BMJ Open Exploring subjective responses in highintensity multimodal training: an online cross-sectional survey

Tijana Sharp 💿 , Clementine Grandou, Aaron J Coutts, Lee Wallace

To cite: Sharp T, Grandou C, Coutts AJ, et al. Exploring subjective responses in high-intensity multimodal training: an online crosssectional survey. BMJ Open 2023;13:e073659. doi:10.1136/ bmiopen-2023-073659

Prepublication history and additional supplemental material for this paper are available online. To view these files. please visit the journal online (http://dx.doi.org/10.1136/ bmjopen-2023-073659).

Received 14 March 2023 Accepted 30 August 2023

Check for updates

C Author(s) (or their employer(s)) 2023, Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BM.J

Sport and Exercise Discipline Group, Human Performance Research Centre, Faculty of Health, University of Technology Sydney, Moore Park, New South Wales, Australia

Correspondence to Tijana Sharp: tijana.sharp@uts.edu.au

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 aroup 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 ≥ 30 min of moderate aerobic activity $5 \text{ days/week or } \ge 20 \text{ min of vigorous aerobic}$ activity 3 days/week.¹ Muscle strengthening activities are also recommended twice weekly. Long-term fulfilment of these guidelines has been shown to promote physical and psychological health.¹ 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.²⁻⁵

STRENGTHS AND LIMITATIONS OF THIS STUDY

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

Protected by copyright, including for uses related Recently, shorter duration sessions performed at a high-intensity have gained interest as a 8 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.⁶ Highintensity 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).⁷ High or vigorous intensity is previously defined by the American College of Sports Medicine.¹ 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 o that select styles of HIMT promote timeefficient aerobic and muscular fitness adaptations.^{8–10} Despite these proposed health and fitness benefits, limited studies have attempted to explain the growing uptake and long-term participation trends associated with HIMT.^{11–13} 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

6

(ie, adherence) by supporting intrinsic motivation in various forms of physical activity.^{4 5} 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.^{11–13} Similar subjective responses have also been observed in other forms of aerobic-based high-intensity exercise.^{9 14 15} These findings may be attributed to an overall positive affective response that is promoted by typical intermittent recovery periods among shorter duration work intervals.^{9 15} 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.^{9 15} 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.^{13 16–18} Similar factors have previously been shown to facilitate greater feelings of affiliation and social recognition.^{13 16–18} 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-Surveys¹⁹ are available in online supplemental table S1. The STROBE cross-sectional checklist was used when writing this report.²⁰ 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.^{17 21} 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).²² The PACES asks participants to rate \exists 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.²² 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 ques- 8 tions. 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 HIMT 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 HIMT participation for enjoyment. A Scheffe 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 $p \le 0.05$. Frequencies were calculated for the total selected and ranked reasons for enjoyment and motivation in current HIMT participants. Exercise enjoyment was not examined in previous HIMT 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 HIMT participants.

Transparency and openness

Authors report all data exclusions, manipulations and measures in the study. Reporting methods follow JARS.²³ 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.²⁴ 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



Sample selection. HIMT, high-intensity multimodal Figure 1 training.

under 18 and over 65 years and those who had participated in HIMT for less than 6 months, the final sample size included 434 responses (figure 1). Overall, 87.3% đ text (n=379) of respondents were current HIMT participants, the other 12.7% (n=55) were previous HIMT participants. Previous HIMT participants were determined by the number of participants who responded 'no' to the question 'Do you regularly participate in HIMT? (at least 2 days per week)*'. Among the previous HIMT participants, 54.5% (n=30) reported not participating in HIMT due to COVID-19 restrictions. The majority of current ≥ participants (74.1%) had been engaging in HIMT for longer than 18 months. The most commonly reported location of participation was specialised HIMT providers (ie, specialised group/challenge/box/bootcamp style training gym) in both current participants (n=292) and previous HIMT 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 HIMT 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 HIMT 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 HIMT (4–7 days/week) demonstrated significantly greater levels of enjoyment compared with less frequent participation (2 days/week) Age, years (mean±SD)

Country of residence

Australia

Canada

China

Egypt

India

Israel

Lebanon

New Zealand

Philippines

Singapore

Thailand

South Africa

United Arab Emirates

Mexico

Cambodia

Costa Rica

Ireland (Republic)

Table 1 Characteristic

Male

Female

Descriptive characteristics of 434 respondents

104 (24.0)

275 (63.4)

36.7±11.07

196 (51.7)

0 (0.0)

8 (2.1)

1 (0.3)

1 (0.3)

1 (0.3)

2 (0.5)

1 (0.3)

1 (0.3)

1 (0.3)

1 (0.3)

24 (6.3)

5 (1.3)

5 (1.3)

1 (0.3)

1 (0.3)

1 (0.3)

Current HIMT participants, n (%)

Previous HIMT participants, n (%)

15 (3.5)

40 (9.2)

45 (81.8)

1 (1.8)

0 (0)

0 (0)

0 (0)

0 (0)

0 (0)

0 (0)

0 (0)

0 (0)

0 (0)

2 (3.6)

1 (1.8)

1 (1.8)

0 (0)

0 (0)

1 (1.8)

30.4±11.29

6	BMJ
	Ope
Total, N (%)	'n: fi
119 (27.4)	rst
315 (72.6)	bup
35.9±11.28	lish
041 (55 5)	ed a
1 (0 2)	s 10
8 (1.8)	-113 Prot
1 (0.2)	6/bi
1 (0.2)	mjoj jd bj
1 (0.2)	pen- y co
2 (0.5)	-202 pyri
1 (0.2)	3-07 ight
1 (0.2)	7365 , inc
1 (0.2)	indi
26 (6.0)	ר ng f
6 (1.4)	Sep or u
6 (1.4)	otem Ens
1 (0.2)	rela
1 (0.2)	202 Nem
2 (0.5)	to t
40 (9.2)	Sup
87 (20.0) 1 (0.2)	nloa erie and
5 (1.2)	ded dat
- ()	a mi
312 (71.9)	ning
40 (9.2)	g, A_
43 (9.9)	bm I tra
101 (23.3)	inin
42 (9.7)	n.br g, al
29 (0.7) 40 (9.2)	nj.c
5 (1.2)	inii 0
6 (1.4)	on . ar te
	Jun
-	e 7, 10lo
-	202) gies
-	: 5 at
-	Age
	эпсе
_	Bit
_	oliog
-	yrap
Continued	hique
pen-2023-073659	de

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
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
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	x)		
2	53 (14.0)	-	-
3	62 (16.4)	-	-
4	88 (23.2)	-	-
5	107 (28.2)	-	-
			Cont
ł		Sharp T, <i>et al. BMJ Open</i> 2023; 13 :e073659. d	loi:10.1136/bmjopen-2023-

Table 1	Continued			
Charact	eristic	Current HIMT participants, n (%)	Previous HIMT participants, n (%)	Total, N (%)
6		60 (15.8)	-	-
7		9 (2.4)	-	-
HIMT. hia	h-intensity multimodal training: N	R. 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 highintensity 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

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

	PACES Score (mean±SD)
Total	112.71±12.52
6–9	108.41±14.53
9–12	112.74±14.21
12–18	107.49±13.41*
>18	113.80±11.77*
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†
	Total 6-9 9-12 12-18 >18 2 3 4 5 6 7

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

+Significant between-group effect (p<0.01).

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

of sport, exercise or training (online supplemental table S3). Protected by copyright, 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 uses among other subjective responses (ie, self-efficacy and intrinsic factors).¹¹⁻¹³ 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 e promoted by intermittent recovery periods during typical HIMT workouts.⁹¹⁵ 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 Ξ 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*¹¹ 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.4 5 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 **3** 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.^{11–13 17}

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

Othe



đ

e



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.⁸ 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.¹⁷ Select HIMT styles may use a group exercise model which has demonstrated greater social capital, belongingness, social recognition and affiliation.^{8 13 16–18 25 26} For example, shared attire, language and norms associated with various HIMT formats have been shown to establish identity.^{25 26} Other HIMT styles have also been described to reflect sporting environments which satisfy the social goals of affiliation, recognition and status.²⁷ Notably, individuals attracted to social interaction may be drawn to group training formats regardless of the positive subjective response associated.²⁸ 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.¹² 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.^{12 29} Previously, Eather et al^{12} 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.¹² 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.

training, 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.^{2-5 30} 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.³¹ Participants & reported various other reasons for dropout including **g** 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.³² Additional selfreported reasons for reduced motivation were associated with cost of the activity and low social support, which are previously identified reasons for dropout.³³ 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, HIFT, 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 longterm 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 5 in HIMT to understand the acute and delayed subjec-tive response to this high-intensity activity. Additionally, in HIMT to understand the acute and delayed subjecthere is a need to examine these underlying features ē in isolation of each other (ie, group training, various session formats, etc) and compare them with and in other ö 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 ā 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.

Twitter Tijana Sharp @tijana_sharp

Contributors TS: conceptualisation, methodology, software, formal analysis, investigation, data curation, writing—original draft, visualisation, project administration, guarantor. CG: conceptualisation, methodology, software, writing—review and editing, visualisation. AJC: conceptualisation, methodology, writing—

review and editing, supervision. LW: conceptualisation, methodology, writingreview and editing, visualisation, supervision.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

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.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/.

ORCID iD

Tijana Sharp http://orcid.org/0000-0001-6878-6343

REFERENCES

- Liguori G, American College of Sports Medicine. ACSM's guidelines for exercise testing and prescription. Lippincott Williams & Wilkins, 2020.
- 2 Australian Institute of Health and Welfare. Physical activity across the life stages. Cat. no. PHE 225. Canberra AIHW; 2018.
- 3 Ryan M, Frederick CM, Lepes D, et al. Intrinsic motivation and exercise adherence. Int J Sport Psychol 1997;28:335–54.
- 4 Ekkekakis P, Hall EE, Petruzzello SJ. The relationship between exercise intensity and affective responses demystified: to crack the 40-year-old nut, replace the 40-year-old nutcracker! *Ann Behav Med* 2008;35:136–49.
- 5 Ekkekakis P, Parfitt G, Petruzzello SJ. The pleasure and displeasure people feel when they exercise at different intensities: decennial update and progress towards a tripartite rationale for exercise intensity prescription. *Sports Med* 2011;41:641–71.
- 6 Thompson WR. Worldwide survey of fitness trends for 2021. ACSMs Health Fit J 2021;25:10–9.
- 7 Sharp T, Grandou C, Coutts AJ, *et al*. The effects of high-intensity Multimodal training in apparently healthy populations: a systematic review. *Sports Med Open* 2022;8:43.
- 8 Feito Y, Heinrich KM, Butcher SJ, *et al.* High-intensity functional training (HIFT): definition and research implications for improved fitness. *Sports (Basel)* 2018;6:76.
- 9 Kilpatrick M, Jung M, Little J. High-intensity interval training: a review of physiological and psychological responses. ACSMs Health Fit J 2014;18:11–6.
- 10 Batrakoulis A, Tsimeas P, Deli CK, et al. Hybrid neuromuscular training promotes musculoskeletal adaptations in inactive overweight and obese women: a training-detraining randomized controlled trial. J Sports Sci 2021;39:503–12.

- 11 Heinrich KM, Patel PM, O'Neal JL, et al. High-intensity compared to moderate-intensity training for exercise initiation, enjoyment, adherence, and intentions: an intervention study. BMC Public Health 2014;14:789.
- 12 Eather N, Babic M, Riley N, *et al.* Integrating high-intensity interval training into the workplace: the work-HIIT pilot RCT. *Scand J Med Sci Sports* 2020;30:2445–55.
- 13 Batrakoulis A, Loules G, Georgakouli K, et al. High-intensity interval neuromuscular training promotes exercise behavioral regulation, adherence and weight loss in inactive obese women. Eur J Sport Sci 2020;20:783–92.
- 14 Bartlett JD, Close GL, MacLaren DPM, *et al.* High-intensity interval running is perceived to be more enjoyable than moderate-intensity continuous exercise: implications for exercise adherence. *J Sports Sci* 2011;29:547–53.
- 15 Jung M, Little J. Taking a HIIT for physical activity: is interval training viable for improving health. American College of Sports Medicine Annual Meeting, Indianapolis (IN); 2013
- 16 Beauchamp MR. Promoting exercise adherence through groups: a self-categorization theory perspective. *Exerc Sport Sci Rev* 2019;47:54–61.
- 17 Fisher J, Sales A, Carlson L, et al. A comparison of the motivational factors between CrossFit participants and other resistance exercise modalities: a pilot study. J Sports Med Phys Fitness 2017;57:1227–34.
- 18 Nielsen G, Wikman JM, Jensen CJ, et al. Health promotion: the impact of beliefs of health benefits, social relations and enjoyment on exercise continuation. Scand J Med Sci Sports 2014;24:66–75.
- 19 Eysenbach G. Improving the quality of web surveys: the checklist for reporting results of Internet E-surveys (CHERRIES). *J Med Internet Res* 2004;6:e34.
- 20 von Elm E, Altman DG, Egger M, et al. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *BMJ* 2007;335:806–8.
- 21 Grandou C, Wallace L, Coutts AJ, et al. Symptoms of overtraining in resistance exercise: international cross-sectional survey. Int J Sports Physiol Perform 2021;16:80–9.
- 22 Kendzierski D, DeCarlo KJ. Physical activity enjoyment scale: two validation studies. *J Sport Exerc Psychol* 1991;13:50–64.
- 23 Appelbaum M, Cooper H, Kline RB, et al. Journal article reporting standards for quantitative research in psychology: the APA publications and communications board task force report. Am Psychol 2018;73:3–25.
- 24 Sharp T, Grandou C, Coutts AJ, et al. Data from: exploring subjective responses in high-intensity Multimodal training: an online crosssectional survey; 2021Jan5. Open science frameworkAvailable: https://osf.io/mesgk and https://osf.io/j3udn
- 25 Dawson MC. Crossfit: fitness cult or reinventive institution. Int Rev Sport Sociol 2017;52:361–79.
- 26 Heinrich KM, Carlisle T, Kehler A, et al. Mapping coaches' views of participation in crossfit to the integrated theory of health behavior change and sense of community. Fam Community Health 2017;40:24–7.
- 27 Allen JB. Measuring social motivational orientations in sport: an examination of the construct validity of the SMOSS. *Int J Sport Exerc Psychol* 2005;3:147–61.
- 28 Whiteman-Sandland J, Hawkins J, Clayton D. The role of social capital and community belongingness for exercise adherence: an exploratory study of the crossfit gym model. *J Health Psychol* 2018;23:1545–56.
- 29 Heinrich KM, Crawford DA, Johns BR, et al. Affective responses during high-intensity functional training compared to high-intensity interval training and moderate continuous training. Sport Exerc Perform Psychol 2020;9:115–27.
- 30 Ryan RM, Deci EL. Intrinsic and Extrinsic motivations: classic definitions and new directions. *Contemp Educ Psychol* 2000;25:54–67.
- 31 Green EC, Murphy EM, Gryboski K. The health belief model. In: The Wiley Encyclopedia of Health Psychology. 2020: 211–4.
- 32 Deci EL, Ryan RM. "The "what" and "Why" of goal pursuits: human needs and the self-determination of behavior. *Psychological Inquiry* 2000;11:227–68.
- 33 Pridgeon L, Grogan S. Understanding exercise adherence and dropout: an interpretative phenomenological analysis of men and women's accounts of gym attendance and non-attendance. *Qual Res Sport Exerc Health* 2012;4:382–99.

Are you a *current* or *previous* **UTS High-Intensity Multimodal Training** participant?

This may include FUNCTIONAL TRAINING, HIIT, BOOT CAMP, GROUP CIRCUITS or exercise that:

for more information visit : <u>https://tijanaj</u>

• emphasises whole-body movements;

- combines aerobic, resistance and/or bodyweight training throughout a single session;
- is completed at high or vigorous intensity

Complete this short survey to help researchers understand your subjective responses to this type of training.

To participate in this survey you must;

• be 18 years - 65 years old at time of completion;

UTS ETH21-6154. Participation is voluntary. Questions? Email : himtsurvey@uts.edu.au or

- have participated for at least 6 months (attending at least 2 sessions per week); OR
- have ceased participation

Follow link below! https://redcap.link/himtsurvey

Supplementary Table S1 Checklist for Reporting Results of Internet E-Surveys (CHERRIES)[1]

Item Category	Checklist Item ¹	Description
Design	Describe survey design	An open cross-sectional survey was used to examine subjective responses (i.e., exercise enjoyment and motivation) in High-Intensity Multimodal Training (HIMT). This survey also identified factors associated with HIMT that mediate these subjective responses. The target population was current and previous HIMT participants. A voluntary non-randomised convenience sample was recruited. Due to the large eligible population, sample randomization was not possible.
Ethics	Ethics approval	This study was approved by the Human Research Ethics Committee of the University of Technology Sydney (ETH21-6154).
	Informed consent	The survey was voluntary and anonymous. Therefore, consent was deemed as given by commencing the online survey. The recruitment flyer and associated blurb included information about the voluntary/ anonymous nature of the survey. This flyer also included an email address and website that participants could access for further information regarding the purpose of the study, informed consent process, identity and qualifications of investigators etc.
	Data protection	REDCap (Research Electronic Data Capture software, version 11.1.10 University of Technology Sydney, Sydney Australia), a secure web application as sued to develop and manage this survey. As the survey was anonymous, no personal information was linked to the results. Data did not require de-identification as the survey did not include identifiable questions. The dataset was stored on password protected computers.
Development and pre- testing	Development and testing	The survey was developed by the authors cooperatively with 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 HIMT participants and previous HIMT participants. Feedback was used to improve the content, readability and quality of the survey. The authors then 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 4 sections: (1) demographic information, (2) participation information, (3) exercise enjoyment (validated 18-item Physical Activity Enjoyment Scale (PACES)) and (4) exercise motivation (Supplementary Table S3.2). 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). This survey modified this introductory statement 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". Within the PACES, 11 items were negatively worded, the remaining 7 were positively worded. Exercise enjoyment levels were measured in current HIMT participants only to reduce recall bias. The survey consisted of both dichotomous questions and open ended questions.
Recruitment process	Open survey versus	This was an open survey.
sample having access to the questionnaire	Contact mode Advertising the survey	Not applicable. Potential applicants were not contacted. Survey recruitment was primarily achieved through flyer distribution via social media and email. The recruitment flyer was posted with a link to the online survey on Twitter, LinkedIn, Facebook and Instagram. Relevant HIMT companies and organisations were contacted via email with information regarding survey participation. These companies and organisations were identified as relevant by the authors if they provided HIMT services as defined in the eligibility criteria outlined on the recruitment flyer. The advertisement was shared by industry contacts approximately 30 times across all social media networks. 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 overrepresent individuals who demonstrate strong opinions on the subject.
Survey administration	Web/E-mail	This was a web-based survey, with respondents recruited through social media advertisement. Responses were collected via the secure online survey platform REDCap and stored on secure local servers. Responses included open-ended, multiple choice, ranking and response scales.
	Context	The survey recruitment flyer was shared among online and industry communities on Twitter, LinkedIn, Facebook and Instagram. Relevant HIMT companies and organisations were contacted via email. Therefore, the survey would have likely only captured individuals active on social media or affiliated with relevant companies contacted. However, this would likely not contribute to response bias. Wording of the survey recruitment flyer was selected to purposely not include terms related to

		HIMT, exercise enjoyment or motivation to further reduce the likelihood of response bias.
	Mandatory/voluntary	Voluntary.
	Incentives	Respondents were not incentivized for their participation.
	Time/Date	Responses were collected over two months from 8 August to 29 September 2021.
	Randomization of items	No randomization of items was used.
	Adaptive questioning	Adaptive questioning (branched logic) was used throughout the survey to reduce the number and complexity of questions. Certain questions were only relevant to specific populations (e.g., current HIMT participants vs. previous HIMT participants) or based on responses to previous questions (e.g., levels of enjoyment and motivation).
	Number of Items	The complete survey consisted of 124 items. Due to the adaptive nature of the survey not all respondents answered all items.
	Number of screens	The entire survey was distributed over 9 pages.
	Completeness check	A completeness check was completed after responses were submitted. Participation information on page 2 was mandatory. Additionally, page 3 (PACES) was mandatory for current HIMT participants. Most items except demographic questions and those required for adaptive questioning included an 'other' option.
	Review step	Respondents were able to change their responses on previous screens through a 'previous page' button whilst completing the survey. However, respondents were unable to change responses after submission.
Response rates	Unique site visitor	Not applicable. Open survey.
	View rate (Ratio of unique survey visitors/unique site visitors)	762 online survey views.
	Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)	Not applicable. Open survey.
	Completion rate (Ratio of users who finished the survey/users who agreed to participate)	Of the 761 respondents who commenced the survey, 469 completed it, giving a completion rate of 61.63%. 292 responded were excluded due to eligibility criteria.
Preventing multiple	Cookies used	Not used.
entries from the same	IP check	Not used.
individual	Log file analysis	Not used.
	Registration	Not used.
Analysis	Handling of incomplete questionnaires	Only responses completed by clicking submit on the final page of the survey were included in the data set.
	Questionnaires submitted with an atypical timestamp	No respondents were removed from the data set for atypical completion times.
	Statistical correction	No methods including weighting of items or propensity scores were used to adjust for the non-representative sample.

Abbreviations: CHERRIES : Checklist for Reporting Results of Internet E-Surveys; HIMT : High-Intensity Multimodal Training; PACES : Physical Activity Enjoyment Scale; REDCap : Research Electronic Data Capture software

References:

 Eysenbach, G. (2004). Improving the Quality of Web Surveys: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES). *Journal of Medical Internet Research* 6(3), e34. doi: 10.2196/jmir.6.3.e34.

Supplementary Table S2 Survey instrument

Field	l	Answer Choice
1.	Demographics	
	Country	Country drop down
	Sex	1. Male
		2. Female
		3. Other
	Age, y	Below 18 years
		18-65
		Over 65 years
2.	Participation Information	

Figure 1. Visual representation of a) HIMT session that combines aerobic and resistance-based exercise; and b) aerobic and bodyweight-based exercise only.



Do you regularly participate in HIMT? (at least 2 days per week)*

Is this due to current or previous COVID-19 restrictions?

- How many days per week do you participate in HIMT?* c) How long have you been regularly participating in HIMT? (at least 2 days per week)*
- Where do you currently participate in HIMT? d) (Tick ALL that apply)

(Tick ALL that apply)

Is this due to current or previous COVID-19 restrictions?

Where did you participate in HIMT prior to current or previous

Where did you participate in HIMT? (Tick ALL that apply)

COVID-19 restrictions?

2.	No
1.	Yes
2.	No
Numerical	1-7
1.	Less than 6 months
2.	6-9 months
3.	9-12 months
4.	12-18 months
5.	Longer than 18 months
1.	Specialised group / chal
	style training gym e.g. l

Yes 1

> sed group / challenge / box / bootcamp ning gym e.g. F45, Orange Theory,

- CrossFit[®] affiliate gym
- 2. Traditional gym (group classes) e.g. Fitness
- First, Crunch Fitness, Anytime Fitness 3. Traditional gym (by myself) e.g. Fitness First,
- Crunch Fitness, Anytime Fitness 4. Home gym (in my own or someone else's
- home) 5
- Outdoors in a group
- 6. Outdoors 1 on 1 7
- Online in a group 8 Online 1 on 1
- 9.
- Other (open) Yes
- 1. 2.
- No Specialised group / challenge / box / bootcamp style training gym e.g. F45, Orange Theory, 1.
- CrossFit[®] affiliate gym
- 2. Traditional gym (group classes) e.g. Fitness
- First, Crunch Fitness, Anytime Fitness 3. Traditional gym (by myself) e.g. Fitness First, Crunch Fitness, Anytime Fitness
- 4. Home gym (in my own or someone else's home)
- Outdoors in a group 5.
- Outdoors 1 on 1 6.
- Online in a group 7.
- 8. Online 1 on 1
- 9 Other (open)
- 1. Specialised group / challenge / box / bootcamp style training gym e.g. F45, Orange Theory, CrossFit[®] affiliate gym
- 2. Traditional gym (group classes) e.g. Fitness First, Crunch Fitness, Anytime Fitness
- Traditional gym (by myself) e.g. Fitness First, 3. Crunch Fitness, Anytime Fitness
- 4. Home gym (in my own or someone else's home)

Was this due to COVID-19 restrictions?

Where did you participate in HIMT prior to COVID-19 restrictions? (Tick ALL that apply)

- Outdoors in a group 5.
- 6. Outdoors 1 on 1
- Online in a group 7.
- 8. Online 1 on 1
- 9. Other (open)
- 1. Yes 2. No
- 1. Specialised group / challenge / box / bootcamp style training gym e.g. F45, Orange Theory, CrossFit[®] affiliate gym
- 2. Traditional gym (group classes) e.g. Fitness First, Crunch Fitness, Anytime Fitness
- 3. Traditional gym (by myself) e.g. Fitness First, Crunch Fitness, Anytime Fitness
- 4. Home gym (in my own or someone else's
- home)
- 5 Outdoors in a group
- Outdoors 1 on 1 Online in a group 6.
- 7.
- 8. Online 1 on 1 Other (open) 9.
- Today 1.
- 2.
- 1-2 days ago
- 3. 3-4 days ago 5-6 days ago 4.
- 5. Over 7 days ago

3. 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.

When did you most recently participate in HIMT?

If you are completing this survey on a mobile device, please turn your device to a landscape orientation.

PACES 18-item Likert scale (1-7)[1].	
Please select UP TO the TOP 3 reasons that you enjoy HIMT.	1. I enjoy training in a group
	I enjoy being led by an instructor
	I enjoy when there is variety in a session
	I enjoy feeling competent when I do it
	I enjoy that it helps me stay fit
	I enjoy that it helps me build muscle
	I enjoy that the sessions are generally short
	8. I enjoy that the sessions are generally fast
	paced
	9. I enjoy it when there is music playing
	10. I enjoy that the workout is high-intensity
	 I enjoy feelings of pain/ displeasure due to the high intensity of the workout
	12 Leniov that it is 'nonular'
	12. Other (open)
Plassa rank your choices in order of importance. (Nou may only	1. First most important
rank up to 2 choices)	2. Second most important
and up to 5 choices).	2. Second most important
Places calast UP TO the TOP 2 reasons that you do not aniou	 Third most important I do not oniou training in a group
Please select OP TO the TOP 3 reasons that you do not enjoy	1. I do not enjoy training in a group
-11IVII.	2. I do not enjoy being led by an instructor
	3. I do not enjoy it when there is variety in a session
	4. I do not enjoy when I do not feel competent when I do it
	5. I do not enjoy that it does not help me stay fit enough
	6. I do not enjoy that is does not help me build
	muscle
	short
	 I do not enjoy that the sessions are generally fast paced
	9. I do not enjoy it when there is music playing
	10. I do not enjoy that the workout is high-
	intensity
	11. I do not enjoy the feeling of pain/displeasure due to high-intensity of the workout
	12 I do not enjoy that it is 'nopular'
	13. Other (open)
Please rank your choices in order of importance. (You may only	13. Other (open) 1 First most important

		3.	Third most important
4.	Exercise Motivation		
	Do you feel motivated to continue to participate in HIMT?	1.	Yes
		2.	No
	How likely are you to continue to participate in HIMT?	1.	Very unlikely
		2.	Unlikely
		3.	Uncertain
		4.	Likely
		5.	Very likely
	How likely are you to drop out of HIMT?	1.	Very unlikely
		2.	Unlikely
		3.	Uncertain
		4.	Likely
		5.	Very likely
	Please select UP TO the TOP 3 reasons that you feel motivated to	1.	I enjoy training in a group
	continue to participate in HIMT.	2.	I enjoy being led by an instructor
		3.	I enjoy when there is variety in a session
		4.	I enjoy feeling competent when I do it
		5.	I enjoy that it helps me stay fit
		6.	I enjoy that it helps me build muscle
		7	Lenjoy that the sessions are generally short
		8	I enjoy that the sessions are generally fast
		0.	paced
		0	Lenjov it when there is music playing
		9. 10	I enjoy that the workout is high intensity
		10.	Lenjoy factings of pain/ displassure due to the
		11.	high intensity of the workout
		10	Ingli-intensity of the workout
		12.	Other (area)
		15.	Other (open)
	Please rank your choices in order of importance. (You may only	4.	First most important
	rank up to 3 choices).	5.	Second most important
		6.	Third most important
	Please select UP TO the TOP 3 reasons that you do not feel	1.	I do not enjoy training in a group
	motivated to continue to participate in HIMT.	2.	I do not enjoy being led by an instructor
		3.	I do not enjoy it when there is variety in a
			session
		4.	I do not enjoy when I do not feel competent
			when I do it
		5.	I do not enjoy that it does not help me stay fit
			enough
		6.	I do not enjoy that is does not help me build
			muscle
		7.	I do not enjoy that the sessions are generally
			short
		8.	I do not enjoy that the sessions are generally
			fast paced
		9.	I do not enjoy it when there is music playing
		10	I do not enjoy that the workout is high-
			intensity
		11	I do not enjoy the feeling of pain/displeasure
			due to high-intensity of the workout
		12	I do not enjoy that it is 'nonular'
		12.	Other (open)
	Places rank your choices in order of importance. (You may only	15.	First most important
	rease rank your choices in order of importance. (Tou may only	1.	Prist most important
	rank up to 3 choices).	2.	Thind most important
	Places select UP TO the TOP 2 means that we did not feel	3. 1	I nird most important
	Please select OP TO the TOP 3 reasons that you did not leef	1.	I did not enjoy it
	motivated to continue to participate in HIMT.	2.	I did not enjoy training in a group
		3.	I did not enjoy being led by an instructor
		4.	I did not enjoy it when there is variety in a
		_	session
		5.	I did not enjoy when I do not feel competent
			when I do it
		6.	I did not enjoy that it does not help me stay fit
			enough
		7.	I did not enjoy that is does not help me build
			muscle
		8.	I did not enjoy that the sessions are generally
			short
		9	I did not enjoy that the sessions are generally

- 9. I did not enjoy that the sessions are generally fast paced
 10. I did not enjoy it when there is music playing
 11. I did not enjoy that the workout is high-instance. intensity

Sharp T, et al. BMJ Open 2023; 13:e073659. doi: 10.1136/bmjopen-2023-073659

	12.	I did not enjoy the feeling of pain/displeasure
		due to high-intensity of the workout
	13.	I did not enjoy that it is 'popular'
	14.	I started another type of sport, exercise or
		training
	15.	It was too expensive
	16.	I finished a challenge
	17.	Family commitments were a priority
	18.	Work commitments were a priority
	19.	Other (open)
Please rank your choices in order of importance. (You may only	1.	First most important
rank up to 3 choices).	2.	Second most important
	3.	Third most important
What other type of sport, exercise or training did you start?	Open	

Abbreviations: HIMT : High-Intensity Multimodal Training; PACES : Physical Activity Enjoyment Scale; y : years; * : must provide value

References:

1. Kendzierski, D., & DeCarlo, K.J. (1991). Physical Activity Enjoyment Scale: Two Validation

Studies. Journal of Sport and Exercise Psychology 13(1), 50-64. doi: 10.1123/jsep.13.1.50.

Supplementary Table S3 Frequency of ranked reasons for enjoyment and motivation in current and previous HIMT participants

	Training in a group	Being led by an instructor	When there is variety in a session	Feeling competent when I do it	That it helps me stay fit	That it helps me build muscle	That the sessions are generally short	That the sessions are generally fast	When there is music playing	That the workout is high-intensity	Feelings of pain/ displeasure	That it is popular	Other	I started another type of sport, exercise or	It was too expensive	I finished a fitness challenge	Family commitments were a priority	Work commitments were a priority	I did not enjoy it
Reasons that current participants enjoy HIMT																			
First most important Second most	66	40	47	8	133	19	1	8	3	29	7	0	4	-	-	-	-	-	-
important Third most	62	38	68	10	52	49	9	25	11	29	7	0	2	-	-	-	-	-	-
important	66	37	75	19	23	25	13	26	23	33	17	3	0	-	-	-	-	-	-
Reasons that current pa	articipant	ts do not	enjoy HIMT																
First most important Second most	0	0	0	0	0	2	0	0	0	0	0	0	1	-	-	-	-	-	-
important Third most	0	0	0	0	0	1	0	1	0	0	0	0	0	-	-	-	-	-	-
important	0	0	0	1	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
Reasons that current participants feel motivated to continue HIMT																			
First most important Second most	70	24	38	9	160	24	2	3	5	21	7	0	6	-	-	-	-	-	-
important Third most	44	41	69	19	62	48	14	22	9	34	4	0	1	-	-	-	-	-	-
important	68	31	61	21	28	29	23	27	14	41	12	1	3	-	-	-	-	-	-
Reasons that current participants do not feel motivated to continue HIMT																			
First most important Second most	0	0	0	0	0	1	0	0	0	0	0	0	0	-	-	-	-	-	-
important Third most	0	0	0	0	0	0	0	0	0	1	0	0	0	-	-	-	-	-	-
important Reasons that previous	0 participa	0 nts did no	0 ot feel motiv	0 ated to con	0 tinue HI	0 MT	0	0	0	0	0	1	0	-	-	-	-	-	-
First most important	0	1	0	0	0	0	1	0	0	1	1	1	13	6	8	0	4	4	4
important Third most	0	0	1	1	1	5	0	2	1	1	0	0	3	6	4	2	1	8	0
important	1	0	0	3	2	2	0	1	1	1	5	0	1	1	1	0	0	4	1
Total selected	1	1	1	6	4	7	2	3	2	3	6	1	17	14	13	2	6	16	5

Abbreviation: HIMT : High-Intensity Multimodal Training