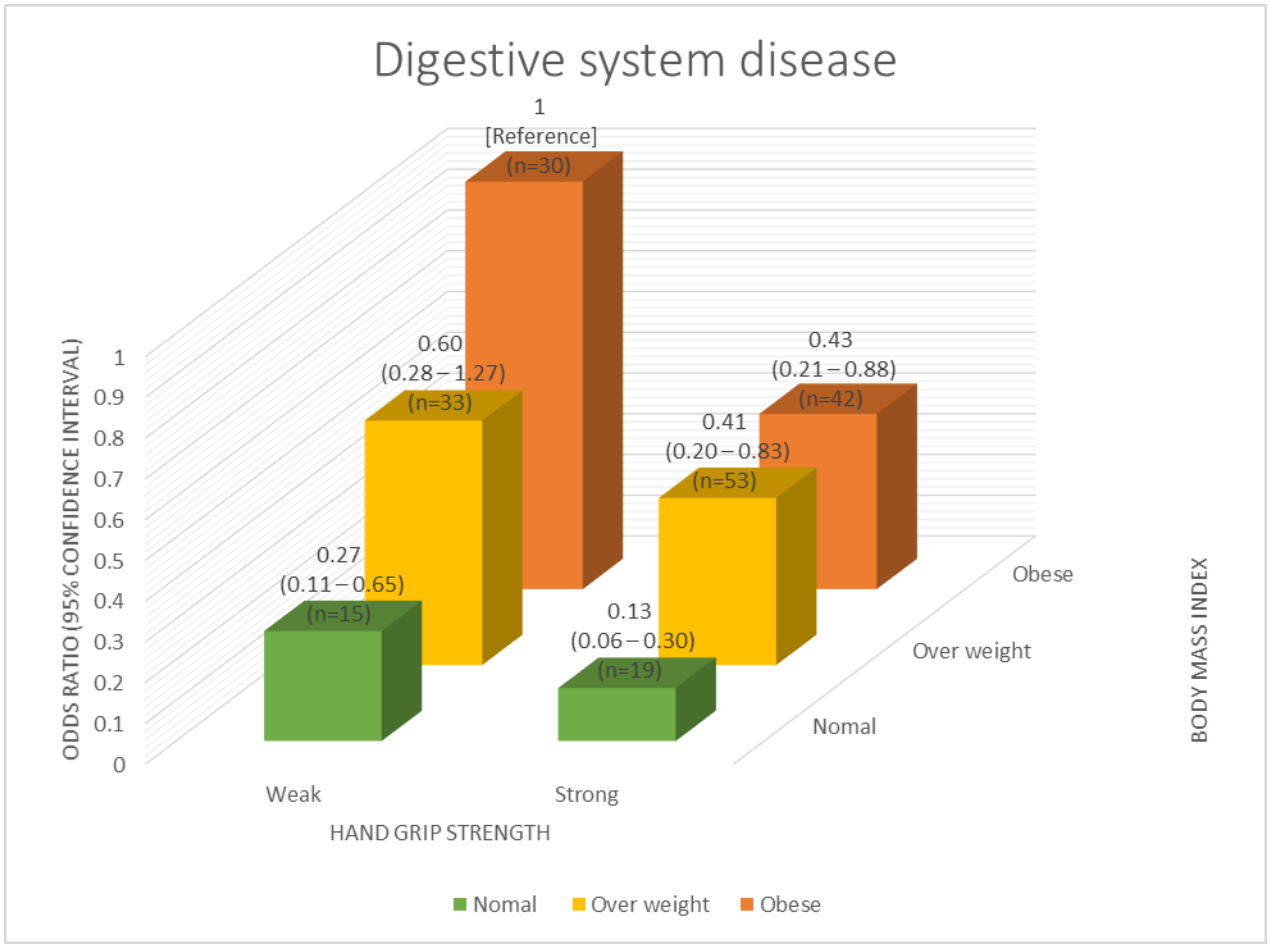
Data are presented as mean (SD) or n (%). Tertile 1 represents participants with the lowest hand grip strength, and Tertile 3 represents participants with the highest Hand grip strength. [a]Weight in kilograms divided by the square of the height in meters. [b]CRF was assessed using a 400-meter walk test in which participants were asked to complete 20 laps of 20 meters as fast as possible. [c]Heavy drinking status was obtained via self-report, and was defined as consuming >7 drinks/week for females, or >14 drinks/week for males.

Table 2. Odds ratios of DSD by tertiles of HGS

	Tertiles of Hand grip strength (kg)			*P* Value for linear trend
	1(Low)	2	3(High)	
No. of participants	170	170	171	
Total digestive system disorders (n=192)				
prevalence cases, No.	78	59	55	
Model 1[a]	1.00 [Reference]	0.58 (0.37 – 0.92)	0.51 (0.32 – 0.81)	**0.004**
Model 2[b]	1.00 [Reference]	0.59 (0.38 – 0.94)	0.54 (0.34 – 0.87)	**0.011**
Model 3[c]	1.00 [Reference]	0.58 (0.37 – 0.92)	0.50 (0.31 – 0.81)	**0.005**
Digestive upper tracts disorders (n=121)				
prevalence cases, No.	52	30	39	
Model 1[a]	1.00 [Reference]	0.47 (0.28 – 0.80)	0.65 (0.39 –1.07)	0.089
Model 2[b]	1.00 [Reference]	0.48 (0.28 – 0.81)	0.67 (0.40 –1.13)	0.127
Model 3[c]	1.00 [Reference]	0.46 (0.27 – 0.79)	0.62 (0.36 – 1.04)	0.070
Digestive intestines disorders (n=69)				
prevalence cases, No.	26	26	17	
Model 1[a]	1.00 [Reference]	0.88 (0.48 – 1.61)	0.51 (0.26 – 1.09)	0.054
Model 2[b]	1.00 [Reference]	0.86 (0.47 – 1.59)	0.49 (0.24 – 0.97)	**0.043**
Model 3[c]	1.00 [Reference]	0.86 (0.47 – 1.59)	0.49 (0.24 – 0.97)	**0.043**
Digestive accessory organs disorders (n=55)				
prevalence cases, No.	22	18	15	
Model 1[a]	1.00 [Reference]	0.85 (0.43 – 1.68)	0.70 (0.34 – 1.45)	0.350
Model 2[b]	1.00 [Reference]	0.88 (0.43 – 1.76)	0.84 (0.39 – 1.78)	0.646
Model 3[c]	1.00 [Reference]	0.83 (0.41 – 1.68)	0.77 (0.36 – 1.65)	0.506

Tertile 1 indicates lower third handgrip strength, tertile 2 indicates middle third handgrip strength and tertile 3 indicate upper third handgrip strength. [a]Model 1 was adjusted for sex, age. [b]Model 2 was adjusted for Model 1 plus smoke, heavy drink, DST, CRF. [c]Model 3 was adjusted for Model 2 plus BMI

Figure 1. Odds ratios (95% confidence intervals) of DSD by combined categories of HGS and BMI



Models were adjusted for sex, age, smoke, heavy drink, DST, CRF. Weak were lower 33% of HGS observation; Strong were Upper 66%of HGS observation. Normal were BMI < 25kg/m^2. Over weight were 25kg/m2 ≤ BMI < 30kg/m^2; Obese were BMI ≥ 30kg/m^2.

Table 3. Odds ratios (95% CI) of DSD by combined categories of HGS and BMI

	Body mass index		
Hand grip strength (kg)	Obese (n)	Over weight (n)	Normal (n)
Digestive upper track disorders (n=121)			
Weak	1.00 [Reference] (23)	0.46 (0.21 – 1.01) (21)	0.18 (0.06 – 0.48) (8)
Strong	0.42 (0.20 – 0.86) (27)	0.34 (0.16 – 0.70) (34)	0.07 (0.03 – 0.20) (8)
Digestive intestines disorders (n=69)			
Weak	1.00 [Reference] (8)	1.14 (0.41 – 3.13) (12)	0.78 (0.23 – 2.57) (6)
Strong	0.54 (0.19 – 1.47) (11)	1.04 (0.41 – 2.66) (24)	0.38 (0.12 – 1.18) (8)
Digestive accessory organs disorders (n=55)			
Weak	1.00 [Reference] (11)	0.43 (0.15 – 1.24) (8)	0.19 (0.04 – 0.78) (3)
Strong	0.67 (0.27 – 1.65) (16)	0.37 (0.13 – 0.09) (11)	0.23 (0.07 – 0.73) (6)

Models were adjusted for sex, age, smoke, heavy drink, DST, CRF. Weak were lower 33% of HGS observation; Strong were Upper 66% of HGS observation. Normal were BMI < 25kg/m^2. Over weight were 25kg/m^2 ≤ BMI < 30kg/m^2; Obese were BMI ≥ 30kg/m^2.