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Relationship between Body Composition and Heart Rate Variability Measurements in Firefighters

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INTRODUCTION & AIM

Heart rate variability (HRV) reflects the balance of the autonomic nervous system (ANS). ANS control is strongly associated with body composition in the general population[1] and athletes[2], suggesting that obesity may indicate negative ANS outcomes. The occupational demands and work environment of firefighters promote high rates of obesity. For example, lack of time for healthy meals at consistent times throughout the day or poor nutritional choices stemming from chronic emotional distress.[3] ANS control is particularly important for firefighters, who have an unpredictable work schedule and who must switch between restful and active states at a moment's notice. Given the importance of ANS function in firefighters and the potential impedance of obesity, studies on the association between HRV and body composition in this unique population are needed. The aim of this study, therefore, was to investigate the relationships between measures of HRV and body composition in firefighters.

METHOD

Participants

Sixteen full-time male firefighters participated in this cross-sectional study. Anthropomorphic characteristics are listed in Table 1.

Characteristic	Mean	Standard deviation
Age (years)	34.37	8.43
Height (cm)	178.28	6.83
Weight (kg)	101.18	18.68
BMI (kg/m^2)	31.75	5.50
Body Fat Percentage (%)	25.21	8.28

Table 1. Descriptive statistics (mean and standard deviation) for sample

Instruments

Body fat percentage and body mass were measured using a bioelectrical impedance analysis device (InBody 570). Height was measured using a wall-mounted stadiometer (Continental Scale Corp.) Mass and height were used to compute BMI (body mass index). HRV data was measured and collected for later analysis with a Polar H10 heart rate monitor and chest-worn sensor. HRV data was processed using a commercially available software program (Kubios HRV Standard, version 3.5.0).

Procedures

In one visit to the AU Exercise Physiology Laboratory, participants completed informed consent paperwork and confirmed that they had adhered to all instructions to refrain from eating and exercising for 8 hours and to refrain from caffeine and nicotine for 12 hours prior to the data collection visit. Demographic variables (age, sex, and ethnicity) were documented at this time.

Height, body mass, and body composition were measured with shoes and socks removed, and only light athletic clothing worn. Participants donned the HR monitor sensor and assumed a seated position. For the next 10 min, resting HR was recorded with no distractions (e.g. talking, cell phones, books). The RR intervals throughout the data collection period were processed to assess the following HRV outcomes: RR interval, RMSSD, percentage of low-frequency power (LF), percentage of high-frequency power (HF), LF/HF ratio, parasympathetic nervous system index, and sympathetic nervous system index averaged over the 10-min. period.

Statistical analysis

Partial correlation coefficient analyses were performed between (a) BMI and (b) body fat percentage, and each of the HRV outcome variables, after adjusting for age. SPSS version 29 was used for statistical analysis (α=0.05).

RESULTS & DISCUSSION

No significant association was observed between any of the HRV measures and either (a) BMI or (b) body fat percentage ($p > 0.473$ for all). All correlation coefficients were considered weak or negligible ($-0.30 < r < 0.30$). Complete results for correlation analyses (*p*- and *r*-values) are displayed in Table 2.

HRV measure	BMI		Body Fat Percentage	
	p	*r*	*p*	*r*
Mean RR interval (ms)	0.856	-0.051	0.604	-0.146
RMSSD (ms)	0.537	0.173	0.649	0.128
Low frequency power (%)	0.579	-0.156	0.664	-0.122
High frequency power (%)	0.472	0.201	0.520	0.180
Low/High frequency power (ratio)	0.724	-0.100	0.856	-0.051
PNS index	0.902	0.035	0.820	-0.064
SNS index	0.883	-0.042	0.928	0.025

Table 2. Correlation analysis results between measures of body composition and measures of HRV (heart rate variability).

The lack of association between HRV measures and body composition/BMI was unexpected. The sample size in this study was likely a limiting factor for determining statistically significant linear relationships. Yet, the strength of relationships observed was also unexpectedly low compared to other reports. Rossi et al. reported a moderate correlation between lean body mass and several measures of HRV indicative of ANS function, both in athletes and non-athletes ($r > 0.456$, $p < 0.038$ for all).[2]

It is possible that there is a factor unique to firefighters which confounded or obscured the relationships of interest that have been reported elsewhere. For example, it is known that firefighters have high rates of post-traumatic and psychosocial stress[4], conditions which contribute to ANS dysfunction.[5]

Future studies in this research area should consider the effects of recently experienced physiological and psychological stress, and their potential impact on HRV measurement.

CONCLUSION

There was no association between body composition variables and HRV outcomes in this small sample of firefighters, in contrast to similar research showing a relationship between HRV measures and fat-free mass in trained athletes. A larger sample with more thorough consideration of stress is needed to make more generalizable conclusions.

FUTURE WORK / REFERENCES

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