Reviewer ID: Carlos L. Cano-Herrera, Frances Fan, William Miller

Last updated: May 13th, 2024

Research Summary – Body Mass Index (BMI) – Other Physiological Systems

Author Year Country Research Design Setting	**Demographics and Injury Characteristics of Sample**	**Validity**	**Reliability**	**Responsiveness Interpretability**
Shin et al. 2022 Single-center retrospective cohort study to assess the validity of different anthropometric measures (waist circumference [WC], body mass index [BMI], and percentage body fat) in diagnosing metabolic syndrome (MetS) among individuals with SCI and provides preliminary data for future studies in setting obesity cutoff values for this population. Single center in Seoul, Korea	N = 157 110M, 47F Mean (SD) time since injury 12.0 (7.9) years Cause of injury: Traumatic (n = 133), non-traumatic (n = 24) Lesion severity: Paraplegia (n = 81), Tetraplegia (n = 76) AIS grade: A (n = 99), B (n = 20), C (n = 18), D (n = 20)			**Pearson correlation coefficients between the number of MetS subfactors and different anthropometric measures:** - Men: BMI (r=0.380, p<0.001) and WC (r=0.346, p<0.001). - Women: BMI (r=0.234, p=0.113) and WC (r=0.213, p=0.151). **Cutoff values:** The BMI (AUC=0.765; 95% CI, 0.689–0.842, p<0.001) was significantly associated with diagnosis of MetS, with a cutoff value of 22.8 kg/m^2 (sensitivity=72.1%, specificity=72.9%).

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Cragg et al. 2015 Observational cross-sectional Canadian public research institution	n=27 with SCI, 70% male Mean (SD) age = 40 (11) years Mean time since injury (SD) = 14 (10) years 59% cervical, 41% thoracic The breakdown according to AIS severity was: 52% AIS A, 22% AIS B, 19% AIS C and 7% AIS D.	BMI is poor predictor of CVD risk (Framingham risk score) r=0.29, non-significant BMI is strong predictor of obesity: r=0.92 with abdominal fat (kg) r=0.91 with total fat (kg) r=0.80 with abdominal fat (%) r=0.77 with total fat (%) all p<.05		**Interpretability:** Mean (SD) BMI = 23.4 (4.4)
Willems et al. 2015 Cross-sectional Elite wheelchair athletes from United Kingdom	N = 14; 7 walkers (wheelchair independent during non-sporting activities) and 7 non-walkers (daily wheelchair users). All male. Walkers: Mean (SD) age = 26 (8) years Time since injury mean (SD) = 19 (10) years	Correlation between BMI and Dual-energy X-ray Absorptiometry (DXA): Walkers: r=0.49 Non-Walkers: r=0.59 Non-significant Anthropometric measurements were used to predict body fat percentage with existing		**Interpretability:** Mean (SD) BMI: Walkers = 23 (4) Non-walkers = 21 (2) Standard error of the estimate (SEE): Walkers = 5.65 Non-Walkers = 7.83

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	Non-walkers: Mean (SD) age = 32 (7) years Time since injury mean (SD) = 12 (7) years	regression equations established for able-bodied persons. Body fat percentage calculated from most existing regression equations was significantly lower than that from DXA, by 2 to 9% in walkers and 8 to 14% in non-walkers.		
Ravensbergen et al. 2014 Cross-sectional Not specified	n=27 with SCI (19M, 8F) mean (SD) age = 40 (11) years Duration of injury mean (SD) = 166 (116) months AIS Grades: ASIA A = 14; ASIA B = 6; ASIA C = 5; ASIA D = 2	Pearson correlation between BMI and body composition: Total body fat (g) = 0.90, Total body fat (%) = 0.73 Abdominal fat (g) = 0.89 Abdominal fat (%) = 0.79 all p<.0001 Pearson correlation between BMI and CVD risk factors: Insulin = 0.29, p=0.18 Fasting glucose = 0.37, p=0.09 Triglyceride = 0.48, p=0.02 Total cholesterol (TC) = 0.33, p=0.12		**Interpretability:** Mean (SD) BMI = 23.7 (4.4)

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		HDL-C = 0.12, p=0.58 LDL-C = 0.12, p=0.57 TC/HDL-C ratio = 0.23, p=0.29 120-min glucose = 0.11, p=0.60 Insulin resistance = 0.34, p=0.11 Not significantly correlated with Framingham risk score.		
Zwierzchowska et al. 2014 Cross-sectional Wheelchair rugby athletes in Poland	n=14, all male Mean age (SD) = 32.6 (5.1) years Time since injury mean (SD) = 12.5 (5.7) years	Differences between the means of BMI<25 and BMI>25 (values reported below) are statistically significant (p<.05) Differences between BMI in groups with >13.5% and <13.5% visceral fat are non-significant. Pearson correlation between BMI and visceral fat: Vfat <13.5% (n=8) = 0.2 Vfat >13.5% (n=6) = 0.6		**Interpretability:** BMI </= 25: n=11 mean (SD) = 21.8 (2.3) BMI > 25: n=3 mean (SD) = 27.2 (0.8)

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		Total (n=14) = 0.6		
Flank et al. 2012 Cross-sectional SCI outpatient centre	n=135 wheelchair-dependent paraplegia (104M, 31F) Mean age (SD) = 47.8 (13.7) Mean injury duration (SD) = 18.4 (12.3) years Injury level, n T1-T6 (AIS A/B/C) = 45 (39/4/2) T7-T12 (AIS A/B/C) = 66 (56/5/5) L1-L4 (AIS A/B/C) = 24 (14/4/6)	Higher body mass index values tended to associate with more hypertension and diabetes mellitus, whereas dyslipidaemia was prevalent across all body mass index categories. Please see Table 1 below. Subjects with hypertension had a significantly higher mean BMI than non-hypertensive subjects (25.4 (SD 4.2) vs 23.7 (SD 3.7), *p*=0.023). Subjects with diabetes mellitus had a significantly higher BMI than participants without (27.8 (SD 3.5) vs 24.1 (SD 3.8), *p* = 0.001). No BMI-related differences were found		

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		when comparing participants with and without dyslipidaemia.		

Table 1

BMI level	**Hypertension (n=73) %**	**Diabetes mellitus (n=13) %**	**Dyslipidaemia (n=109) %**
<22 (*n*=33)	25	0	21
22-23 (*n*=14)	10	8	11
23-24 (*n*=18)	8	0	16
24-25 (*n*=13)	10	8	9
25-30 (*n*=44)	31	54	33
≥30 (*n*=13)	16	30	10
Total (*n* = 135)	100	100	100

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Alschuler et al. 2012 Cross-sectional Postal survey	n=488 with SCI (324M, 164F) Males: Mean age (SD) = 51.29 (13.8) Years since diagnosis mean (SD) = 15.91 (11.4) Males: Mean age (SD) = 47.49 (14.2) Years since diagnosis mean (SD) = 14.48 (11.0)	Correlation between BMI and waist circumference: Male = 0.46 Female = 0.45 p<.0001 Presence of group differences (between variables and conditions) in BMI but not waist circumference. Suggests BMI may not accurately represent health risk in		**Interpretability:** **Male:** Mean BMI (SD) = 26.21 (5.9) BMI categorization (%): Underweight = 19 (5.8) Normal weight = 120 (36.6) Overweight = 115 (35.1) Obese = 69 (21.0) **Female:** Mean BMI (SD) = 24.46

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		SCI because of biasing elements of the condition such as changes in body composition and mobility limitations.		(6.7) BMI categorization (%): Underweight = 18 (11.0) Normal weight = 84 (51.2) Overweight = 37 (22.6) Obese = 21 (12.8)
Eriks-Hoogland et al. 2011 Comparative cross-sectional study Convenience sample at outpatient clinic of spinal cord center	n=23, all male mean (SD) age = 43.3 (12) years Duration of injury mean (SD) = 14.6 (13.3) years AIS A = 22; AIS B = 1	Criterion validity: Pearson correlation between BMI and bioelectrical impedance analysis (gold standard to estimate obesity) = 0.51		**Interpretability:** Mean (SD) BMI = 24.9 (3.5) Range = 18-31.5
Gupta et al. 2006 Retrospective chart review Veterans Administration	n=408 with SCI (401M, 7F) 387 included in analysis mean age = 55.84 (range=21-85) years 213 with paraplegia, 195 with tetraplegia	**Difference between groups:** Patients with paraplegia mean BMI = 28.36 kg/m^2 Patients with tetraplegia mean BMI = 27.29 kg/m^2 Difference was statistically significant		**Interpretability:** Normal BMI (BMI = 20–25 kg/m^2) = 108 (27.91%) Underweight (BMI < 18.5kg/ m^2) = 14 (3.62%) Overweight or the

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Hospital in Wisconsin.	mean duration of injury = 19 years (range = 2 month-60 years). AIS Grades: ASIA A = 188; ASIA B = 45; ASIA C = 52; ASIA D = 119			severely overweight category (BMI > 25 kg/m^2) = 255 (65.89%) The prevalence of overweight and obesity by age, ASIA Score and Type of Injury is shown in Tables 1 and 2 of article.
Buchholz & Bugaresti 2005 Literature review	Persons with chronic SCI.	**BMI and Obesity:** The percentage of body weight as fat mass is 8–18% higher in SCI versus age-, height- and/or weight-matched able-bodied control subjects. 30kg/m2 BMI cutoff correctly identified only 20% of truly obese paraplegic subjects, as compared with published sensitivity values of 48–66% in able-bodied populations. **BMI and coronary heart disease (CHD):**		

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		Inconsistent evidence of relationship between BMI and CHD risk factors (i.e. lipid levels). **Author's conclusions:** In the SCI population, BMI may be prone to measurement error, does not adequately discriminate between the obese versus non-obese, explains less of the variance in measured percent fat mass than in able-bodied populations, and is inconsistently associated to CHD risk factors.		