

# BMJ Open Exploring subjective responses in high-intensity multimodal training: an online cross-sectional survey

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## ABSTRACT

**Objectives** The purpose of this study was to investigate exercise enjoyment in high-intensity multimodal training (HIMT) in current and previous HIMT participants and identify factors associated with HIMT that mediate exercise enjoyment and motivation.

**Design and setting** A 124-item web-based survey was distributed to a cross-sectional voluntary convenience sample from August to the end of September 2021.

**Participants** Global current and previous HIMT participants.

**Results** The final sample included 469 responses (completion rate: 61.6%). Among eligible respondents (n=434), 379 were current HIMT participants, 55 were previous HIMT participants. Current participants demonstrated high enjoyment (Physical Activity Enjoyment Scale). The most frequently reported reasons for increased enjoyment and motivation to continue HIMT in current participants included (1) *it keeps me fit*, (2) *training in a group* and (3) *variety in a session*. The most frequently reported reasons for reduced motivation to continue HIMT among previous HIMT participants included (1) *other (injury, COVID-19 restrictions, low motivation, personal preferences)*, (2) *work commitments* and (3) *I started another type of sport, exercise or training*.

**Conclusions** These findings indicate that HIMT is an enjoyable training method among current participants. The most commonly reported reasons for increased enjoyment and motivation were associated with the combined training method and the group environment. Reasons for reduced motivation to continue HIMT among previous HIMT participants may be related to commonly reported barriers to exercise and personal factors.

## INTRODUCTION

Current physical activity guidelines recommend healthy adults (aged 18–65) participate in  $\geq 30$  min of moderate aerobic activity 5 days/week or  $\geq 20$  min of vigorous aerobic activity 3 days/week.<sup>1</sup> Muscle strengthening activities are also recommended twice weekly. Long-term fulfilment of these guidelines has been shown to promote physical and psychological health.<sup>1</sup> Despite this, adherence to physical activity guidelines remains low, with lack of time and poor exercise enjoyment or intrinsic motivation among the most commonly reported barriers to exercise.<sup>2–5</sup>

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This is the first global survey to examine subjective responses in all styles of high-intensity multimodal training (HIMT).
- ⇒ This study identified and distinguished between specific reasons for increased exercise enjoyment in HIMT participants.
- ⇒ This study is limited by the self-reported nature of individuals' subjective responses to HIMT.
- ⇒ A large proportion of participants were current HIMT participants who reported increased enjoyment. This may reflect potential bias in the voluntary sample.

Recently, shorter duration sessions performed at a high-intensity have gained interest as a time-efficient method of promoting physical health. Notably, some of the top 20 worldwide fitness trends for 2021 included high-intensity interval training (HIIT), bodyweight, functional fitness and group training.<sup>6</sup> High-intensity multimodal training (HIMT) has been recently defined as any high or vigorous intensity exercise style that emphasises whole body movements combining aerobic, resistance and/or bodyweight training in a single session (eg, circuit HIIT, high-intensity functional training (HIFT), bodyweight HIIT, resistance HIIT).<sup>7</sup> High or vigorous intensity is previously defined by the American College of Sports Medicine.<sup>1</sup> Although previous definitions exist, terms such as functional, bodyweight or resistance may not consistently refer to all combinations of aerobic and resistance training styles. Previous studies demonstrate that select styles of HIMT promote time-efficient aerobic and muscular fitness adaptations.<sup>8–10</sup> Despite these proposed health and fitness benefits, limited studies have attempted to explain the growing uptake and long-term participation trends associated with HIMT.<sup>11–13</sup> While the mechanisms underpinning exercise behaviour are complex, the subjective response to exercise (in particular exercise enjoyment) has been suggested to be associated with long-term exercise behaviours

(ie, adherence) by supporting intrinsic motivation in various forms of physical activity.<sup>4 5</sup> However, the exact association of exercise enjoyment and HIMT remains unclear.

Previous studies that have examined subjective responses in various styles of HIMT suggest that HIMT participation promotes increased enjoyment and intrinsic factors related to adherence.<sup>11–13</sup> Similar subjective responses have also been observed in other forms of aerobic-based high-intensity exercise.<sup>9 14 15</sup> These findings may be attributed to an overall positive affective response that is promoted by typical intermittent recovery periods among shorter duration work intervals.<sup>9 15</sup> In contrast, other studies have demonstrated feelings of pain and displeasure following similar aerobic-based high-intensity exercise, with moderate to low intensity alternatives suggested to be more tolerable.<sup>9 15</sup> These conflicting findings limit the current understanding of the relationship between exercise intensity and enjoyment. It is plausible that other mediating factors independent of exercise prescription (eg, group training, instructor) are associated with exercise enjoyment in HIMT.<sup>13 16–18</sup> Similar factors have previously been shown to facilitate greater feelings of affiliation and social recognition.<sup>13 16–18</sup> Given that these features are rarely observed in isolation, the exact magnitude and codependence of these effects remain unclear. Therefore, the purpose of this study was to examine levels of exercise enjoyment in current HIMT participants. This study also aimed to identify factors associated with HIMT that may underlie exercise enjoyment and motivation. This may provide a clearer understanding of subjective responses in HIMT and assist in explaining long-term training behaviours, in particular exercise adherence.

## METHODS

### Experimental approach to the problem

An open cross-sectional survey was used to examine subjective responses in current and previous HIMT participants. The survey examined enjoyment levels in current HIMT participants. The survey also identified the features of HIMT that mediate enjoyment and motivation in current and previous HIMT participants. Detailed methods according to the Checklist of Reporting Results of Internet E-Surveys<sup>19</sup> are available in online supplemental table S1. The STROBE cross-sectional checklist was used when writing this report.<sup>20</sup> This study was approved by the Human Research Ethics Committee of the University of Technology, Sydney (ETH21-6154). It was not appropriate or possible to involve the public in the design, conduct and reporting of this research.

### Subjects

A voluntary convenience sample of current and previous HIMT participants were recruited. Respondents were recruited through various digital means (ie, social media, email) from August through to September 2021. Respondents from all global countries with access to the online

survey were eligible. All respondents were required to complete the survey in English. The sample size used in this study was comparable or greater than other exploratory studies with a similar and purpose and design.<sup>17 21</sup> Eligibility of respondents was self-determined based on the criteria defined in the recruitment flyer (online supplemental figure S1). Survey responses would be used to exclude any respondents who were ineligible based on demographic information or participation behaviour. Eligible respondents were categorised into current (ie,  $\geq 2$  sessions/week for  $\geq 6$  months) or previous HIMT participants (ie, ceased participation).

### Procedures

An anonymous survey was developed on REDcap (Research Electronic Data Capture software, V.11.1.10). This software is a secure web application for creating and managing online surveys. The survey was developed by the authors and a multidisciplinary team of experts in psychology in sport and exercise. Content validity and reduced response bias were ensured through convenience sample piloting with both current and previous HIMT participants within the researchers' networks. Feedback from researchers with experience in survey-based research methods was used to improve the content, readability and quality of the survey (eg, question syntax). The authors completed a heuristic evaluation to ensure usability of the survey software on various devices (PC, Macintosh, iPhone and Android). The final survey comprised of 124 fields, with four sections: (1) demographic information, (2) participation information, (3) exercise enjoyment (validated 18-item Physical Activity Enjoyment Scale (PACES)) and (4) exercise motivation (online supplemental table S2).<sup>22</sup> The PACES asks participants to rate *how you feel at the moment about the physical activity you have been doing* using a 7-point bipolar Likert Scale from 1 (I enjoy it) to 7 (I hate it). The 18-item PACES is scored between 18 and 126, whereby higher scores indicate greater levels of enjoyment. For the purpose of this study, the introductory statement was modified to ask current HIMT participants to *Think back to your most recent HIMT session. Please rate how you felt in the moment immediately after the physical activity that you were doing.* For a detailed overview of the validated PACES instrument see Kendzierski and DeCarlo.<sup>22</sup> Enjoyment levels were measured using the PACES in current HIMT participants only to reduce recall bias. The survey consisted of both dichotomous and open-ended questions. To reduce acquiescence bias, participants were not guided by preloaded questions. Instead, participants were asked to rank only three responses from most to least important, reducing the likelihood of falsely selecting all options. Respondents were provided the option of writing 'other' answers to further reduce this bias. The complete survey instrument is available in online supplemental table S2. A sample of approximately 750 responses were collected. Primary recruitment methods included emails distributed to relevant HIMT companies and direct sharing of a recruitment flyer on

social media (online supplementary figure S1). To avoid voluntary response bias, the terms enjoyment and motivation were not used in the survey flyer or until section (3) of the survey. This reduced the likelihood that the sample would over-represent individuals who demonstrate strong opinions on the subject or were drawn to participate based on these opinions. Submission of the online survey indicated participants' informed consent as outlined in the participant information sheet (online supplemental figure S1).

### Patient and public involvement

No patients or public were involved in the design, conduct or reporting of this research.

### Statistical analyses

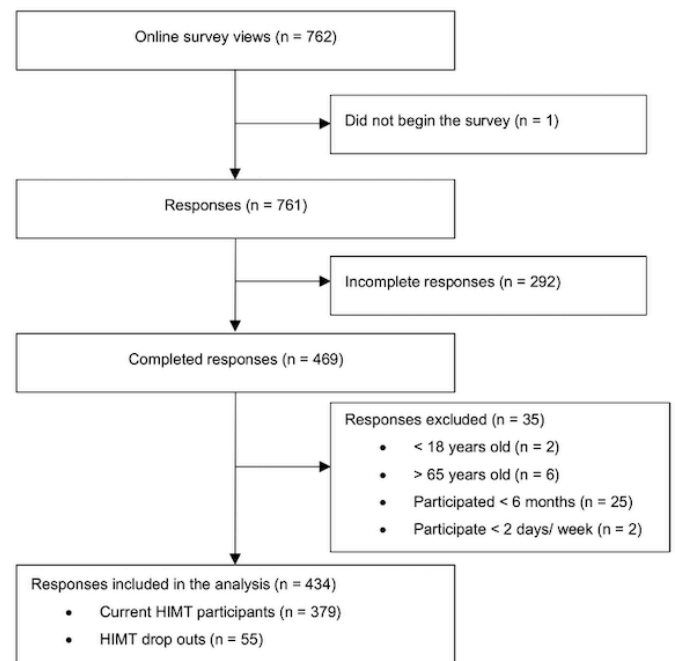
Statistical analysis of the anonymous data set was conducted using Microsoft Excel V.16.36. Missing data checks were conducted to confirm data integrity and incomplete responses were excluded from analysis. Frequencies were calculated, tabulated and graphed for the respondents' demographic and participation characteristics. The total score for the PACES (mean±SD) was calculated for current HIMIT participants only after the 11 negatively worded items were reversed scored. The average PACES Score was calculated for based on length and frequency of participation. Higher scores indicate higher levels of enjoyment. A one-way analysis of variance (ANOVA) was used to identify any differences in training frequency or length of HIMIT participation for enjoyment. A Scheffé post hoc analysis was used to identify any significant between-group differences. SPSS V.25 was used for statistical analysis with statistical significance set at  $p \leq 0.05$ . Frequencies were calculated for the total selected and ranked reasons for enjoyment and motivation in current HIMIT participants. Exercise enjoyment was not examined in previous HIMIT participants to reduce the risk of recall bias in completing the PACES and subsequent ranking questions about enjoyment. Therefore, only frequencies for reasons for reduced motivation were calculated in previous HIMIT participants.

### Transparency and openness

Authors report all data exclusions, manipulations and measures in the study. Reporting methods follow JARS.<sup>23</sup> The complete survey instrument developed in REDcap (Research Electronic Data Capture software, V.11.1.10) used for data collection is available in online supplemental table S2. All data (raw and coded) are available at <https://osf.io/mesgk> and <https://osf.io/j3udn>, respectively.<sup>24</sup> Data were analysed using Microsoft Excel V.16.36 and SPSS. The design and statistical analysis of this study were not preregistered.

## RESULTS

Among the 762 online survey views, 469 responded (61.6% completion rate). Following the exclusion of individuals



**Figure 1** Sample selection. HIMIT, high-intensity multimodal training.

under 18 and over 65 years and those who had participated in HIMIT for less than 6 months, the final sample size included 434 responses (figure 1). Overall, 87.3% (n=379) of respondents were current HIMIT participants, the other 12.7% (n=55) were previous HIMIT participants. Previous HIMIT participants were determined by the number of participants who responded 'no' to the question 'Do you regularly participate in HIMIT? (at least 2 days per week)\*'. Among the previous HIMIT participants, 54.5% (n=30) reported not participating in HIMIT due to COVID-19 restrictions. The majority of current participants (74.1%) had been engaging in HIMIT for longer than 18 months. The most commonly reported location of participation was specialised HIMIT providers (ie, specialised group/challenge/box/bootcamp style training gym) in both current participants (n=292) and previous HIMIT participants (n=20) (table 1). Participation location was reported to be affected by COVID-19 restrictions in 21.9% of current participants and 10.9% of previous HIMIT participants. Other locations of participation reported included using *fitness apps*, *one on one with a trainer*, *in a small group at a local hall* and in a *physio rehabilitation group class*. The demographic and participation characteristics of participants are summarised in table 1.

Overall, current HIMIT participants demonstrated high PACES Scores (112.71±12.52) (table 2). Additionally, significantly greater levels of enjoyment were shown in participants who participated for >18 months (113.8±11.8) compared with 12–18 months (107.49±13.41) ( $p < 0.05$ ). Additionally, respondents who participated more frequently in HIMIT (4–7 days/week) demonstrated significantly greater levels of enjoyment compared with less frequent participation (2 days/week)

**Table 1** Descriptive characteristics of 434 respondents

Characteristic	Current HIMT participants, n (%)	Previous HIMT participants, n (%)	Total, N (%)
Male	104 (24.0)	15 (3.5)	119 (27.4)
Female	275 (63.4)	40 (9.2)	315 (72.6)
Age, years (mean±SD)	36.7±11.07	30.4±11.29	35.9±11.28
Country of residence			
Australia	196 (51.7)	45 (81.8)	241 (55.5)
Cambodia	0 (0.0)	1 (1.8)	1 (0.2)
Canada	8 (2.1)	0 (0)	8 (1.8)
China	1 (0.3)	0 (0)	1 (0.2)
Costa Rica	1 (0.3)	0 (0)	1 (0.2)
Egypt	1 (0.3)	0 (0)	1 (0.2)
India	2 (0.5)	0 (0)	2 (0.5)
Ireland (Republic)	1 (0.3)	0 (0)	1 (0.2)
Israel	1 (0.3)	0 (0)	1 (0.2)
Lebanon	1 (0.3)	0 (0)	1 (0.2)
Mexico	1 (0.3)	0 (0)	1 (0.2)
New Zealand	24 (6.3)	2 (3.6)	26 (6.0)
Philippines	5 (1.3)	1 (1.8)	6 (1.4)
Singapore	5 (1.3)	1 (1.8)	6 (1.4)
South Africa	1 (0.3)	0 (0)	1 (0.2)
Thailand	1 (0.3)	0 (0)	1 (0.2)
United Arab Emirates	1 (0.3)	1 (1.8)	2 (0.5)
United Kingdom	40 (10.6)	0 (0)	40 (9.2)
United States of America	84 (22.2)	3 (5.5)	87 (20.0)
Vanuatu	0 (0.0)	1 (1.8)	1 (0.2)
NR	5 (1.3)	0 (0)	5 (1.2)
Participation location			
Specialised location	292 (77.0)	20 (36.4)	312 (71.9)
Traditional gym (group)	25 (6.6)	15 (27.3)	40 (9.2)
Traditional gym (individual)	32 (8.4)	11 (20.0)	43 (9.9)
Home gym	87 (23.0)	14 (25.5)	101 (23.3)
Outdoors (group)	31 (8.2)	11 (20.0)	42 (9.7)
Outdoors (1 on 1)	27 (7.1)	2 (3.6)	29 (6.7)
Online (group)	38 (10.0)	2 (3.6)	40 (9.2)
Online (1 on 1)	5 (1.3)	0 (0)	5 (1.2)
Other	5 (1.3)	1 (1.8)	6 (1.4)
Length of participation (months)			
6–9	27 (7.1)	–	–
9–12	34 (9.0)	–	–
12–18	37 (9.8)	–	–
>18	281 (74.1)	–	–
Participation frequency (days/week)			
2	53 (14.0)	–	–
3	62 (16.4)	–	–
4	88 (23.2)	–	–
5	107 (28.2)	–	–

Continued

**Table 1** Continued

Characteristic	Current HIMT participants, n (%)	Previous HIMT participants, n (%)	Total, N (%)
6	60 (15.8)	–	–
7	9 (2.4)	–	–

HIMT, high-intensity multimodal training; NR, not reported;

( $p < 0.01$ ) (table 2). Among the current participants who selected that they enjoy HIMT, the top 3 reasons for enjoyment were *I enjoy*: (1) *that it keeps me fit*, (2) *training in a group* and (3) *variety in a session* (figure 2, online supplemental table S3). Other reported reasons for enjoyment related to a sense of community, competition, health, self-confidence, accomplishment and mental health. Only four current HIMT participants reported reasons for not enjoying HIMT (online supplemental table S3). Of the current HIMT participants, 98.9% reported that they felt motivated to continue participating in HIMT, with 90.2% indicating they were *very likely* to do so. The top 3 reasons for respondents feeling motivated to continue participation were the same as the reasons for enjoyment (figure 2). Other reported reasons for motivation to continue HIMT related to *feeling good*, *community*, *accountability*, *physical health*, *skill mastery* and *accomplishment*. Another two respondents reported reasons for not feeling motivated to continue participating in HIMT. These included *HIMT does not help me build muscle*, *the high-intensity of the workout* and *that HIMT is popular*. Among previous HIMT participants (n=55), the top 3 reasons for reduced motivation to continue HIMT included (1) *other reasons*, (2) *work commitments* and (3) *I started another type*

*of sport, exercise or training* (online supplemental table S3). Other reasons reported included injury, COVID-19 restrictions, low motivation and preferences relating to session prescription and delivery.

## DISCUSSION

This is the first global survey to examine subjective responses (eg, exercise enjoyment) in various styles of HIMT and identify factors that may underlie exercise enjoyment and motivation in HIMT. The results of this study demonstrate high levels of enjoyment in current HIMT participants. These findings are consistent with previous studies demonstrating increased enjoyment among other subjective responses (ie, self-efficacy and intrinsic factors).<sup>11–13</sup> Despite this, a number of respondents selected that they *enjoy that the workout is high-intensity* and *feelings of pain/displeasure* associated with select styles of HIMT (n=131 and n=55, respectively). These findings may be attributed to a positive affective response promoted by intermittent recovery periods during typical HIMT workouts.<sup>9 15</sup> However, these findings contrast with previous studies that demonstrate high-intensity is associated with feelings of pain and displeasure in select populations. Therefore, these conflicting observations limit the current understanding of the association between exercise intensity and enjoyment in HIMT. This study also demonstrated higher PACES Scores in current participants who had been engaging in HIMT more frequently or for greater periods of time (table 2). Similarly, Heinrich *et al*<sup>11</sup> previously observed greater adherence in individuals with higher levels of exercise enjoyment following HIMT (ie, HIFT) participation. These findings support the well-understood notion that exercise enjoyment is associated with adherence.<sup>4 5</sup> However, these findings should be interpreted with caution due to unequal sample size with the ANOVA (ie, the greatest number of respondents participating for >18 months may reduce the robustness of unequal variance assumption). Additionally, further longitudinal research is required to determine the strength of this relationship to better understand long-term adherence behaviours in HIMT specifically. While previous findings suggest HIMT may have a positive impact on subjective responses, limited research has attempted to identify specific characteristics of HIMT that may promote greater exercise enjoyment and long-term exercise adherence.<sup>11–13 17</sup>

The results of this study identified fitness adaptations as the most frequently self-reported reason that participants

**Table 2** PACES Scores in current HIMT participants according to length and frequency of participation

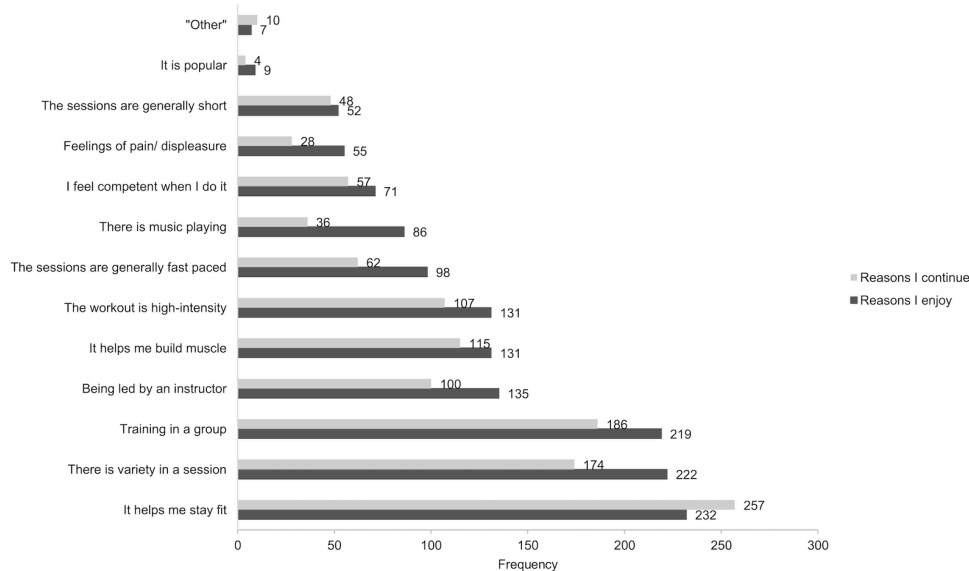
	Total	PACES Score (mean±SD)
		<b>112.71±12.52</b>
Length of participation (months)	6–9	108.41±14.53
	9–12	112.74±14.21
	12–18	107.49±13.41*
	>18	113.80±11.77*
Frequency (days/week)	2	104.26±13.58†
	3	108.74±13.57‡
	4	114.01±11.87†
	5	114.43±11.62†
	6	118.02±8.31†‡
	7	121.11±5.71†

\*Significant between-group effect ( $p < 0.05$ ).

†Significant between-group effect ( $p < 0.01$ ).

‡Significant between-group effect ( $p < 0.01$ ).

HIMT, high-intensity multimodal training; PACES, Physical Activity Enjoyment Scale.



**Figure 2** Total frequency of reported reasons current HIMT participants enjoy and feel motivated to continue participation. HIMT, high-intensity multimodal training.

enjoy HIMT and feel motivated to adhere. These findings support the notion that the time-efficient combination of training modes characteristic of HIMT is an attractive feature helping participants fulfil physical activity guidelines.<sup>8</sup> However, as respondents did not report session durations, this association cannot be confirmed. Additional psychosocial factors associated with the group training environment were among the top 3 reasons for increased enjoyment and motivation in current HIMT participants. Participants also self-reported *other* reasons for enjoyment and motivation related to feelings of community and competition which may be promoted in a group environment.<sup>17</sup> Select HIMT styles may use a group exercise model which has demonstrated greater social capital, belongingness, social recognition and affiliation.<sup>8 13 16–18 25 26</sup> For example, shared attire, language and norms associated with various HIMT formats have been shown to establish identity.<sup>25 26</sup> Other HIMT styles have also been described to reflect sporting environments which satisfy the social goals of affiliation, recognition and status.<sup>27</sup> Notably, individuals attracted to social interaction may be drawn to group training formats regardless of the positive subjective response associated.<sup>28</sup> Future research should attempt to examine subjective responses to HIMT performed as an individual compared with in a group setting (eg, with shared attire or language). This will assist in developing a clearer understanding of whether it is the combined modality prescription or the group environment that has a greater effect on subjective responses. The examination of different participating genders within a group setting may also provide further insight into the group environment's impact on the subjective response to HIMT. Furthermore, typical diversity in HIMT session structures (ie, mode, equipment, duration, work-to-rest ratios and intensity) has been suggested to facilitate feelings of self-efficacy and competency.<sup>12</sup> This

may be important among populations hesitant to engage in the emerging exercise modality. For example, *variety in a session* was among the top 3 reasons for increased enjoyment and motivation in current HIMT participants. This may be attributed to the opportunity to self-select work intensity, rest periods, progressions and regressions or the novelty of the HIMT format.<sup>12 29</sup> Previously, Eather *et al*<sup>12</sup> demonstrated high levels of enjoyment and increased HIIT-self-efficacy following participation in HIMT sessions that selected appropriate work to rest ratios, exercises, location and equipment for the study population. Additionally, sessions were prescribed to promote autonomy, social support and positive feedback.<sup>12</sup> Collectively, these findings suggest that regular variation in the prescription of HIMT sessions may positively mediate the subjective response to exercise and promote long-term adherence.

Subjective responses in previous HIMT participants were also examined. Similar to previous findings, commonly reported reasons for low desire to continue participation were associated with a lack of time and reduced motivation.<sup>2–5 30</sup> For example, reasons for reduced motivation in previous HIMT participants included being *too busy/lazy* and *not motivated to carve out time even though I know it's important and have access to online tools*. According to the health belief model, these reflect commonly reported predictors of physical activity dropout.<sup>31</sup> Participants reported various other reasons for dropout including work or family commitments. Despite the proposed time-efficiency of HIMT, these findings may reflect the inability for individuals to identify exercise participation as a priority. This may reduce the likelihood of engaging in autonomous exercise behaviour.<sup>32</sup> Additional self-reported reasons for reduced motivation were associated with cost of the activity and low social support, which are previously identified reasons for dropout.<sup>33</sup> Considering that a small proportion of respondents were previous

HIMT participants, the results of this study should be taken with caution due to a risk of response bias present in the sample. Future research should further examine subjective responses in previous HIMT participants to better understand if there is a relationship between poor subjective responses and dropout. This may assist in more strategic tailoring of HIMT programmes to provide better services to the community and promote adherence.

This is the first global survey to examine subjective responses among current and previous participants of HIMT based on a definition that broadly captures various styles of combined aerobic and resistance training. A primary limitation of this study was the self-reported nature of subjective responses to HIMT. Interparticipant variability in determining responses to the PACES and reasons for respective levels of enjoyment and motivation should be considered when interpreting the results of this study. While the PACES instrument is a validated measurement of exercise enjoyment, the use of other validated theory driven instruments is required to effectively examine subjective responses in high-intensity exercise. Furthermore, self-determination of eligibility may present selection bias in the sample, whereby the precise style or intensity of HIMT that each respondent participated in was not controlled for. This reflects the variety of existing HIMT styles (eg, HIIT, bodyweight HIIT, circuit HIIT), poor standardisation in exercise prescription and the lack of an operational term that broadly captures the various styles of combined aerobic and resistance training. Furthermore, this study did not compare enjoyment responses experienced across different styles of HIMT. This limits the generalisability of the findings to individuals participating in various styles of HIMT. The primary means of survey distribution were through social media and email. This risk of sampling bias should be considered when interpreting the results. There is also a risk of non-response bias due to the large number of participants that began the survey but did not complete it (61.6% completion rate). This may be attributed to the voluntary nature of this survey or indicate participant burden. There is an additional risk of bias in the sample whereby a large proportion of respondents were current HIMT participants. Moreover, current participants primarily reported reasons for increased enjoyment and motivation. This limits the ability of this study to examine reasons for decreased subjective responses in current participants. Furthermore, respondents were recruited from a convenience sample, restricted to current and previous HIMT participants. Therefore, the findings cannot be generalised to individuals who have not participated. Additionally, this study was cross-sectional in design, and did not intend to measure changes in subjective responses over time. Therefore, causal inferences (causal link to HIMT initiation or length of participation) were precluded. Furthermore, data collection for this study took place when COVID-19 restrictions may have been in place, whereby gym and exercise services may have been closed or limited. This may have restricted the

potential sample of respondents who considered themselves eligible and increased selection and response bias. No precautionary measures were used to prevent duplicate participant entries. However, records were screened before data analysis to assess for duplicity.

### Practical applications

The findings of this study demonstrate that HIMT is an enjoyable training method among current HIMT participants. This may suggest that HIMT can promote long-term physical activity behaviours based on the association of enjoyment with exercise adherence in other forms of exercise. This study identified features associated with HIMT that may underlie the subjective response to exercise (ie, time-efficient aerobic and resistance adaptations due to the combined modal training, group environment and associated psychosocial attributes). However, further studies are required to understand the derivatives of these identified factors to further explain the growing popularity of the training mode. For example, future research should continue to examine the relationship between exercise intensity and subjective responses more closely in HIMT to understand the acute and delayed subjective response to this high-intensity activity. Additionally, there is a need to examine these underlying features in isolation of each other (ie, group training, various session formats, etc) and compare them with and in other concurrent training modes. Moreover, further research is required to examine subjective responses in previous HIMT participants to better understand the mechanisms of non-adherence. Future research should also consider possible reasons for non-engagement in HIMT (ie, hesitancy). This may assist in demographic-specific delivery of HIMT programmes in the community that promote greater self-efficacy, exercise uptake and adherence.

The findings of this study demonstrate high levels of enjoyment among current HIMT participants. This contrasts with previous studies showing high-intensity exercise to be painful and unpleasurable in select populations. The most commonly reported reasons for increased enjoyment and motivation were associated with the combined training modality, the group environment and session variety. In contrast, reasons for reduced motivation to adhere among previous HIMT participants reflected commonly reported barriers to other forms of physical activity (ie, time, low motivation). These findings identify some of the factors that may underlie subjective responses in HIMT. This may assist in better understanding the features of HIMT that may contribute to the growing popularity of the training mode and guide tailored service delivery in the community for increased exercise adherence.

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review and editing, supervision. LW: conceptualisation, methodology, writing—review and editing, visualisation, supervision.

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**Patient consent for publication** Not applicable.

**Ethics approval** This study was approved by the Human Research Ethics Committee of the University of Technology, Sydney (ETH21-6154). Participants gave informed consent to participate in the study before taking part.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data are available in a public, open access repository. The raw and coded data that support the findings of this study are available at <https://osf.io/mesgk> and <https://osf.io/j3udn>, respectively.

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