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Letter to the Editor

Phase Angle as an Indicator of Health and Fitness in Patients Entering an Exercise Referral Scheme

To the Editor:

The loss of function as we age may be related to changes at the cellular level.¹ Recently, attention has been given to measurement of the **phase angle** (PhA); a noninvasive simple measure using bioelectrical impedance analysis (BIA). Indeed, **PhA is considered a valuable indicator of cellular health** and, as it is derived purely from electrical properties of the tissue, it **avoids** typical concerns associated with BIA **using prediction equations**. PhA is calculated from the arctangent of the ratio between the resistance and reactance from BIA, and a number of studies have evidenced its associations with age and sex,² lean body mass,³ and strength.⁴ Indeed, **PhA has even been shown to be predictive of mortality risk**.⁴

Physical fitness is important for health and longevity, and it has been argued that measurements should be considered routinely in clinical practice.^{5,6} Yet, many general practitioners (GPs) have too little time to engage in discussions around physical activity or fitness, let alone their measurement.⁷ However, BIA is a quick and simple measure and, **if PhA is predictive of such outcomes, may offer a valuable alternative for GPs and other clinical practitioners**. Despite various studies in other specific clinical populations,^{4,8,9} there is little research considering the typical person at elevated risk of cardiometabolic disease or type 2 diabetes who might present to a GP and be referred for exercise. As such, **the aim** of this study was to **examine the predictive value of PhA** with respect to these measures **in a sample of exercise referral patients**.

This study was a cross-sectional analysis of data collected in a wider trial of exercise referral schemes from **146 patients** who were **overweight and/or obese [body mass index (BMI) 25–35]**, and/or at **increased risk of type 2 diabetes** as determined by their GP. Relationships between PhA and a range of common health measures used as risk factors including BMI, systolic blood pressure, diastolic blood pressure, and body fat were examined, in addition to lean body mass, muscular strength, and cardiorespiratory fitness. The Pearson or Spearman correlations were performed dependent upon distribution and 95% confidence intervals calculated. Hierarchical multiple linear regression was also performed by examining the predictive capacity of PhA as the independent variable upon dependent variables and adjusting for inclusion of both age and sex. An α of 0.05 was accepted as the threshold for statistical significance.

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PhA was found to be significantly correlated with age ($r = -0.392$; -0.240 to -0.525), body mass ($r = 0.205$; 0.038 – 0.361), **lean mass** ($r = 0.353$; 0.197 – 0.492), and **muscular strength** ($r = 0.368$; 0.186 – 0.525). Model 1 considering PhA as an independent variable alone was significantly predictive of body fat, lean body mass, and muscular strength. However, variance explained for these was significantly increased when age and sex were included (model 3). The final models of PhA, age, and sex to predict body fat ($R^2 = 0.477$, $F_{(3,133)} = 40.376$, $P < .001$, adjusted $R^2 = 0.465$), lean body mass ($R^2 = 0.458$, $F_{(3,133)} = 37.391$, $P < .001$, adjusted $R^2 = 0.445$), and muscular strength ($R^2 = 0.278$, $F_{(3,98)} = 12.595$, $P < .001$, adjusted $R^2 = 0.256$) were all **statistically significant**. Model coefficients for body fat, lean body mass, and muscular strength are shown in **Table 1**.

Similarly to previous studies, our findings show **PhA appears to be primarily linked to elements of body composition and muscular health and fitness including body fat, lean body mass, and muscular strength**, whereas it was **not linked to** other traditional risk factors such as **BMI**, systolic blood pressure or diastolic blood pressure, or fitness measures such as cardiorespiratory fitness. Considering its ease of administration, **PhA might be considered as a simple indicator of cellular and overall muscular health, which could be employed by GPs in screening patients**.

Identification of low PhA might be a useful clinical marker to aid in prescription of exercise interventions for patients. As PhA appears to most strongly predict muscular health and fitness, it might be used to indicate patients who might benefit most from resistance training-based interventions. Despite GPs rarely prescribing physical activity of any kind, resistance training is an approach that receives comparatively less emphasis, even compared with other

Table 1
Model Coefficients for Body Fat, Lean Body Mass, and Muscular Strength

	Model 1		Model 2		Model 3	
	B	β	B	β	B	β
Body fat						
(Constant)	51.580**		58.165**		52.127**	
PhA	−2.193*	−0.187	−2.649*	−0.226	0.337	0.029
Age			−0.076	−0.099	0.111*	0.145
Sex					−15.994**	−0.714
Lean body mass						
(Constant)	21.530*		20.281		26.783*	
PhA	5.351**	0.366	5.438**	0.372	2.223*	0.152
Age			0.014	0.015	−0.188*	−0.196
Sex					17.225**	1.934
Muscular strength						
(Constant)	−6.092		−5.339		−0.324	
PhA	6.009**	0.337	5.956*	0.333	3.103	0.174
Age			−0.008	−0.007	−0.150	−0.129
Sex					14.175**	0.434

* $P \leq .05$; ** $P \leq .001$.

modalities. Simple approaches to resistance training using low volume and frequency in line with current guidelines are effective in improving PhA.¹⁰ Future work should consider larger samples and examine the effectiveness of different exercise referral schemes upon PhA to identify if this clinical marker can also be used to identify changes as a result of such interventions.

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