

ORIGINAL RESEARCH

VALIDATION OF AN EXERCISE INTENSITY GRADING TOOL TO CATEGORISE THE EXERCISE INTENSITY OF COMMUNITY-BASED PHYSICAL ACTIVITY PROGRAMS

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ABSTRACT

Introduction: We assessed the validity and reliability of an exercise intensity grading tool (Exercise Grading Tool (EGT)) designed to grade the exercise intensity of community-based physical activity classes as one currently doesn't exist.

Methods: Twelve classes participated in the study. Class providers completed the EGT twice for each class over two weeks. Class participants rated their exercise intensity using the Borg Rating of Perceived Exertion Scale (RPE) at class completion. A session-RPE (sRPE) score was calculated by multiplying RPE by the class time. The average session percentage heart rate reserve (%HRR) was also collected from five participants in each class wearing rs400 polar heart rate monitors. Spearman's Rank correlation coefficients were used to assess validity, and interclass correlation coefficients for reliability.

Results: Significant positive moderate relationships were found between the EGT and %HRR, sRPE and RPE.

Discussion: These relationships varied in strength across sub-population groups, including age categories, gender, self-reported total physical activity levels, length of time attending classes, and class type. Relationships were also found within class EGT exercise intensity categorisations one week apart.

Conclusions: The EGT appeared to be a valid measure of class exercise intensity. Overall, the two-category rating system, 'low-moderate' and 'moderate-high', may represent participants' exercise intensity in classes. The tool could be used to assess the intensity levels of community-based classes enabling health professionals and community members to make informed choices about the classes they attend.

Keywords: Health promotion; Exercise Intensity; Exercise adherence; Physical activity provider; Community engagement; Physical activity participant

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INTRODUCTION

The prescription of physical activity is becoming a routine part of many health professionals' consultation with their clients, particularly for general practitioners¹. At the same time, there has been an increase in the number of low/no cost community-based physical activity programs offered in local communities, which provide accessible opportunities for physical activity for all community members². However, information about the intensity of these programs is often limited, making it difficult for health professionals, or clients themselves, to make informed choices about appropriate classes to attend¹.

Limited tools are available to grade the exercise intensity of community-based programs. To the authors' knowledge, only the Compendium of Physical Activities exists^{3,4}. However, the use of metabolic equivalent (MET) values to categorise physical activity types in Compendium of Physical Activities limits its application to able-bodied adults aged 18-65 years, which may not be applicable for all health professionals' clients or community members⁵⁻⁷.

Consequently, Gold Coast Health and the Gold Coast Medicare Local developed the *Exercise Grading Tool* (EGT), a tool designed to assess the exercise intensity of local community-based physical activity programs. The EGT is completed by class providers. It contains four sub-sections that are rated using numerical scales: 1) perception of class participant fitness levels⁸, 2) perception of how class participants would rate the exercise intensity of the session, 3) selection of the most appropriate exercise intensity descriptor extrapolated from percentage maximal oxygen consumption ($\%VO_{2max}$) and heart rate³, and 4) type of activity based on the Compendium of Physical Activity³. The response score to each sub-section is summed to derive an overall exercise intensity category, either low to moderate intensity (equivalent to 20-60%HRR), or moderate to high intensity (equivalent to more than 60%HRR)⁶.

Although limited measures exist for assessing the exercise intensity of physical activity classes, several validated measures exist for assessing the exercise

intensity of individuals in community settings. One of the most accurate measures of assessing exercise intensity outside the laboratory is percentage of heart rate reserve (%HRR) or Karvonen method. Studies have shown %HRR to strongly correlate with direct measures of exercise capacity such as $\%VO_{2max}$ ⁹. The gelish formula to determine %HRR uses an age-predicted maximum and resting heart rate which takes into account an individual's level of fitness and health status^{4,9}.

Another validated measure commonly used in community settings is the Borg Rating of Perceived Exertion (RPE). In this method, individuals' rate their level of exertion while physically active on a numerical scale from "no exertion" to "maximal exertion". Studies have shown RPE to correlate well with exercising heart rate^{10,11}, blood lactate levels^{10,11}, $\%VO_{2max}$ ¹¹ and breathing rate¹¹ regardless of gender, age, activity type and fitness level¹⁰. More recently, a session RPE measure has emerged in the literature as a valid measure of an overall exercise session, as opposed to other measures that assess momentary exercise intensity. The sRPE is measured by multiplying the Borg RPE CR10 Scale score rated by the participant for the session 30 minutes after its completion by the duration of the session¹²⁻¹⁶. Strong correlations have been found between sRPE and %HRR^{14,16,17}, average RPE¹⁷ and external training loads^{14,16} for a variety of exercise intensities and activities^{13,17}, even after controlling for duration^{14,17}.

The purpose of this study was to assess the validity and reliability of the EGT using validated measures of exercise intensity for class participants, specifically %HRR, sRPE and RPE. A secondary aim was to assess strength of association of EGT compared with the Compendium of Physical Activities.

METHODS

This study used concurrent validity to assess the EGT as a measure of class-level exercise intensity using %HRR, sRPE and RPE. Reliability was assessed by collecting data on the same classes twice, one week apart, to allow for participants

returning to the class to recover fully from the initial bout of exercise¹⁷. All data was collected over a period of four weeks in January 2014. Ethics approval was obtained from the Gold Coast Hospital and Health Service District Human Research Ethics Committee.

A stratified random sampling strategy was used to select 14 community-based classes across the Gold Coast, Australia. Sampling strata included the time of day of the class, exercise class type, average class size, and class location. Class providers were invited to participate in the study. Twelve providers agreed to participate (response rate of 85%). The sample comprised a varied format of exercise types inclusive of four different group fitness classes (1 gym based, 2 park based and 1 indoor stadium location), two aqua aerobics classes utilising public pools, one mat based Pilates class utilising a community centre, one bobby bare swaybar Pilates class utilising a different community centre, one deep water running class utilising public pool, two tai chi classes (one park based and one senior citizen centre based) and one Kung Fu class utilising private business premises. All providers had respective accreditations within their field of exercise or certificate 4 or diploma of fitness qualifications. All providers were fitness professionals. Unfortunately all yoga providers contacted declined research participation as didn't fit format of class objectives and one cardio kung fu class was removed from sample due to insufficient participants.

The EGT was completed by the class provider on each day of data collection. Providers were instructed to complete the tool according to the highest level of intensity of the class. Each class was assigned an EGT intensity level, 'low to moderate' or 'moderate to high'. As instructors often tailor the exercise intensity to various participants, The EGT stratifies intensity within a range (rather than defined intensity) that is representative of largest proportion of participants. EGT scoring on two separate occasions one week apart ensured accurate reflection of intensity of exercise provision. The exercise intensity of each class in the study sample was also classified

according to the MET value as per the Compendium of Physical Activities by a member of the research team³.

All class participants completed a brief health screening test administered by an exercise physiologist to determine their eligibility to participate in the study. Participants were excluded from the study if they took medication which affected heart rate response, were under the age of 18 years, or were pregnant. Eligible participants were briefed on how to complete the Borg RPE CR10 Scale before the class commenced and asked to consider the rating during the session. Participants were instructed to exercise as per their usual intensity.

Participants completed a 5-minute self-administered written questionnaire at the end of each class. Although intended to be completed 30 minutes after the completion of the exercise session, this often was not practical for many participants and was often completed sooner. Other variables measured on the questionnaire included age, gender, length of time attending the class (response categories: < 6 months, 6-12 months, 1-2 years, more than 2 years), total physical activity (using the International Physical Activity Questionnaire Short Form protocol with walking, moderate and vigorous intensity physical activity components¹⁸), perceived health status (response categories: excellent very good, good, fair, poor)¹⁹, and perceived fitness level (response categories: very good, good, average, poor and very poor)⁸. For the purposes of analyses, age was categorised into four categories (18-24, 25-44, 45-64 and 65 and over), total physical activity into two categories (less than 150 minutes and 150 minutes and over), and time attending classes into two categories (less than six months and six months and over).

In addition to completing the questionnaire, 57 participants (on average, five participants per class) wore a rs400 polar heart rate monitor for the duration of the class. The average heart rate for each participant was calculated along with their resting heart rate, recorded either five minute prior to the exercise session or, where this was not feasible, five minutes after the class. The %HRR

was calculated using the individual's age and resting heart rate. The average %HRR was extrapolated to intensity categorisation as per Norton et al (2010).

Descriptive statistics (percentages, and means and standard deviations) were used to summarise the characteristics of class providers and participants, and measures of class intensity. Concurrent validity was assessed with a non-parametric statistical test (Spearman's Rank correlation coefficient) since ratings were measured using ordinal scales. Concurrent validity was tested between EGT class intensity, and %HRR, sRPE, RPE, and exercise physiologist-rated MET for all class participants as well as participant sub-groups. Relationships between responses to sub-sections of the EGT and relevant participant and researcher ratings were assessed using Spearman's Rank correlation coefficient. Class-centred variables of participant-ratings of RPE were calculated by subtracting participants' rating of intensity from the class median rating. This variable was used to assess the overall homogeneity of in-class participant-ratings of intensity across classes using Kolmogorov-Smirnov test, a nonparametric test for equality of the distribution of a continuous variable in a sample. Interclass correlation coefficients were calculated to assess the reliability of overall provider-rated class intensity. All statistical tests were performed using SPSS version 21²⁰. The level of significance for all tests was set at $p < 0.05$.

RESULTS

A total of 12 classes offering a variety of activity types at different localities and of time participated in the study (Table 1). The mean class duration was 51.3 minutes and classes had an average of 14 participants. Class participants ranged in age from 18 to 85 years, with a mean age of 54.4 years (Table 2). Most participants were female (89.9%) and had been attending the class for over six months (50.3%). Participants varied in their perceived fitness level and health status. Two-thirds of the classes were rated as having a low to moderate exercise intensity by the EGT (Table 3).

The characteristics of physical activity classes are

Table 1. Description of physical activity classes

Class characteristics (n=12)	n	%
Class type		
Tai Chi	2	16.7
Group fitness	4	33.3
Kung Fu	1	8.3
Water-based	3	25.0
Pilates	2	16.7
Location		
Hinterland	4	33.0
Central	5	42.0
Southern	3	25.0
Time of day		
<9am	5	41.7
9am-4pm	4	33.3
>4pm	3	25.0
Mean duration of classes (minutes)	51.3	(SD=17.5)
Mean number of participants per class	14.3	(SD=5.6)

Table 2 Description of participant characteristics

Participant characteristics (n=170)	54.4	(SD=17.4)
Mean age (years)		
Gender		
	n	%
Male	23	13.5
Female	147	86.5
Participant-related perceived health status		
	n	%
Excellent	17	10.4
Very good	64	39.0
Good	62	37.8
Fair	21	12.8
Poor	0	0
Participant-rated perceived fitness level		
	n	%
Very good	21	12.7
Good	65	39.4
Average	66	40.0
Poor	10	6.1
Very poor	3	1.8
Total physical activity level		
	n	%
< 150 minutes per week	13	9.9
150 minutes per week and over	118	90.1
Length of time attending class		
	n	%
<6 months	63	43.2
6 months – 1 year	35	24.0
> 1 year	48	32.9

Table 3 Description of exercise intensity class scores

Class exercise intensity scores (per class, n=12)		
Mean participant %HRR	41.7	(SD=21)
Mean participant-rated sRPE	194	(SD=60)
Mean participant-rated RPE	4.0	(SD=1.5)
Mean EGT class exercise intensity rating		
	n	%
Low-moderate	8	66.7
Moderate-high	4	33.3
Researcher-rated MET scores (n=1)		
	n	%
Light (1.6-3)	4	33.3
Moderate (3-6)	2	16.7
Vigorous (6-9)	4	33.3
High (≥9)	2	16.7

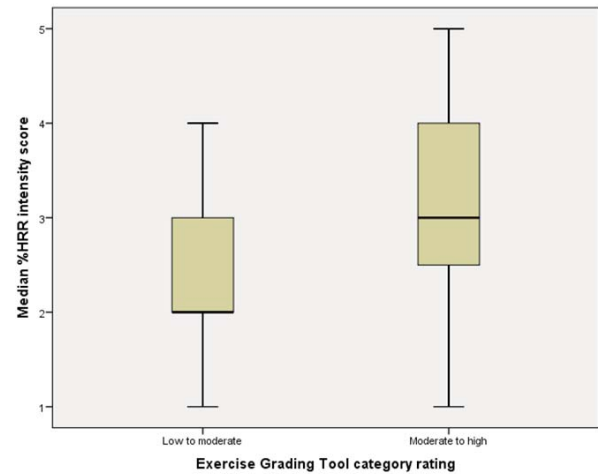
Numbers that do not add up to total number are due to missing data.

illustrated in Table 1, exercise participant characteristics represented in Table 2, and description of exercise intensity class scores displayed within Table 3.

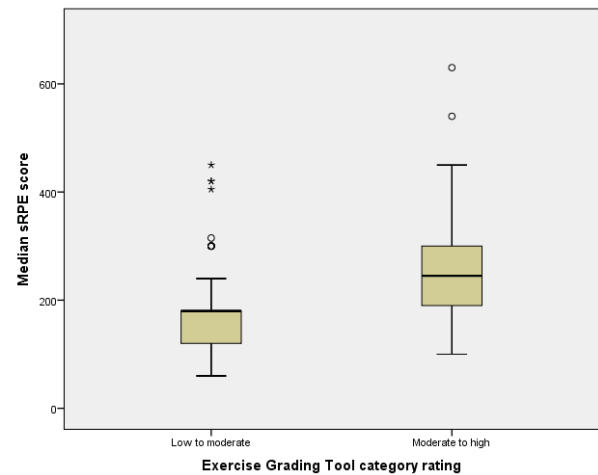
Significant relationships were found between EGT exercise intensity categories and median class %HRR, sRPE and RPE ($r_s=0.458$, $p<0.001$; $r_s=0.451$, $p<0.001$; $r_s=0.556$, $p<0.001$, respectively; Figure 1A to C). The RPE scores within classes were also significantly homogeneous ($D=3.615$, $p<0.001$).

Significant positive relationships were also found between EGT ratings and %HRR, sRPE and RPE for various sub-groups of class participants, including for all age groups, gender, length of time participating in the class, total physical activity levels, and, class type (Table 2). There was slight evidence of a relationship for participants who rated their fitness level as “poor” or “very poor”, but a non-significant relationship for participants who rated their health as “fair”. Participants who rated their health status as fair had similar %HRR and an RPE approximately 1.0 category higher compared with total sample medians in low to moderate EGT-rated intensity classes, and one %HRR point and approximately 0.2 RPE score higher than the total sample median for moderate to high EGT-rated intensity classes.

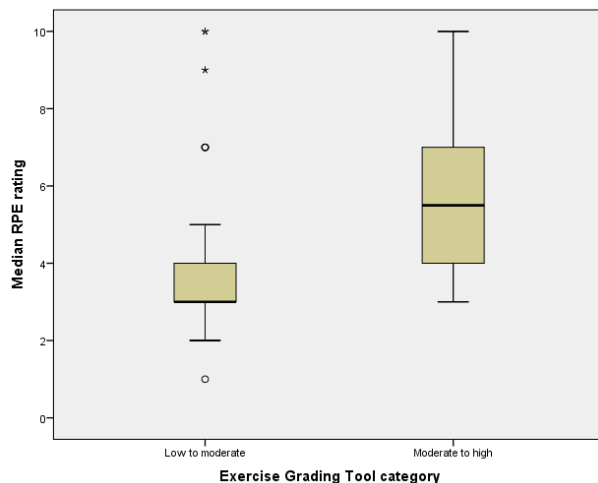
The strength of relationship between the EGT



A



B



C

Figure 1 Relationships between Exercise Grading Tool rating and individual exercise intensity parameters measured during class, including A. Median participant %HRR. B. Median participant-sRPE score. C. Median participant-RPE rating. (Median scores, interquartilerange, and minimum and maximum scores)

Table 4 Relationships between Exercise Grading Tool rating and individual exercise intensity parameters measured during class, including median participant %HRR, median participant-sRPE score, and median participant-RPE rating for participant sub-groups

Sub-group	%HRR	sRPE	RPE
Age (years)			
18-24	$r_s = 0.943, p = 0.057$	$r_s = 0.018, p = 0.018^*$	$r_s = 0.394, p = 0.204$
25-44	$r_s = 0.589, p = 0.044^*$	$r_s = 0.306, p = 0.062$	$r_s = 0.140, p = 0.403$
45-64	$r_s = 0.408, p = 0.043^*$	$r_s = 0.553, p < 0.001^{**}$	$r_s = 0.449, p < 0.001^{**}$
65 and over	$r_s = 0.022, p = 0.936$	$r_s = 0.530, p < 0.001^{**}$	$r_s = 0.403, p = 0.004^{**}$
Sex			
Male	$r_s = 0.546, p = 0.007^{**}$	$r_s = 0.336, p = 0.285$	$r_s = 0.232, p = 0.288$
Female	$r_s = 0.559, p < 0.001^{**}$	$r_s = 0.606, p < 0.001^{**}$	$r_s = 0.429, p < 0.001^{**}$
Perceived health status			
Excellent/very good	$r_s = 0.378, p = 0.057$	$r_s = 0.531, p < 0.001^{**}$	$r_s = 0.502, p < 0.001^{**}$
Good	$r_s = 0.547, p = 0.005^{**}$	$r_s = 0.627, p < 0.001^{**}$	$r_s = 0.464, p = 0.285$
Fair/poor	$r_s = 0.696, p = 0.125$	$r_s = 0.293, p = 0.198$	$r_s = 0.183, p = 0.428$
Perceived fitness level			
Very good/good	$r_s = 0.599, p < 0.001^{**}$	$r_s = 0.515, p < 0.001^{**}$	$r_s = 0.417, p < 0.001^{**}$
Average	$r_s = 0.274, p = 0.256$	$r_s = 0.607, p < 0.001^{**}$	$r_s = 0.506, p < 0.001^{**}$
Poor/very poor	-	$r_s = 0.524, p = 0.080$	$r_s = 0.256, p = 0.422$
Total physical activity level (minutes per week)			
<150	$r_s = 0.943, p = 0.057$	$r_s = 0.695, p = 0.012^*$	$r_s = 0.141, p = 0.662$
150 and over	$r_s = 0.518, p < 0.001^{**}$	$r_s = 0.545, p < 0.001^{**}$	$r_s = 0.445, p < 0.001^{**}$
Time attending class (months)			
< 6	$r_s = 0.646, p = 0.001^{**}$	$r_s = 0.654, p < 0.001^{**}$	$r_s = 0.463, p < 0.001^{**}$
6 and over	$r_s = 0.331, p = 0.060$	$r_s = 0.480, p < 0.001^{**}$	$r_s = 0.453, p < 0.001^{**}$
Class type			
Tai Chi	#	#	#
Group fitness	$r_s = 0.755, p < 0.001^{**}$	$r_s = 0.677, p < 0.001^{**}$	$r_s = -0.107, p = 0.489$
Kung Fu	#	#	#
Water-based	$r_s = 0.754, p < 0.001^{**}$	$r_s = 0.558, p < 0.001^{**}$	$r_s = 0.165, p = 0.591$
Pilates	$r_s = 0.945, p < 0.001^{**}$	$r_s = 0.651, p < 0.001^{**}$	$r_s = 0.651, p < 0.001^{**}$

* $p < 0.05$; ** $p < 0.01$

- Insufficient data to perform analysis; # Intensity ratings did not vary across categories.

and individual exercise intensity parameters were stronger than the relationship between the independent researcher-rated METs and physiological parameters (%HRR, $r_s = 0.485$, $p < 0.001$ vs $r_s = 0.294$, $p = 0.027$; sRPE, $r_s = 0.451$, $p < 0.001$ vs $r_s = 0.151$, $p = 0.052$; and RPE, $r_s = 0.556$, $p < 0.005$ vs $r_s = 386$, $p < 0.001$, respectively).

A fair, positive correlation was found between EGT sub-section rating of participant fitness level and participant self-rated fitness level ($r_s = 0.227$, $p = 0.003$). A moderate, positive correlation was found between EGT sub-section class intensity score and researcher-rated MET score ($r_s = 0.663$, $p < 0.001$).

A significant intraclass correlation was found between of EGT scores one week apart (IC = 0.690, $p = 0.007$). Significant relationships were also found in participant exercise intensity scores over the same period (%HRR, $r_s = 0.737$, $p = 0.037$; sRPE, $r_s = 0.894$, $p < 0.001$; and RPE, $r_s = 0.758$, $p = 0.011$).

DISCUSSION

The EGT was found to be a reliable measure of class exercise intensity over more than one session. A significant positive moderate relationship was found between the EGT scores measured a week apart. A strong positive relationship was also found between participant ratings of class exercise intensity across classes a week apart, suggesting it may be possible and appropriate to categorise the exercise intensity of classes over time appropriately. This study found significant homogeneity within class participant exercise intensity scores across classes, also supporting the feasibility of a class-level exercise intensity rating. Class providers seemed to also understand their participants well as evidenced by positive correlation found between EGT sub-section rating of participants' fitness level and participants self-rated fitness level.

Results confirmed that an individual's RPE more closely correlated to EGT score than % HRR. This is to be expected as exercise intensity is more complex than the individual HR response as other physiological responses such as oxygen delivery and

exchange, blood pressure, lactate threshold and circulation have an accumulative influence. This explains why fitness and health professionals encourage participants to gauge their exercise tolerance more by general symptoms of exertion that contribute to self-reported rating of perceived exertion and physiological responses to exercise.

Inconsistent findings in some sub-groups may be expected. The relationships found in this study were influenced by the limitations of the exercise intensity measures used to valid the EGT. For instance, Skatrud-Mickelson et al (2011) found that exercise intensity measured using RPE to be influenced by the level of an individual's physical fitness level²¹. If this were true, it would skew the true results of the study for relevant sub-groups. Regardless, this study found that participants who rated their health status as fair did attend low to moderate and moderate to high EGT-rated classes, and approximately one-third had been attending their class for over six months, indicating these classes may be appropriate for participants with a poorer health status. Participants who reported a fair health status appeared to have slightly higher exercise intensity scores than other class participants. This infers that irrespective of participants perceived health status class participants govern their exertion within comfort. It is expected that as participants engage in an exercise program over time higher levels of perceived health due to improved exercise tolerance result. Given the low numbers of this sub-group in this study, further research into the applicability of the EGT for people with different levels of health may be warranted.

The EGT was found to have stronger relationships with validated exercise intensity measures than the Compendium of Physical Activities. In part, this may be attributed to the EGT only having two intensity categories compared with the five MET score categories in the Compendium of Physical Activities. The advantages of the EGT are that it uses relative exercise intensity measures and is not reliant solely on MET values which may not be appropriate for adults with various health and fitness levels and older age

groups^{7,22}. For instance, Miller et al (2010) found that at the standard 3-6 MET absolute intensity measures would be underestimated for people over 60 years⁷. It could be that the usability and applicability of the EGT may be more appropriate for a wider population. Also, the class provider who completes the EGT may also have a better understanding of the clientele and class characteristics and better placed to assess class exercise intensity. This study found a significant relationship between provider-rated participant physical activity levels and participant self-rated fitness level. In addition, there was a significant relationship between class provider and independent researcher rated MET scores for classes.

There were some limitations to this study. The reliance of other validated measure of exercise intensity to validate the EGT meant that deficiencies in these measures would skew the findings of this study. Using more than one measure of validity in the study may have assisted somewhat in overcoming the issue in the absence of other suitable validation methods. The timing of the study in January may have resulted in a different cohort of class participants due to people being on holidays or having New Year resolutions to commence a physical activity program. However, there were a wide range of participant and class types included in the study and the EGT appeared to represent these diverse situations. The timing of data collection for some measures, particularly sRPE and resting heart rate for some participants was not ideal given the real world nature of this study. This may have influenced the accuracy of some of the measures taken, especially sRPE. Again, the use of multiple measures to validate the EGT may have compensated for some of these deficiencies. Finally, the generalisability of the findings to other community-based programs will need to be considered with caution. As this study found, the appropriateness of the EGT may vary for different sub-groups.

CONCLUSION

Overall, the EGT appeared to be a valid measure to categorise the exercise intensity of community-based classes. The two-category rating system, 'low to moderate' and 'moderate to high', represented class participants' exercise intensity for sessions well. The EGT also appeared to be a feasible measure of the exercise intensity of classes over time, from week to week. Class providers seemed to have a good understanding of their class participants, and as such, were well positioned to assess their class exercise intensity. The simple categorisation system of the EGT could also be easily used by health professionals and the general public. Providing simple information about the exercise intensity of community-based classes may increase the confidence of health professionals to refer clients to these programs and potentially enable clients to better manage their own health and wellbeing. Individuals commencing a physical activity program may also have increased confidence and less anxiety about physical activity program suitability, particularly when starting out for the first time.

In application, it may be useful to monitor the uptake and adherence of clients referred by health professionals to community-based physical activity programs in further understanding the effectiveness of the EGT, especially across population groups with different levels of fitness and health. In addition, evaluating the usability of the EGT by health professionals with a focus on increasing health professional confidence to refer clients to local community-based physical activity programs will also be important. Finally, understanding how often to re-administer the EGT as participants and classes change to accommodate participant needs over time may be useful to inform practicalities about how often to administer the tool to update class information.

PRACTICAL APPLICATIONS

Class providers can now appropriately market their program as low to moderate or moderate to high with potential greater participation

The uptake of community based exercise may increase as a result of health professionals improved referral confidence and exercise participants exercise tolerance being appropriately matched to exercise intensity.

Transitioning exercise participants through varied facilities and providers (fitness professionals, accredited exercise physiologists and physiotherapists) becomes more seamless as flow between intensities categories are matched inter program to either of two categories.

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