Running head: Mental Toughness and Barriers to Exercise

Title: Relationships between mental toughness, barriers to exercise, and exercise behaviour in undergraduate students

Authors: Elizabeth Stamp[a], Lee Crust[a], Christian Swann[b] & John Perry[c]

[a]School of Sport and Exercise Science, The University of Lincoln, Brayford Pool, Lincoln, Lincolnshire, LN6 7TS, United Kingdom

[b]Early Start Research Institute, Faculty of Social Sciences, University of Wollongong, Northfields Avenue, Wollongong, 2522, NSW, Australia

[c]Department of Sport Health and Exercise Science, University of Hull, Cottingham Road, Hull, HU6 7RX, United Kingdom

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Abstract

The present study explored relationships between mental toughness (MT), barriers to exercise, and self-reported exercise behaviour in university students. Perceived barriers to exercise are important since previous work has identified barriers as strong predictors of exercise behaviour. MT was hypothesised to predict exercise barriers and self-reported exercise behaviour. Participants were 173 undergraduate students (45 men, 128 women) from 10 United Kingdom universities. Questionnaires were used to assess MT, exercise levels, and exercise barriers. Path analysis identified that MT predicted barriers to exercise, with higher MT associated with weaker perceived barriers. Regular exercisers were found to have significantly higher MT than non-regular exercisers, with commitment identified as a key difference. These findings support the proposed hypotheses and provide further evidence of the importance of MT in exercise / physical activity contexts. Future research that adopts longitudinal designs and tests targeted interventions to reduce perceptions of barriers and enhance exercise participation are encouraged.

Keywords: Exercise, exercise barriers, higher education, individual differences, physical activity.

1.0 Introduction

Inactive lifestyle is one of the most serious threats to public health in the United Kingdom (UK) and across the western world (Lee et al., 2012; Townsend, Wickramasinghe, Williams, Bhatnagar & Rayner, 2015). Physical inactivity has been consistently associated with higher levels of obesity and increased risk of developing preventable chronic illnesses such as cardiovascular disease, diabetes, and osteoporosis (Lee et al., 2012). Despite the known physiological (e.g., cardiovascular, respiratory function) and psychological (e.g., wellbeing, mood) benefits of regular and frequent physical activity (PA) / exercise[1], it is evident that knowledge alone is not enough to facilitate the adoption and maintenance of active lifestyles (Buckworth, Dishman, O'Conner & Tomporowski, 2013). PA behaviour change and maintenance has proven complex and challenging and is influenced by numerous psychosocial, economic, environmental, and personal factors. For example, levels of PA in the UK and elsewhere have generally been found to decline when young people attend university (Bray & Born, 2004; Daskapan, Tuzun & Eker, 2006; Lovell, Ansari & Parker, 2010). Time at university signifies an important transition period into adulthood that represents an opportunity to influence PA behaviours (Lovell et al., 2010). One study found almost a quarter of students gained significant weight during the first semester of study (Wengreen & Moncur, 2009). This trend is concerning given that habits formed during early adulthood may impact upon life-long PA behaviour, with evidence that patterns of PA can remain relatively stable up to five years post-graduation (Sparling & Snow, 2002).

Numerous theoretical approaches have been developed and applied to understand health behaviours in general and PA in particular. One important framework is the Health Belief Model (HBM). The HBM predicts that the likelihood of engaging in preventative

[1] While the term 'exercise' is used throughout, we situate this within the broader conceptualisation of physical activity as a lifestyle behaviour of which exercise is a subcomponent.

health behaviours such as PA is a function of the perceived threat (inactivity in this case) and the relative costs (e.g., barriers, difficulties, hindrances), as opposed to benefits of adopting a new behaviour. Despite this prediction, evidence has identified a greater number of perceived PA barriers to be associated with lower levels of PA (Ross & Melzer, 2015). Much research has focused upon identifying the correlates of PA and, in particular, understanding the perceived barriers that predict low adoption and dropout, as an important prerequisite for designing and implementing interventions for change (Buckworth et al., 2013). Although it is not the aim of the current paper to test or extend models of behaviour, awareness of such models is important for exploring an individual's behaviour.

Sechrist, Walker and Pender (1987) presented four main categories of exercise barriers: (1) exercise milieu, which concerns the environment limiting participation (e.g., access to facilities, being embarrassed to exercise into front of others), (2) physical exertion, referring to the pain and discomfort of exercise deterring the individual from PA, (3) time expenditure, which concerns the amount of time exercise takes from other commitments, and (4) family discouragement, which reflects family members inhibiting exercise participation. Research concerning university students found that barriers such as lack of family support and unpleasantness of exertion (Daskapan et al., 2006; Lovell et al., 2010) are of high theoretical importance with influence dependent on demographics such as age, gender, and ethnicity. It is apparent that in PA / exercise settings most reported barriers are perceived rather than real (thus within personal control), and are indicative of priorities. It is therefore likely that individuals who have high control over their lives perceive fewer barriers to exercise.

Certain psychological traits (e.g., extroversion, neuroticism) have been found to predict PA / exercise behaviour. A meta-analysis (Rhodes & Smith, 2006) that included 33 studies examining a range of personality traits found extraversion (i.e., tendency to be lively,

energetic, sociable, seek excitement and experience positive affect) and conscientiousness (i.e., tendency to be organised, self-disciplined, and goal-oriented) to be significantly and positively related to PA (r = .23, 95% credibility interval of r = .08, .38; r = .20, 95% credibility interval of r = .06, .34 respectively). In contrast neuroticism (i.e., tendency to be emotionally unstable and anxious) was found to be a significant negative predictor of PA behaviour. When controlling for demographic factors, these reported relationships were found to explain a small but significant proportion of variance. In addition, two other important psychological variables (self-efficacy and self-motivation) have been found to be among the best predictors of PA behaviours, especially in the long-term pursuit of behavioural goals (Buckworth et al., 2013). As such, individual differences in key psychological variables have been found to be important in adopting and maintaining PA / exercise in light of numerous potential barriers that may need to be circumnavigated.

Mental toughness (MT) is defined as a collection of experientially developed and inherent values, attitudes, emotions, and cognitions that influence the way in which an individual approaches, responds to, and appraises both negatively and positively construed pressure, challenge, and adversity to consistently achieve his or her goals (Gucciardi, Gordon & Dimmock, 2009). It is generally agreed MT is a multi-dimensional construct which influences an individual's interpretation of a situation, and an important resistance resource linked to successful coping in adverse or stressful conditions (Nicholls, Levy, Polman & Crust, 2011). Although appearing similar to other psychological variables (e.g., hardiness, resilience) MT is a distinct construct. For example, whereas a hardy individual copes with challenges which are encountered, a mentally tough individual will seek challenges and even thrive off competition (Strycharczyk & Clough, 2015). Furthermore, hardiness does not consider the role of confidence which is consistently recognised as a key component of MT (e.g. Jones et al., 2002). Differences also exist between MT and resilience. Resilience refers

to coping during negatively construed situations and bouncing back, whereas MT incorporates the effect of positively construed situations and thriving on the pressure and challenge (Gucciardi, Gordon & Dimmock, 2008). Clough, Earle, and Sewell (2002) proposed that MT is represented by: (1) control (emotional and life), which reflects a tendency to feel and act as if one is influential, (2) commitment, which concerns deep involvement with whatever one is doing, in contrast to alienation, (3) challenge, refers to the extent to which individuals see problems as opportunities for self-development rather than threats, and (4) confidence (in abilities and interpersonal), reflecting a high sense of self belief and an unshakeable faith in having the ability to achieve success while not being intimidated when dealing with other people. More recently Clough and Strycharzyck (2012) have described MT as trait-like after behavioral genetic research found MT, like most traits, was influenced by a combination of inherited (95% CI of parameter estimates = .30, .62) and non-shared environmental factors (95% CI of parameter estimates = .38, .61; Horsburgh, Schermer, Veselka, & Vernon, 2009). In addition, Horsburgh et al. also found MT to be significantly correlated with all components of the common five factor taxonomy of personality (i.e., extraversion, conscientiousness, openness to experience, agreeableness and neuroticism; 95% CI of parameter estimates = .35, .68; .16, .60; .07, .43; .17, .58; -.77, -1.00 respectively). Subsequent work has supported the enduring properties, as well the variable nature of MT (Gucciardi, Hanton, Gordon, Mallet & Temby, 2015).

The importance of MT has been demonstrated in a plethora of applied settings such as business, health, and education (Clough & Strycharzyck, 2012). In higher education, MT was recently found to predict academic achievement and progression in 161 first year students; while those with lower MT were more likely to withdraw from their programme (Crust, et al., 2014). In addition, MT was found to predict psychological wellbeing across all levels of

undergraduate study (Stamp, et al., 2015). Thus MT appears to facilitate coping with the challenges associated with transition and also the ongoing demands of higher education.

Other work has begun to examine the relationship between MT and PA behaviours given that MT is a multidimensional construct that incorporates aspects such as commitment, self-confidence, and life control, which are likely important to adopting and maintaining target behaviours. Gerber et al. (2012) examined relationships between self-reported PA and MT in 284 high school students (M = 18 years). Higher levels of PA and exercise were significantly and positively related to overall MT and the subscales of life control, commitment and challenge, with those who met current PA guidelines reporting significantly higher MT than those who did not.

Using qualitative interviews with exercisers and exercise leaders, Crust, Swann, Allen-Collinson, Breckon and Weinberg (2014) sought to understand MT in exercise settings. Participants appeared to perceive fewer barriers to exercise; while injury, lack of energy, and time constraints were reported, participants made sacrifices and were adaptable to ensure exercise goals were achieved. It appears likely that exercisers with high or low MT experience similar potential barriers to exercise, but those higher in MT have somewhat different perceptions (i.e., challenge rather than threat) and appear more adept at coping with life demands to ensure enough time to remain physically active. This finding is consistent with research concerning MT and coping that has found tougher individuals employ more problem-focused coping strategies and less avoidance coping (Nicholls, Polman, Levy & Backhouse, 2008), and were more effective at coping with stressors remaining relatively unaffected (Gerber et al., 2013; Nicholls et al., 2011).

The present study examined relationships between MT and perceived barriers to exercise in undergraduate university students. We hypothesised that students with lower MT would perceive stronger barriers to PA. This population was chosen because the transition

from further to higher education is characterised by ambiguity and changing academic, social and emotional demands that require psychological adjustment (Macaskill, 2013; Wynaden, Wichmann & Murray, 2013). There is evidence that levels of moderate and vigorous PA drop significantly following transitions to college or University as other life stressors (i.e., independent living, assignment work, examinations etc.) impinge on lifestyle habits (Bray & Born, 2004; Han, et al., 2008). It is likely that individual differences account for some of this variance, in particular students with higher MT are predicted to perceive their environment and encountered situations as less threating, thus perceiving fewer barriers to overcome. When barriers are encountered students with higher MT are predicted to be better able to cope with the challenges of higher education and thus maintain pre-university lifestyles (e.g., PA). The main aim of the present study is to extend existing work on the relationship between MT and PA by examining self-reported levels of exercise in university students, and to evaluate perceived barriers to exercise within this population. Examining these relationships could be important in regards to identifying students at risk of adopting more inactive lifestyles and subsequently developing targeted interventions to attenuate the risks (e.g., change perceptions of barriers).

2.0 Method

2.1 Participants

Participants were 173 undergraduate university students (45 males, 128 females) from a range of undergraduate courses across 10 UK institutions. Participants' ages ranged between 18 – 40 years (M = 20.86, SD = 3.39). The majority of the sample was White British; approximately 5% were other ethnicities including Sri Lankan, Zimbabwean, and French. The sample was representative of students from a wide range of courses including Zoology, Fashion and Design, and Sport and Exercise Science. The sample consisted of 63

first years, 45 second years, and 65 third years, with 76% of the sample moving away from the family home to attend university.

2.2 Instruments

2.2.1 Self-reported PA. Initially the International Physical Activity Questionnaire (IPAQ; Craig et al., 2003) was used to record self-reported PA but following reliability issues one of the demographic questions, which asked participants if they partook in regular exercise at least three times a week, was used as an alternative measure. This presented as a dichotomous variable that indicated whether or not participants met pre-specified criteria. Thus, in the present study a regular exerciser was defined as an individual who exercises for 30 minutes or more at a moderate to vigorous intensity to maintain or improve health / fitness at least three times a week.

2.2.2 Exercise barriers. The exercise barriers scale from the Exercise Benefits and Barriers Scale (EBBS; Sechrist et al., 1987) was used to assess participants' barriers to exercise and took less than five minutes to complete. Although this is an older measure of exercise barriers, contemporary research has demonstrated the barriers appear relevant to current students. For example, pain of exercise (Lovell et al., 2010), family influences (Daskapan et al., 2006), lack of time (Gomez-Lopez, Gallegos & Extremera, 2010), and environmental factors such as lack of resources (Kulavic, Hultquist & McLester, 2013) have recently been reported to inhibit exercise participation. Furthermore, the EBBS has been used in recent research (e.g., Cantell, Wilson, Dewey, 2014; Stroud, Minahna, Sabapathy, 2009). Participants rated the 14 items that describe potential barriers to exercise on a 4-point Likert scale ranging from (1) strongly agree to (4) strongly disagree. The instrument provides an overall score as well as four individual component scores which represents the strength of each barrier (i.e., exercise milieu, physical exertion, time expenditure, family discouragement). Higher scores represented a weaker barrier to exercise. The barriers scale

was previously reported to have good internal consistency, construct validity (Brown, 2005), and test – re-test reliability (Sechrist et al., 1987).

2.2.3 Mental toughness. The Mental Toughness Questionnaire (MTQ48; Clough et al., 2002) was used to assess MT and took approximately 10 minutes to complete. This questionnaire consists of 48 items which participants rated on a 5-point Likert scale; ranging from (1) strongly disagree to (5) strongly agree. The instrument provides an overall MT score and a score for the six subscales (i.e. challenge, commitment, life control, emotional control, confidence in abilities, interpersonal confidence) with higher scores representing greater MT. Some acrimonious debate has ensued about measuring MT, and in particular the appropriateness of using the MTQ48 and the underpinning 4C's model (Clough, Earle, Perry, & Crust, 2012; Gucciardi, Hanton, & Mallett, 2012). While Gucciardi et al. report strong concerns and have called for use of the MTQ48 to cease, others have highlighted problems associated with applying an overly rigid assessment of model fit with multi-dimensional measures (Hopwood & Donnellan, 2010; Perry, Nicholls, Clough, & Crust, 2015). The MTQ48 has generally been reported to have good criterion, content, and construct validity (Clough et al., 2002); other studies have supported the reported factor structure (Horsburgh et al., 2009) and one large-scale psychometric analysis found broadly adequate psychometric properties (Perry, Clough, Crust, Earle & Nicholls, 2013). However, the reliability of the emotional control subscale has been identified as problematic (Perry et al., 2013). Nevertheless, emotional control is theoretically an important component of MT which should be retained within the model, thus Perry et al. (2013) recommended continuing to use the scale with caution, potentially removing two problem items to achieve better fit indices.

2.3 Procedure

Following ethical approval from a university research ethics committee, six academic staff known to the research team were contacted via e-mail and asked to disseminate to

students, a link to the online questionnaire. The link contained an advertisement for students to participate in a study exploring psychological characteristics and lifestyle choices. A broad description of the study was forwarded to avoid a biased sample, for example being more appealing to students who regularly exercise, and reduce socially desirable responses. Given the relatively equal split of regular exercisers (57%) and non-regular exercisers (43%), it appeared as though the sample was not overtly biased towards exercisers. Staff were from a range of departments and institutes, resulting in students from 10 universities being represented in the current study. The self-paced questionnaire consisted of demographic questions, as well as standardised questionnaires previously described, and took approximately 20 minutes to complete. The order the questions were administrated were: (1) demographic questions (age, ethnicity, changes in PA since attending university), (2) MTQ48, (3) IPAQ, and (4) EBBS. Data collection occurred half way through the academic year. Following completion of the questionnaire an online written debrief was provided.

2.4 Data Analysis

Data was initially screened for outliers and missing variables. Mean, standard deviation, skewness and kurtosis of variables were calculated prior to proceeding with further statistical analysis. Omega point estimates and confidence intervals were used to assess the internal consistency of the questionnaires, as omega holds fewer assumptions about the scale and sampling than alpha (Dunn, Baguley, & Brunsden, 2013). Regular and non-regular exercisers' MT and exercise barriers were compared using independent *t*-tests with 5,000 bootstraps to generate confidence intervals. Pearson correlations explored the relationships between MT and exercise barriers. A path analysis model was examined posited MT components as predictor variables of exercise barriers whilst controlling for age, gender, and year of study.

3.0 Results

No missing data was evident. Tests of univariate normality found all data were within standard limits of kurtosis and skewness (< 2). Descriptive statistics are displayed in Table 1. We calculated Omega point estimates and confidence intervals using the MBESS package (Kelley & Lai, 2012), in R (R Development Core Team, 2012), with 1,000 bootstrap samples.

Subscales of MT had good internal consistency (i.e., > .70) with the exception of emotional control (.49 [95% CI = .28, .60]) and life control (.69 [95% CI = .57, .78). Life control internal consistency was deemed to be at the lower end of acceptability. Inter-item correlation matrix was examined to identify troublesome items of emotional control. Negative correlations were identified between items 26 and 34, which is in line with previous research (Perry et al., 2013) resulting in the removal of these items. This resulted in the five remaining components presenting omega of .60 (95% CI = .44, .66). The remaining items were used as a measure of emotional control in all proceeding analyses. All exercise barrier scales presented good internal consistency, with the exception of family discouragement (.56, 95% CI = .40, .70). This is to be expected, as this subscale only includes two items. These items were reasonably well correlated (.39, 95% CI = .23, .55).

Regular exercisers' overall MT (M = 3.43, SD = .41) was significantly higher than non-regular exercisers' MT (M = 3.26, SD = .55, $p < .05$, d = .35). The regular exercisers reported significantly weaker overall barriers to exercise (M = 3.21, SD = .48) than non-regular exercisers (M = 2.68. SD = .45, $p < .001$, d = 1.14). Differences in overall MT and individual barriers to exercise between regular and non-regular exercisers are presented in Table 2. Although there are statistically significant differences in MT, it should be noticed that these are small effects. Thirty percent of the sample reported a reduction in exercise levels after starting university.

The relationships between MT components and exercise barriers were explored using Pearson's bivariate correlations with 95% confidence intervals achieved from 5,000 bootstrapped samples (Table 1). Overall MT was significantly correlated with overall barriers to exercise (r = .35, 95% CI = .19, .50, p < .01). The strongest relationships existed between exercise milieu and life control (r = .38, 95% CI = .22, .52, p < .01), and exercise milieu and confidence in abilities (r = .36, 95% CI = .20, .49, p < .01) which displayed a moderate relationship.

To determine the extent to which MT variables were predictive of exercise barriers, we examined a path model using Mplus 7 (Muthén & Muthén, 2012). We employed the maximum likelihood estimator and obtained confidence intervals by running 5,000 bootstrapped samples. Age, gender, and year of study where inserted as moderating variables. The results (Table 3) indicated that emotional control negatively predicted exercise milieu (β = -.22, 95% CI = -.45, .02, p < .05) and time expenditure (β = -.24, 95% CI = -.51, .04, p < .05). In contrast confidence in abilities positively predicted the same two exercise barriers (exercise milieu: β = 27, 95% CI = -.05, .53, p < .05; time expenditure: β = .41, 95% CI = 07, .72, p < .01). Physical exertion was positively predicted by commitment (β = .20, 95% CI = -08, .46, p < .05) and there was a non-significant trend to suggest a positive association for physical exertion on confidence in abilities (β = .21, 95% CI = -.10, .51, p = .06). Family discouragement was not predicted by any components of MT.

4.0 Discussion

The main aim of the present study was to evaluate relationships between MT, perceived barriers to exercise, and self-reported exercise behaviour, across a broad range of undergraduate students. Several important findings emerged. First, in support of the main hypothesis, MT was found to be significantly and positively related to the strength of perceived barriers to exercise (r = .35, p < .01). That is, participants with lower MT perceived

barriers to exercise to be stronger thus more of an obstacle to overcome, or deterrent to exercise. This finding is consistent with previous research that has shown MT to be related to different perceptions during challenging situations (Clough et al., 2002; Levy et al., 2006) and greater optimism (Nicholls et al., 2008). Theoretically this result is important given the role of perceived barriers in predicting actual behaviour in the HBM. The present evidence highlights that individual differences such as MT are important in determining how barriers are perceived, and in turn influence actual behaviour. In terms of barriers, although all barriers were significantly related to MT, exercise milieu (environmental factors) was found to have the strongest relationship. Commitment and control have previously been significantly and positively correlated with meeting PA guidelines (Gerber et al., 2012), which is consistent with the current study that found commitment to be a key distinguishing factor between regular and non-regular exercisers.

Commitment emerged as a key component of MT in the present study and was found to be the strongest predictor of the physical exertion barrier. This is consistent with Crust et al. (2014) who reported mentally tough exercisers were highly committed, exhibited high volumes and intensity of training, enjoyed punishing training schedules, and associated exercise pain positively as an indication of working hard. Crust et al. also found mentally tough exercisers prioritised exercise, organised their time effectively and made sacrifices to ensure exercise goals were achieved. Previous research also identified commitment to be significantly and positively correlated with pain-tolerance, and negatively associated with pain catastrophising during sports rehabilitation (Levy et al., 2006). Commitment is significantly related to conscientiousness which in turn has been found to be a significant predictor of PA (Rhodes & Smith, 2006).

Confidence in abilities was the strongest predictor of exercise milieu and time expenditure barriers. This is congruent with previous findings that confidence in abilities is

related to planning and logical analysis, which enables the individual to transform perceived unmanageable events to appear manageable (Nicholls et al., 2008). Despite family discouragement being significantly related to MT there were no individual MT components which were significant predictors, however this was found to be the weakest barrier to exercise.

Consistent with the findings for MT and exercise barriers, students who participated in regular exercise reported significantly higher MT than those who did not. This result with university students supports previous work that found differences in MT between high school students who reported no days, as opposed to three or more days of vigorous PA per week (Gerber et al., 2012). While Gerber et al. (2012) highlighted differences in coping as one potential explanation, and the possibility that involvement within PA contexts could develop MT, present findings indicate the importance of perceptions. The role of commitment was also reinforced as the factor most clearly differentiating between regular and non-regular exercisers.

As expected, regular exercisers reported significantly weaker barriers to exercise than non-regular exercisers, which shows perceived barriers to exercise is related to actual exercise behaviour. This finding is consistent with the HBM which proposes the associated costs of behaviour (i.e., barriers to exercise) are related to actual behaviour (i.e., exercise). The strongest barrier found amongst the current sample was physical exertion (hard work, associated fatigue) which is consistent with a previous study of non-exercising female UK university students (Lovell et al., 2010). Similar to previous work (Bray & Born, 2004) current findings identified 30% of students reported decreased exercise behaviour since starting university. It would appear that some students are better able to adjust to the upheavals and challenges of University life. The decline in exercise levels amongst some

university students highlights the importance of personal resources in overcoming perceived exercise barriers.

The current findings demonstrate the importance of MT as a predictor of exercise / PA, and provide further evidence that individual differences are part of a complex range of factors that determine exercise / PA behaviours (Rhodes & Smith, 2006). High levels of MT are associated with effective time management, maintaining several commitments at once, doing things which an individual does not want to, working hard, having a sense of purpose, being less influenced by others, perceiving to have control and self-selecting behaviours as opposed to 'drifting' through life (Clough & Strycharzyck, 2012). Furthermore, mentally tough individuals directly address problems (Nicholls et al., 2008) and effectively cope with stressors (Gerber et al., 2013). Thus these individuals may be more effective at adapting to the challenging environment of higher education and circumnavigating perceived barriers to exercise. In contrast, individuals with lower MT tend to adopt more avoidance coping strategies (Nicholls et al., 2011), and view obstacles as threats to be avoided. This may explain why these individuals perceive stronger barriers to exercise.

One strength of the current study was the inclusion of participants from all three undergraduate years, from a range of subjects, and from across several institutions. Furthermore, adopting a multidimensional approach to measuring MT enabled the effect of individual components to be identified which may help future researchers to develop and test targeted interventions. Given that present findings identified differences in perceived rather than actual barriers, future researchers may wish to examine the effects of interventions to change perceptions. Similar approaches to those adopted in sport psychology that have shown performance benefits from training participants to perceive anxiety as more facilitative (Hanton & Jones, 1999), may be useful in exercise / PA settings (e.g. learning to perceive exercise fatigue as indication of a beneficial workout). Given present findings, university

students with lower MT and those who perceive greater barriers to exercise may benefit from targeted interventions to develop confidence and commitment; two components of MT seen as crucial in regards to achieving exercise goals (Crust et al., 2014). For example, setting goals to enhance commitment to achieve a weekly exercise target (Clough & Strycharzyck, 2012).

Limitations of the present study include the possibility of socially desirable responding, a concern associated with all types of questionnaires. Online data collection is difficult to control in terms of potential influences on respondents (e.g. others being present). Furthermore, only a small percentage of students contacted (around 10%) actually completed the questionnaire with the majority being female respondents, however, gender was not found to be a significant predictor in the current study. The present study employed a self-report measure of exercise whereas to gain more precise measures future researchers should consider measuring actual PA via methods such as accelerometry. Furthermore, the use of a cross-sectional design provides a snapshot analysis of the relationships between MT, exercise barriers and exercise behaviour, while future work should consider longitudinal designs, to examine behaviours long-term or assess the effectiveness of targeted interventions or environmental manipulation on PA. In addition to modifying an individual's MT, institutions could make changes to reduce perceived barriers. For example, by promoting convenient times and locations of low cost exercise sessions, or providing sessions which are lower intensity and allow beginners to develop confidence and achieve goals.

5.0 References

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1 Table 1

2 *Descriptive statistics, normality estimates, internal consistency coefficients, and bivariate correlations*

Variable	M ± SD	Skew	Kurt	1	2	3	4	5	6	7	8	9	10	11	12
Overall MT (1)	3.36 ± .48	-.70	1.29	(.92 [.90, .94])											
Challenge (2)	3.54 ± .55	-.51	.55	.77** [.70, .83]	(.70 [.61, .77])										
Commitment (3)	3.49 ± .58	-.51	.55	.79** [.71, .85]	.55** [.42, .66]	(.81 [.75, .85])									
Emotional control (4)	2.86 ± .69	-.06	-.33	.73** [.65, .80]	.60** [.50, .69]	.42** [.26, .55]	(.60 [.44, .66])								
Life control (5)	3.45 ± .56	-.77	1.67	.80** [.72, .86]	.48** [.33, .62]	.63** [.52, .72]	.46** [.32, .57]	(.69 [.57, .78])							
Confidence in abilities (6)	3.14 ± .69	-.42	.04	.85** [.81, .89]	.55** [.42, .65]	.56** [.42, .67]	.63** [.53, .72]	.69** [.59, .77]	(.84 [.79, .87])						
Interpersonal confidence (7)	3.50 ± .75	-.45	-.06	.60** [.49, .69]	.39** [.25, .51]	.29** [.11, .45]	.38** [.24, .50]	37** [.21, .52]	.39** [.25, .52]	(.78 [.71, .83])					
Total barriers (8)	2.98 ± .54	-.05	-.52	.35** [.19, .50]	.21** [.03, .38]	.29** [.12, .44]	.18* [.02, .33]	.36** [.20, .49]	.38* [.23, .51]	.15* [-.01, .30]	(.87 [.83, .89])				
Exercise milieu (9)	3.06 ± .62	-.22	-.42	.35** [.17, .50]	.21** [.01, .39]	.30** [.13, .45]	.16* [-.01, .31]	.38** [.22, .52]	.36** [.20, .49]	.15 [-.02, .30]	.89** [.86, .92]	(.79 [.73, .83])			

Physical exertion (10)	2.48 ± .76	.17	-.36	.25** [.09, .39]	.19* [.03, .33]	.26** [.11, .41]	.18* [.03, .33]	.19* [.03, .33]	.25** [.09, .40]	.04 [-.14, .21]	.66** [.57, .75]	.43** [.28, .56]	(.78 [.71, .83])		
Time expenditure (11)	3.14 ± .75	-.95	.67	.20** [.05, .34]	.09 [-.05, .23]	.09 [-.07, .24]	.07 [-.09, .23]	.21** [.04, .37]	.28** [.13, .41]	.13 [-.04, .28]	.79** [.73, .85]	.61** [.52, .70]	.30** [.15, .44]	(.83 [.75, .87])	
Family discouragement (12)	3.25 ± .68	-.49	-.52	.23** [.09, .36]	.13 [-.01, .28]	.17* [.03, .30]	.14 [-.01, .27]	.25** [.10, .39]	.23** [.09, .37]	.14 [-.02, .29]	.65** [.55, .75]	.44** [.31, .57]	.30** [.15, .44]	.54** [.38, .67]	(.56 [.40, .70])

Note. 95% Bootstrapped confidence intervals presented in brackets. Internal consistency coefficients presented along the diagonal in parentheses. * Statistically significant at $p < 0.05$; **Statistically significant at $p < 0.01$.

Table 2

Independent samples t-test

Variable	Regular exercisers (n = 99) ($M \pm SD$)	Non-regular exercisers (n = 74) ($M \pm SD$)	Mean Diff (95% CI)	*D*
Overall MT	3.43 ± .41	3.26 ± .55*	.18 (.03, .33)	.35
Challenge	3.58 ± .52	3.48 ± .59	.10 (-.07, .27)	.18
Commitment	3.58 ± .52	3.37 ± .63**	.22 (.04, .39)	.36
Emotional control	2.91 ± .64	2.79 ± .75	.12 (-.09, .33)	.17
Life control	3.49 ± .45	3.39 ± .68	.10 (-.08, .28)	.17
Confidence in abilities	3.24 ± .63	3.00 ±.75*	.25 (.03, .46)	.35
Interpersonal confidence	3.60 ± .68	3.38 ± .82*	.22 (.00, .46)	.29
Overall barriers	3.21 ± .48	2.68 ± .45***	.53 (.39, .67)	1.14
Exercise milieu	3.30 ± .58	2.74 ± .53***	.56 (.39, .72)	1.01
Physical exertion	2.70 ± .77	2.20 ± .67***	.49 (.27, .71)	.69
Time expenditure	3.40 ± .58	2.80 ± .81***	.60 (.39, .82)	.85
Family discouragement	3.42 ± .62	3.03 ± .69***	.39 (.19, .59)	.60

Note. A higher MT score represents higher MT, a higher exercise barrier score represents a weaker barrier.

* Statistically significant at $p < 0.05$.

**Statistically significant at $p < 0.01$.

*** Statistically significant at $p < 0.001$.

Table 3

Standardized path estimates with 95% bootstrapped confidence intervals

Variable	Exercise milieu	Physical exertion	Time expenditure	Family discouragement
Challenge	.06 (-.26, .36)	.06 (-.24, .32)	.04 (-.21, .28)	-.01 (-.27, .25)
Commitment	.12 (-.12, .35)	.20 (-.08, .46)*	-.07 (-.32, .18)	.03 (-.23, .30)
Emotional control	-.22 (-.45, .02)*	-.07 (-.33, .19)	-.24 (-.51, .04)*	-.01 (-.29, .27)
Life control	.18 (-.11, .47)	-.05 (-.33, .27)	.03 (-.31, .38)	.13 (-.20, .41)
Confidence in abilities	.27 (-.05, .53)*	.21 (-.10, .51)	.41 (.07, .72)**	.13 (-.20, .46)
Interpersonal confidence	-.02 (-.22, .18)	-.09 (-.33, .17)	.02 (-.23, .25)	.03 (-.20, .26)

Note. * Statistically significant at $p < 0.05$; **Statistically significant at $p < 0.01$.