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Original Research

Incidence and Risk Factors of Metabolic Syndrome in Track and Field Throwing Athletes

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Abstract

International Journal of Exercise Science 18(6): 1199-Y, 2025. https://doi.org/10.70252/HOKT7948 Track and field (T&F) throwers are a prominent subgroup of athletes that may be at risk for the development of Metabolic Syndrome (MetSyn) and other cardiometabolic disease conditions. However, limited research exists examining the prevalence of MetSyn in these athletes. Therefore, the purpose of this study was to examine the incidence of MetSyn and associated risk factors in collegiate throwers. Collegiate Division I men (n=17) and women (n=4) T&F throwers participated in a single day of lab assessments, which included anthropometrics, body composition, blood pressure, a venous blood draw, and aerobic capacity. MetSyn was diagnosed based on the following clinical markers: HDL, triglycerides, glucose, waist circumference, and blood pressure. MetSyn was present in 47% of men and 0% of women athletes. The most common risk factors were excessive waist circumference (men: 65%, women: 25%), reduced HDL (men: 59%, women: 50%), and elevated systolic blood pressure (men: 47%, women: 25%). BF% was associated with SBP (r=0.71), DBP (r=0.74), insulin (r=0.58), insulin resistance (r=0.58), triglycerides (r=0.51), and VO_{2max} (r=0.79) ($p<0.05$). This study observed a high incidence of MetSyn and other associated adverse cardiometabolic biomarkers in collegiate T&F throwers. Regular assessments of body composition and aerobic capacity may serve as practical and effective tools to identify at-risk athletes and guide targeted interventions aimed at reducing long-term cardiometabolic disease risk.

Keywords: Collegiate throwers, cardiometabolic health, blood pressure, body composition, insulin resistance

Introduction

Metabolic syndrome (MetSyn) is a condition, associated with multiple cardiometabolic risk factors, that collectively increase the likelihood of cardiovascular disease (CVD), type 2 diabetes, and other chronic health conditions.[1] MetSyn is defined by the presence of at least three of the following five criteria: abdominal obesity, reduced high-density lipoprotein (HDL) cholesterol, elevated triglycerides, increased fasting blood glucose, and hypertension.[1] Additionally, insulin resistance and elevated inflammatory markers are often considered secondary indicators of MetSyn because they contribute to its development and progression, but are not included in the primary diagnostic criteria due to challenges in routine clinical measurement and variability in individual responses.[2,3]

While exercise and sport participation have been recommended as a beneficial strategy to protect against cardiometabolic disease risk factors,[4] not all sports may elicit favorable effects. Research has increasingly demonstrated the prevalence of MetSyn in strength and power sports such as American football, in particular those positions prioritizing large body masses.[5–7] For example, National Football League (NFL) linemen had a 52% greater risk of death from cardiovascular disease compared with the general population, 3 times the risk of dying from heart disease compared with non-linemen, and almost 60% of retired linemen met the criteria for MetSyn compared with less than one-third of age-matched subjects.[3,8] Athletes who compete within these positions are often encouraged to prioritize increases in body mass and fat-free mass, as these characteristics can contribute to enhanced strength, power, and overall performance. Moreover, greater mass provides advantages in blocking, tackling, and maintaining position against opponents.[9] However, the emphasis on size may encourage unhealthy eating habits and often leads to disproportionate gains in fat mass, thereby contributing to an increased risk of metabolic dysfunction and long-term health complications. While MetSyn is a growing problem in American football, its prevalence in weight-focused strength sports, such as throwers in track and field (T&F) has yet to be explored.

Outdoor T&F throwing events include shot put, discus, hammer, and javelin. Throwing athletes prioritize the development of power and strength through resistance training and plyometrics, often at the expense of aerobic conditioning.[10,11] Since there are no weight restrictions or the need to perform repeated running and jumping in competition, throwing athletes may intentionally gain body mass, in an effort to maximize fat-free mass accrual.[12,13] As a result, throwers tend to have some of the highest fat-free mass index (FFMI) values ($25.7\ kg \cdot m^{-2}$) among athletes, reflecting their emphasis on muscle mass and overall size.[14,15] Unlike endurance-based disciplines, throwing events necessitate high force production over short durations, leading to training adaptations and dietary habits that may not support optimal metabolic health.[16–18] In conjunction with dietary strategies that favor high energy intake to support mass gain,[19] these athletes may experience disproportionate increases in fat mass,[13,20–22] contributing to central adiposity, elevated blood pressure, hypercholesteremia, and insulin resistance.[23] Moreover, previous findings suggest that aerobic capacity, as measured by maximal oxygen uptake (VO_{2max}), is inversely associated with MetSyn risk factors.[4,24] further highlighting the potential vulnerabilities of throwers, who do not commonly include aerobic conditioning as part of their training.

Despite these concerns, there is a lack of research examining the prevalence of MetSyn in T&F throwers. To date, one study has specifically investigated MetSyn in throwers, reporting 36% of elite Chinese throwers met diagnostic criteria for the syndrome.[7] Interestingly, there are no published studies on collegiate throwers, yet the behaviors and health outcomes developed during the college years can have lasting effects on health, and the risk of developing cardiometabolic diseases.[25] Therefore, the purpose of the current study was to examine the prevalence and associated risk factors of MetSyn in collegiate T&F throwers. These findings may help inform targeted interventions to mitigate long-term health risks in throwers.

Methods

Participants

No a priori power analysis was conducted for this study. Instead, a convenience sampling approach was used, and the sample size was determined by the number of eligible participants who could be recruited within the data collection period as part of a doctoral dissertation project. As such, we aimed to include as many participants as possible to ensure a sufficient sample for exploratory analyses and to inform future research requiring formal power calculations. National Collegiate Athletic Association Division I men (n=17; age: 19.7 ± 1.4 yrs; weight: 120.49 ± 17.12 kg; height: 183.93 ± 6.12 cm) and women (n=4; age: 19.8 ± 1.0; weight: 89.63 ± 9.45 kg; height: 171.88 ± 1.65 cm) T&F "heavy" throwers (shot put, discus throw, hammer throw, or weight throw) participated in this study. Participants were categorized as "men" or "women" based on their roster designation, which reflects gender rather than biological sex. All athletes were under the direction of a certified strength and conditioning coach and were following sport-specific training regimens. All athletes were medically cleared for intercollegiate athletic participation, had the risks and benefits explained to them beforehand, signed an institutionally approved consent form to participate, and completed a medical history form. All procedures involving human subjects were conducted in accordance with the requirements of the Declaration of Helsinki and approved by the College's Institutional Review Board. This research was carried out fully in accordance with the ethical standards of the *International Journal of Exercise Science*.[26]

Protocol

Data were collected in the off-season during a single lab visit, following an overnight (8-hour) fast. Women athletes were instructed to schedule their lab visits within 14 days of menses.[27] Participants underwent the following assessments: anthropometrics, body composition, resting blood pressure, a venous blood draw, and an aerobic capacity test administered on a treadmill.

Anthropometrics.

Upon arrival to the laboratory, height and body mass were recorded to the nearest 0.01 cm and 0.02 kg, respectively, using a stadiometer (Detecto, Webb City, MO, USA) and digital scale (Bod Pod; Cosmed, Chicago, IL, USA) calibrated according to manufacturer guidelines with subjects' bare foot. Waist circumference was obtained at the narrowest part of the torso between the xiphoid process and umbilicus using a spring-loaded Gulick tape measure. Measurements were taken in duplicate by the same single researcher. A third measurement was taken if the second was not within 5 mm of the first reading. The average of the two closest measurements was used.

Body Composition.

Body composition was assessed using air displacement plethysmography (BODPOD, Cosmed USA Inc., Concord, CA, USA) for determination of body fat percent (BF%), fat-mass (FM) and fat-free mass (FFM). At the beginning of each testing day, calibration procedures were completed according to the manufacturer guidelines, using the provided calibration cylinder of a standard volume (49.55 L). Participants were instructed to refrain from exercise, eating, and drinking for ≥4 h prior to testing. Additionally, participants were instructed to wear spandex or tight-fitting clothing, remove all jewelry, and wear a swim cap to reduce excess air displacement. Lung volume was estimated for determination of relative body volume based upon thoracic volume. Body mass and body volume were used to estimate body fat composition using the Brozek equation.[28] The same trained technician performed all testing.

Resting Blood Pressure.

Participants were instructed to sit quietly and motionless in an upright position for 10 minutes, prior to their blood pressure measurement. A sphygmomanometer cuff was placed over the upper midarm that was resting on a table at the level of the heart, and blood pressure was measured using an automated blood pressure cuff (SphygmoCor® XCEL, ATCOR Medical, Naperville, IL, USA). Systolic BP (SBP) and diastolic BP (DBP) were determined using the average of three consecutive BP recordings.

Blood Chemistry.

Blood samples (20 mL) were collected from an antecubital vein using standard sterile phlebotomy procedures. Blood was drawn into one 10-mL vacutainer tube that contained no additive (BD Biosciences, San Jose, CA, USA). Samples coagulated in cooling beds for approximately 20 min, then were centrifuged for 15 min at 2500 rpm (Eppendorf 5702R, Eppendorf North America, Hauppauge, NY, USA) before being stored at −80 °C until analysis. A second 10-mL vacutainer tube containing the anticoagulant ethylenediaminetetraacetic acid (EDTA) was collected, centrifuged as previously described, and stored at −80 °C. TNF-alpha, IL-6, and insulin were assessed in duplicate using commercially available ELISA kits (R&D Systems, Inc., Minneapolis, MN), while triglycerides (Crystal Chem High Performance Assays, Elk Grove Village, IL), glycose (Cayman Chemical Company, Ann Arbor, MI, and HDL (Crystal Chem High Performance Assays, Elk Grove Village, IL) were determined via colorimetric assays. Intra-assay coefficients of variation for TNF-alpha, IL-6, insulin, triglycerides, glucose, and HDL were 6.97%, 6.33%, 7.36%, 8.82%, 2.69%, and 9.64%, respectively. Insulin resistance was calculated via the Homeostatic Model Assessment of Insulin Resistance (HOMA-IR = fasting insulin x fasting glucose / 22.5).[29]

Aerobic Capacity.

Participants performed a maximal graded running exercise test (NORAMCO® Fitness HS-Elite treadmill, Willis, TX, USA) using the McConnell protocol. Expired gas fractions (oxygen and carbon dioxide) were collected at the mouth and analyzed with a calibrated metabolic cart

(ParvoMedics TrueOne 2400, Metabolic Cart, Sandy, UT, USA). Participants performed the treadmill test until: 1) VO_2 plateaued, 2) a respiratory exchange ratio >1.1 was achieved, and 3) rate of perceived exertion was >18 on the Borg scale. A verification phase was conducted to determine a true VO_{2max}. For this, participants rested passively for 10 minutes after completing their graded exercise test, then resumed the test again, starting at two stages below their previously identified final stage. Participants continued the test until reaching the same ending criteria as previously outlined. The higher VO_{2max} score of either the initial test or the verification phase was used to identify their true VO_{2max}.

Statistical Analysis

Normality was confirmed via Shapiro-Wilks tests for all variables. Descriptive statistics for all variables are presented as mean ± standard deviation. Athletes were diagnosed with MetSyn if they met 3 of the 5 following criteria:[30] 1) HDL < 40 mg/dL in men; <50 mg/dL in women; 2) Fasting triglycerides > 150 md/dL; 3) Fasting plasma glucose > 110 mg/dL; 4) Waist circumference > 102 cm in men; > 88 cm in women; 5) Systolic blood pressure > 130 mmHg and/or diastolic blood pressure > 85 mmHg. A Mann Whitney U test was run to identify gender-based differences among these variables. Fisher's exact test was employed to determine gender-based differences in the prevalence of MetSyn. The phi coefficient (φ) was calculated as a measure of effect size and interpreted as: small: 0.10, medium: 0.30, and large: 0.50. Exploratory correlation coefficients were calculated to assess relationships and were interpreted as: very weak: <0.20, weak: 0.20–0.39, moderate: 0.40–0.59, strong: 0.60–0.79, and very strong: >0.80. IBM SPSS version 29.0.2.0 software was used for statistical analysis ($p<0.05$).

Table 1. Measured Cardiometabolic Disease Risk Factors

	Men (n=17)	Women (n=4)	p-value	Cohen's d
Anthropometrics and Body Composition				
Height (cm)	184 ± 6	172 ± 2	0.001	2.6
Weight (kg)	120 ± 17	90 ± 9	0.004	2.2
BMI (kg/m^2)	34 ± 5	30 ± 4	0.144	0.9
BF%	24 ± 8	30 ± 4	0.031	0.9
Waist-to-height ratio	0.56 ± 0.06	0.50 ± 0.06	0.099	1.0
Metabolic Syndrome Criteria				
Waist Circumference (cm)	104 ± 10	85 ± 10	0.009	1.9
HDL (mg/dL)	41 ± 14	55 ± 15	0.122	0.9
Triglycerides (mg/dL)	129 ± 97	71 ± 29	0.335	0.8
Glucose (mg/dL)	79 ± 16	68 ± 24	0.554	0.6
Systolic BP (mm Hg)	134 ± 15	121 ± 17	0.275	0.8
Diastolic BP (mm Hg)	80 ± 9	76 ± 5	0.203	0.5
Other Cardiometabolic Health Indicators				
IL-6 (pg/mL)	2.4 ± 1.9	2.1 ± 2.0	0.202	0.2
TNF-a (pg/mL)	1.0 ± 0.1	1.3 ± 0.3	0.871	1.3
Insulin (pmol/L)	89 ± 58	54 ± 21	0.412	0.8
HOMA-IR	3.0 ± 2.0	1.7 ± 1.0	0.245	0.8
VO_{2max} (mL•min^{-1}•kg^{-1})	37 ± 7	37 ± 4	0.100	0.0

Values are mean ± SD. BMI: body mass index; BF%: body fat percent; MetSyn: metabolic syndrome; HDL: high-density lipoprotein; BP: blood pressure; IL-6: interleukin-6; TNF-a: tumor necrosis factor-alpha; HOMA-IR: homeostasis model assessment of insulin resistance

Results

Cardiometabolic disease risk factors for the participant sample are presented in Table 1.

The incidence of the clinically recognized criterion risk factors for MetSyn is listed in Table 2. No significant difference was observed regarding the incidence of MetSyn between men and women ($\chi^2(1, n = 21) = 3.04$, $p = 0.131$, $\varphi=0.310$).

Table 2. Number of Metabolic Syndrome Risk Factors Present

# of Risk Factors Present	# of Men (% of Sample) (n=17)	# of Women (% of Sample) (n=4)
0	2 (12%)	1 (25%)
1	4 (24%)	2 (50%)
2	3 (18%)	1 (25%)
3	6 (35%)	0 (0%)
4	2 (12%)	0 (0%)
5	0 (0%)	0 (0%)
Presence of MetSyn	**# of Men (% of Sample) (n=17)**	**# of Women (% of Sample) (n=4)**
Yes	8 (47%)	0 (0%)
No	9 (53%)	4 (100%)
p-value	0.131	
Phi coefficient (φ)	0.310	

A summary of the incidence of the individual risk factors for MetSyn is reported in Table 3. High waist circumference and reduced HDL were the most common risk factors, with 57% of our sampled athletes failing these criteria.

Table 3. Incidence of Metabolic Syndrome Risk Factors

Metabolic Syndrome Risk Factor	# of Men (% of Sample) (n=17)	# of Women (% of Sample) (n=4)
Excess Waist Circumference (≥102cm in men, ≥88cm in women)	11 (65%)	1 (25%)
Elevated Systolic Blood Pressure (≥130 mmHg)	8 (47%)	1 (25%)
Elevated Diastolic Blood Pressure (≥85 mmHg)	5 (29%)	0 (0%)
Elevated Fasting Triglycerides (≥150 mg/dL)	5 (29%)	0 (0%)
Elevated Fasting Glucose (≥110 mg/dL)	0 (0%)	0 (0%)
Low HDL (≤40 mg/dL in men and ≤50 mg/dL in women)	10 (59%)	2 (50%)

Exploratory correlations are reported in Table 4.

Table 4. Correlations among measures of cardiometabolic health

	BMI	WC	BF%	HDL	TG	Glu	SBP	DBP	IL-6	TNF-a	Insulin	Homa-IR
BMI												
WC	0.91**											
BF%	0.59**	0.40										
HDL	-0.07	-0.20	0.37									
TG	0.46*	0.45*	0.28	-0.34								
Glu	0.43	0.44	0.34	-0.11	0.36							
SBP	0.81**	0.77**	0.51*	0.04	0.36	0.41						
DBP	0.80**	0.74**	0.40	-0.27	0.44	0.39	0.78**					
IL-6	0.50*	0.38	0.38	-0.13	0.11	0.29	0.32	0.40				
TNF-a	0.05	0.08	0.10	-0.33	0.08	-0.10	-0.21	-0.01	0.58*			
Insulin	0.56*	0.66**	0.33	-0.32	0.55*	0.22	0.56*	0.52*	-0.11	-0.07		
HOMA-IR	0.60*	0.71**	0.39	-0.38	0.54*	0.43	0.57*	0.54*	-0.02	-0.07	0.96**	
VO_{2max}	-0.70**	-0.56**	-0.68**	-0.25	-0.45*	-0.17	-0.58**	-0.51**	-0.11	0.24	-0.54*	-0.50*

BMI: body mass index; WC: waist circumference; BF%: body fat %; HDL: high-density lipoprotein; LDL: low-density lipoprotein; TG: triglyceride; Glu: glucose; SBP: systolic blood pressure; DBP: diastolic blood pressure; IL-6: interleukin-6; TNF-a: tumor necrosis factor; HOMA-IR: Homeostatic Model Assessment for Insulin Resistance. *p<0.05; **p<0.001

Discussion

The primary purpose of the current study was to examine the incidence of MetSyn and its association with individual risk factors in a sample of collegiate T&F throwers. Our findings indicate that 47% of men throwers in the current study met the criteria for MetSyn, while none of the women athletes we tested were classified as having MetSyn. Further, BF% and VO_{2max} were strongly associated with various MetSyn risk factors. These findings suggest that despite high levels of physical activity, collegiate T&F throwers are an at-risk group for developing MetSyn. Since body composition and aerobic capacity were strong correlates of MetSyn risk factors, they may serve as inexpensive screening tools for identifying individuals who may require additional evaluation and possible interventions for promoting long-term cardiometabolic health.

Findings support and expand upon conclusions of previous research that explored MetSyn in athletic populations competing in strength and power sports. For example, previous research on Chinese elite heavy-weight athletes (i.e., throwers, weightlifters, and powerlifters) reported a MetSyn prevalence of 89% in men (n=52) and 47% in women (n=49).[7,31] While these results are higher than in our observed sample, their cohort included 1) multiple strength sports, and 2) all elite and professional athletes with greater training volume and competition demands, with a likely emphasis on achieving larger body sizes. Similar metabolic health concerns have been previously documented in collegiate football players, particularly in linemen. Studies have reported the MetSyn prevalence ranging from 7% to 49% in football players across all position types, with linemen accounting for up to 92% of all cases.[3,5,32–35]

The most prevalent risk factors for MetSyn in our sample were excessive waist circumference and reduced HDL cholesterol. When compared to elite male heavy-weight athletes as discussed above, 98% had at least 1 risk factor and 88% had at least 2 risk factors, with the most prevalent factors being central obesity (100%), high triglycerides (98%), hypertension (82%), low HDL (38%), and elevated glucose (33%).[7] Similarly, in college football linemen, 19% of players had 1 risk factor, 31% had 2 risk factors, 36% had 3 risk factors, 11% had 4 risk factors, and 0.1% had 5 risk factors present. In alignment, the most common risk factors were excessive waist circumference, elevated blood pressure, low HDL, and fasting glucose.[3,5] Interestingly, Steffes et al.[3] explored MetSyn in high school football players, and 54% of players had low HDL, 25% had elevated glucose, and 15% had elevated blood pressure, which differed compared to college players (35%, 52%, and 18%, respectively). While the long-term implications of these risk factors in athletic populations are largely unknown, it significantly increases the likelihood for the development and progression of chronic diseases, regardless of their current activity levels.[8]

The similar metabolic profiles observed in football linemen and T&F throwers are likely due to their comparable sport-specific training demands that encourage these athletes to prioritize strength and power development in a desire to increase fat free mass, often at the expense of aerobic conditioning. Performance success in both sports is dependent upon the ability to generate high levels of explosive force over short durations, leading to training regimens that emphasize strength and power development, improvements in anaerobic capacity and hypertrophic adaptations, while minimizing a reliance on endurance performance. Additionally, increased body mass is a critical factor in both sports, enhancing performance through improved blocking and tackling in football, and greater force production during throwing events. However, the pursuit of increased body mass often leads to an elevated BF %, as athletes focus on maximizing overall size without precautionary measures to minimize accumulations in fat mass, therein suggesting that sports emphasizing high body mass for performance may predispose athletes to increased metabolic health risks. Consequently, it is unsurprising that T&F throwers displayed a similar MetSyn profile to football linemen.

While an exploratory analysis, an interesting finding of our study was the strong association between BF% and various cardiometabolic risk factors, including systolic blood pressure, diastolic blood pressure, insulin, HOMA-IR, and triglycerides. These relationships underscore the critical role of adiposity in metabolic dysfunction and suggest that appropriate body composition management should be a key consideration while monitoring the programs and health of T&F throwers. Specifically, while fat-free mass accrual can remain a top training priority, efforts should be made to reduce concomitant increases in fat mass. In addition, we identified a strong inverse relationship between aerobic capacity and BMI, BF%, systolic blood pressure, and HOMA-IR, suggesting that regular aerobic exercise may provide protective effects against the deleterious health outcomes observed. While all other analyses in this study were stratified by gender, the correlations were conducted on the full sample. Subgroup correlations by gender were not performed due to the limited number of women (n = 4), which would not provide stable or interpretable estimates. In addition, these analyses should be viewed as exploratory and hypothesis-generating, providing direction for future studies with larger and more balanced samples to determine whether these associations remain strong, and differ by gender.

The mean VO_{2max} values for our men and women throwers were relatively low, reflecting the limited emphasis on aerobic conditioning in throwers' training programs. This finding suggests that incorporating structured aerobic interval training might serve as a protective mechanism against metabolic dysfunction without necessarily compromising sport-specific performance. In fact, Guo et al.[31] reported that following 12 weeks of aerobic training (180-420 minutes/week), 30% of elite heavy weight athletes became free of MetSyn (< 3 MetSyn components), decreasing the prevalence of MetSyn by 31% in women, and 23% in men. Further, fasting glucose, HDL, and blood pressure significantly improved, whereas BMI, waist circumference, and BF% improved in male athletes.[31] Specifically, high-intensity interval training (HIIT) may be an effective strategy to provide a sufficient stimulus to elicit the desired cardiorespiratory adaptations to improve aerobic capacity while reducing the chance of any interference effect associated with their strength and power training.[36]

The absence of MetSyn diagnosis among our sample of women throwers, despite similar training demands and sport-specific requirements, raises interesting questions about gender-based differences in metabolic risk. However, given the small sample size of women (n=4) in our study, these observations should be considered exploratory, and no definitive conclusions about gender-differences can be drawn. This finding does appear to align with broader epidemiological evidence demonstrating a lower MetSyn prevalence in women sport athletes[7] and women college-aged students when compared to age-matched men,[37–42] which is likely linked to the protective effects of estrogen.[43] The presence of individual risk factors (25-60%),[39,41,42] particularly reduced HDL cholesterol in our women sample, suggests that women and women athletes are not immune to cardiometabolic risk.

Limitations existed in the current study. The relatively small sample size, particularly for women athletes, limits the ability to run subgroup analyses, generalize findings, and draw robust conclusions about gender-based differences in metabolic risk. The number of correlations tested further increases the risk of Type I error. Additionally, dietary intake was not assessed, which could affect body fat and metabolic health, particularly in collegiate student-athletes who may be likely consume low nutrient dense, highly processed, high fat, and high sodium foods.[44,45] Lastly, the cross-sectional nature of the current study prevents the establishment of causal relationships or determining changes in metabolic health over time. It is recommended that future research address the aforementioned limitations through longitudinal studies that track metabolic health changes throughout throwers' collegiate careers and into retirement from competition.

Current findings provide a characterization of MetSyn indicators and associated risk factors among collegiate men throwers, suggesting that current training and dietary practices may have unintended negative consequences for body composition and long-term cardiometabolic health risks. The protective relationship observed between aerobic fitness and metabolic health provides a potential avenue for reducing MetSyn risk without compromising sport performance. These results emphasize the importance of regular metabolic health monitoring and the need for targeted interventions to promote diet-based performance strategies for long-term health adaptation, especially as throwers transition out of competitive sport. Similar to retired football linemen who show elevated rates MetSyn (prevalence: ~50-60%) post-career,[8,46,47] throwers may face increased health risks as their activity levels decrease while maintaining high body masses. Regular screening for MetSyn risk factors should be incorporated into routine health monitoring for collegiate throwers, with particular attention of body composition management and central adiposity.

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