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REVIEW ARTICLE

The effects of high intensity interval training on quality of life: a systematic review and meta-analysis

M. Griffiths[1] · J. J. Edwards[1,2] · J. McNamara[2] · A. Galbraith[2] · S. Bruce-Low[2] · J. M. O'Driscoll[1]

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Abstract

Aim This study aimed to ascertain the impact of high intensity interval training (HIIT) on physical, mental, and overall quality of life (QoL) through a comprehensive systematic review and meta-analysis.

Subject and methods A systematic search for relevant trials was performed via PubMed, the Cochrane Library and Web of science as well as the manual screening of prior meta-analyses and their respective reference lists (PROSPERO reference: CRD42022326576). Adult controlled trials investigating the effects of a >2-week HIIT intervention with an eligible non-intervention control group were considered. As the primary outcome, studies were required to include at least one measure of physical and/or mental and/or overall QoL, on any validated QoL domain, pre and post intervention.

Results Twenty-two studies with twenty-four effect sizes were included; seventeen comparing HIIT and overall QoL, fourteen comparing HIIT and physical QoL and thirteen studies comparing HIIT and mental QoL. There was a statistically significant improvement in physical (SMD= 0.405, 95% CI: 0.110- 0.700, p= 0.007), mental (SMD= 0.473, 95% CI: 0.043 –0.902, p=0.031) and overall QoL (SMD= 0.554, 95% CI 0.210-0.898, p=0.002) following a program of HIIT. Secondary analysis of 5 studies comparing HIIT against moderate intensity continuous training demonstrated no significant difference in improvement between the two modes (SMD= -0.094, CI= -0.506-0.318, p=0.655).

Conclusion Engaging in HIIT produces statistically significant improvements in physical, mental, and overall quality of life in clinical and non-clinical populations at a small to moderate effect size. Furthermore, HIIT appears as effective as MICT in improving overall QoL, offering a more time-efficient exercise option.

Keywords HIIT · Quality of Life · Meta-Analysis · SF36 · HrQoL

Introduction

High intensity interval training (HIIT), defined as exercise containing short intervals of vigorous physical activity (PA) with alternate periods of passive or active rest (Gibala et al. 2012), is a well-established training mode in healthy individuals, with a more recent expansion into clinical populations (Cassidy et al. 2017). Previous work has evidenced the effectiveness of HIIT in improving numerous health parameters (Ito 2019), including blood pressure regulation (Edwards et al. 2021, 2022), body composition (Wewege et al. 2017), and other important risk factors of cardiovascular disease (Batacan et al. 2017a). Furthermore, HIIT provides greater improvements in VO_2 peak in a 6–8-week intervention when compared to a moderate intensity continuous training (MICT) intervention of the same length (Ito 2019). Importantly, although not to statistical significance, the recent 'Generation 100' study demonstrated a 37% and 49% lower all-cause mortality risk following HIIT compared to both the current physical activity guidelines and MICT programmes; respectively (Stensvold et al. 2020).

Currently 1 in 4 adults do not meet the current international PA guidelines (Bull et al. 2020), with lack of time being one of the most frequently reported barriers to exercise (Withall et al. 2011). Indeed, HIIT is a short, time-efficient mode of exercise, increasing its accessibility and potential for increased adherence across clinical and non-clinical

✉ J. M. O'Driscoll
jamie.odriscoll@canterbury.ac.uk

1 School of Psychology and Life Sciences, Canterbury Christ Church University, North Holmes Road, CT1 1 QU, Canterbury, Kent, UK

2 Applied Sport & Exercise Sciences Research Group, School of Health, Sport and Bioscience, University of East London, Water Lane, London, Stratford, UK

populations (Vella et al. 2017). Previous HIIT research has largely focused on physiological adaptations, with primary and secondary disease prevention remaining the predominant interest (Ito 2019). However, as a measure concerned with a person's perception of self-well-being, the 'ultimate' goal of patient care for health practitioners is to improve and maintain Quality of Life (QoL) (Jacobs 2009).

Prior research has shown promise regarding the role of HIIT in improving QoL, particularly in specific clinical groups (Lavín-Pérez et al. 2021; Reed et al. 2022); however, there are no large-scale pooled analyses investigating its effects across varying populations. The use of HIIT to improve QoL may provide an avenue of non-pharmaceutical treatment, which can be individually tailored using a variety of protocols and approaches (Cassidy et al. 2017). Therefore, the aim of this study was to establish the effectiveness of HIIT on physical, mental, and overall QoL in both clinical and non-clinical participant groups compared to a non-intervention control.

Methodology

This review was performed according to the Preferred reporting items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (Page et al. 2021).

Search strategy

This work is a sub-study of a larger systematic review and meta-analysis registered to PROSPERO (CRD42022326576). As such, a systematic search of PubMed (MEDLINE), the Cochrane Library and Web of Science was conducted using the key words 'high-intensity interval training' and 'HIIT' to broadly identify all published HIIT trials of varying outcomes in which QoL data was later extracted from. Studies published before June 2022 were considered. Prior meta-analyses and their respective reference lists were also rigorously screened for any relevant HIIT and QoL research not identified within the broad search.

Screening, eligibility and data extraction

Following conduction of the search, Rayyan was used by two authors (MG and JE) who independently screened all studies for eligibility. All studies were screened by title and abstract for initial relevance. Those studies included following the initial inclusion phase were screened by full text. Subsequently, the QoL, study characteristic and intervention-specific data of all included studies was extracted via Microsoft Excel and any inconsistencies in data collection or confliction regarding study eligibility were discussed by the researchers until a consensus was reached. The opinion of a third researcher (JOD) was provided if necessary.

Studies were considered eligible if they reported the pre and post HIIT intervention changes in questionnaire QoL across any validated domain or scale with a corresponding non-intervention control group. Validated domains included SF-36, SF-12, HRQOL, WHOQOL, WEMBES, MLHFQ, MSqOL-54, KCCQ, EQ-5D, EQ-5D-5L and IBDQ. Participants were required to be ≥18 years of age with no predetermined limitations on health or disease state. The non-intervention control groups of the included papers were required to minimise confounders, with any dietary, counselling or exercise influence resulting in exclusion. Where applicable, studies that included an MICT group adjacent to HIIT and control were included. HIIT was defined as an exercise intervention performed in high intensity intervals that contained active or passive rest periods (Gibala et al. 2012). Exercise intervals were considered high intensity according to the EXPERT tool (Hansen et al. 2017) at intensity metrics falling within the categories of 'High intensity, vigorous effort' or 'Very hard effort'.

Due to variation in QoL instruments and scoring across different studies, data extraction was standardised for consistency. If a specific physical QoL value was not given, then physical functioning/health was used depending on the questionnaire measuring QoL. If a sole mental QoL measure was not available, then a mental/emotional wellbeing value was used. If overall QoL was not available, then a general health value was used.

Methodological quality of studies

Study quality was measured via the 'Tool for the assEssment of Study qualiTy and reporting in EXercise' (TESTEX) (Smart et al. 2015). The TEXTEX scale is a 15-point scoring tool, with 5 points allocated for study quality and 10 points for reporting. Full TESTEX scores for the included studies can be found in the supplementary file (Table S1).

Statistical analysis

Pooled analyses of all studies were performed individually for overall, physical, and mental QoL. Owing to variances in QoL instruments used across the different studies, the standardised mean difference (SMD) was selected as the appropriate outcome measure. SMD effect thresholds were as follows: 0.2-0.5 small effect, 0.5-0.8 medium effect and above 0.8 as a large effect (Cohen 1988). The SMD between the HIIT group and non-intervention control group was measured for each QoL category. Separate secondary analyses were also performed comparing HIIT and MICT. Data was synthesised using Comprehensive Meta-Analysis (Comprehensive Meta-Analysis

Version 3, Biostat, Englewood, NJ, USA). Statistical heterogeneity was performed alongside the pooled analysis and reported as the I^2 statistic. If the I^2 statistic is >40% it was considered significant. Past the I^2 threshold, Eggers Regression Test (Egger et al. 1997) was systematically planned to create a funnel plot looking for asymmetry related to potential publication bias. Random effects analysis was conducted when interstudy variability was confirmed through significant heterogeneity. Pooled analysis results were considered significant if the P value was <0.05 and the Z-Value >2.

Results

Search selection

Figure 1 details the PRISMA flowchart. 4033 papers were identified through the systematic search. Following duplicate removal, 2508 papers remained, which then underwent abstract and title screening. 258 papers were full text screened against the inclusion criteria with 9 studies included from the search. Subsequent screening of previous meta-analyses and their respective reference lists identified a further 18 papers, of which 13 were included in the final pool. Ultimately, 22 studies constituting 24 effect sizes were analysed.

Study characteristics

1322 individuals participated in the included studies. The included studies contain a wide variety of populations, QoL instruments and training characteristics, as seen in Tables 1 and 2. All studies except one (Burn et al. 2021) were randomised trials. 14 studies compared the effects of HIIT on physical QoL, 13 on mental QoL and 17 studies on overall QoL. Five studies additionally compared HIIT vs MICT, constituting the secondary analysis of this work. As demonstrated in the study TESTEX scoring, common limitations include limited activity monitoring in the control groups, no blinding of assessors and participants, and a lack of intention to treat analysis.

HIIT and overall, physical and mental QoL

Figures 2, 3 and 4 detail the overall, physical and mental QoL SMD between the HIIT and non-intervention control groups, respectively. There was a statistically significant 'medium' improvement in overall QoL in HIIT compared to the control group (SMD: 0.554, CI= 0.210-0.898, p=0.002). There was a statistically significant 'small' improvement in physical QoL following HIIT compared to the control group (SMD: 0.405, CI= 0.110- 0.700, p=0.007). Finally, there was also a significant 'small' improvement in mental QoL

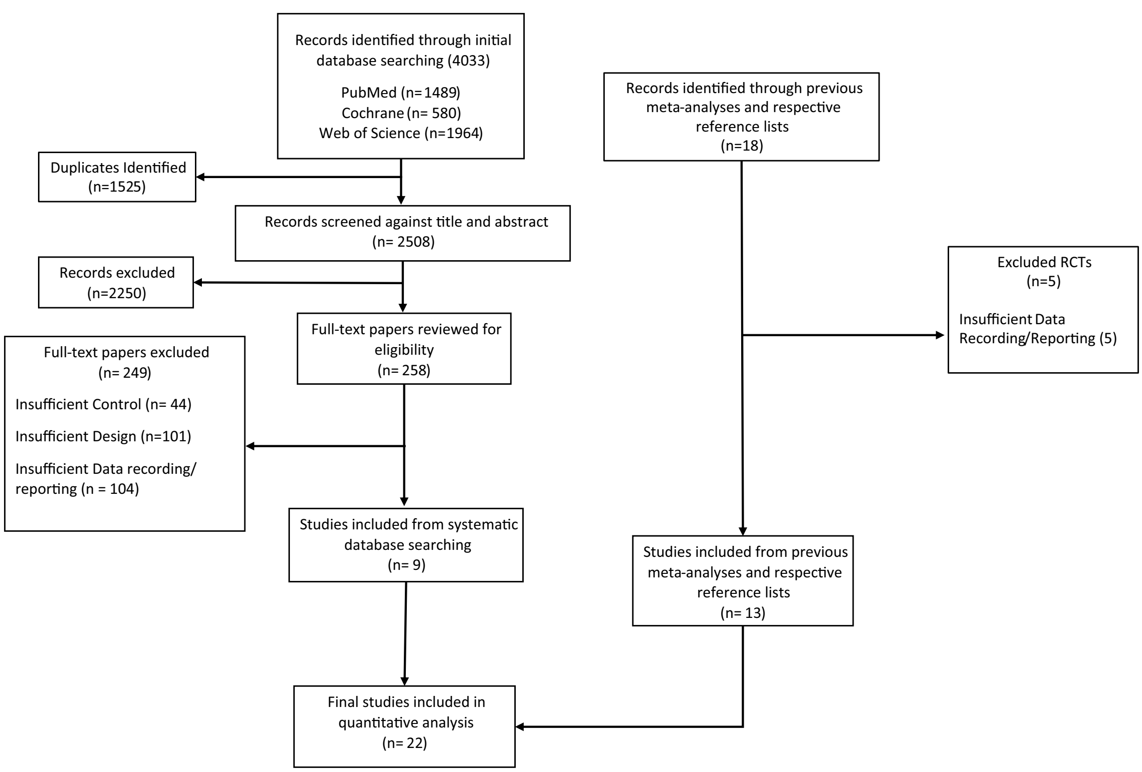

Fig. 1 PRISMA flowchart of study selection

Table 1 Study Characteristics

Study Title	Population	Country	Questionnaire	Domain	Participant Numbers	Withdrawal%	Testex
Adams et al. (2018)	Testicular Cancer Survivors	UK	SF36	Physical and Mental	Control: 27 HIIT: 35	2%	10
Alarcón-Gomez et al. (2021)	Type 1 Diabetes	Spain	SF36	Physical, Mental and Overall	Control: 8 HIIT: 11	0%	9
Atan and Karavelioglu (2020)	Female Adults with Fibromyalgia	Turkey	SF36	Physical, Mental and Overall	Control: 17 HIIT: 19 MICT: 19	8.3%	10
Ballin et al. (2019)	Obese Older Adults	Sweden	SF36	Physical, Mental and Overall	Control: 35 HIIT: 36	6.5%	11
Burn et al. (2021)	Adults in the Workplace	UK	HrQoL & WEMBES	Physical, Mental and Overall	Control: 21 HIIT: 25	14.81%	8
Chrysohoou et al. (2014)	Chronic Heart Failure	Greece	MLHFQ	Overall	Control: 39 HIIT: 33	28%	8
Connolly et al. (2020)	Inactive Premenopausal Females	UK	WEMBES	Overall	Control: 12 HIIT: 12	21.88	8
Connolly et al. (2017)	Premenopausal Females	UK	WEMBES	Overall	Control: 15 HIIT: 15 MICT: 15	NR	5
Ellingsen et al. (2017)	Adults with Heart Failure	Norway	KCCQ	Physical and Overall	Control: 76 HIIT: 82 MICT: 73	6.93%	10
Engel et al. (2019)	Healthy moderately trained adults	Germany	WHOQOL	Physical and Mental	Control: 10 HIIT: 10	0	7
Ghram et al. (2021)	Patients with pulmonary embolism	Iran	SF36	Physical, Mental and Overall	Control: 12 HIIT: 12	0%	9
Madssen et al. (2014)	Individuals after Cardiac Rehab	Norway	HrQol	Physical and Mental	Control: 25 HIIT: 24	0%	8
Malmo et al. (2016)	AF Patients	Norway	SF36	Physical, Mental and Overall	Control: 25 HIIT: 26	0%	7
Mokhtarzade et al. (2017)	Females with MS	Iran	MSqOL-54	Physical, Mental and Overall	Control: 18 HIIT: 22	8.88%	7
Mueller et al. (2021)	Patients with HFrEF	Germany	KCCQ	Physical and Overall	Control: 60 HIIT: 58 MICT: 60	2.2% at primary endpoint	11
Ochi et al. (2022)	Breast Cancer Survivors	Japan	EQ-5D	Overall	Control: 24 HIIT: 24	4%	9
Romain et al. (2019)	Overweight adults with psychiatric disorders	Canada	SF12	Physical and Mental	Control: 28 HIIT: 38	21.21%	13
Stavrinou et al. (2019)	Sedentary Adults	Greece	SF36	Overall	Control: 8 HIIT (2/wk): 14 HIIT (3/wk): 13	NR	8
Stavrinou et al. (2018)	Healthy inactive adults	Greece	SF36	Physical and Mental	Control: 8 HIIT (2/wk): 14 HIIT (3/wk): 13	NR	8
Tew et al. (2019)	Adults With Crohns disease	UK	IBDQ & EQ-5D-5L	Overall	Control: 11 HIIT:12 MICT: 12	5.5%	9
Tew et al. (2017)	Patients awaiting a AAA repair	UK	SF36	Physical and Mental	Control: 26 HIIT: 27	9.43%	10
Woodfield et al. (2022)	Patients awaiting surgery	New Zealand	SF36	Physical and Mental	Control: 35 HIIT: 28	25.4%	9

Table 2 High-intensity interval training characteristics

Study Title	Training Mode	Training Protocol	Training Duration	Training Frequency /Wk
Adams et al. (2018)	Uphill Treadmill	4x4 minute intervals at 75-95% VO2 peak with intensity increasing each week with 3 min active recovery 5-10% below VT	12 Weeks	3
Alarcón-Gomez et al. (2021)	Cycle Ergometer	Wks1& 2 = 12 x 30 secs @ 85 % PPO with 1 min Active rest at 40%, ks. 3 and 4 - 16 x 30 seconds with same AR and intensity and Wks. 5 and 6 - 20 x 30 sec reps with same AR and intensity	6 Weeks	3
Atan and Karavelioglu (2020)	Cycle Ergometer	HIIT: 4 x 4min 80-95% HR peak with 3 min rest intervals @ 70% peak HR MICT: 45 minutes at 65-75% Peak HR	6 Weeks	5
Ballin et al. (2019)	Gym Based	40 seconds at 7/10 RPE and 20 seconds rest for 18 minutes adding 2 minutes on per week	10 Weeks	3
Burn et al. (2021)	Stair Climber, boxing, Stepping	4 x7 60 seconds with 75 seconds rest over 85 % max HR	8 Weeks	3
Chrysohoou et al. (2014)	Cycle Ergometer	30 seconds at 80-100% Wpeak followed by 30 seconds passive rest for 45 minutes	12 Weeks	3
Connolly et al. (2020)	3x3m Grid, acceleration/ deceleration	15x 30s low, 20s moderate, 10s high Table 1 and 2 in paper gives full details	12 Weeks	3
Connolly et al. (2017)	Cycle Ergometer	HIIT: 1-minute intervals of 30 seconds at 30%, 20 seconds 50-60% intensity, 10 seconds of 90% maximum effort repeated 3-4 times in week 1 and 5 times in other weeks, done in 5min blocks with 2 min passive recovery between the 5 min blocks MICT: 50 minutes continuous	12 Weeks	3
Ellingsen et al. (2017)	Bike or Treadmill (participants chose)	HIIT: 4x4 min intervals at 90-95% Max HR with 3 min active recovery at 60% MICT: 47 minutes at 60-70% HR max	12 Weeks	3
Engel et al. (2019)	Tabata Protocol	30 minute sessions: no more data given	8 Weeks	2
Ghram et al. (2021)	Treadmill and cycle Ergometer	4x2 minutes at 80-95% PeakHR with 2 minutes active recovery at 50-70% Peak HR	8 Weeks	3
Madssen et al. (2014)	Gym Based	4x4minute intervals at 85-95% Hrmax with 3-minute active rest at 70% Hr max	12 Months	3
Malmo et al. (2016)	Treadmill	4 x 4min intervals @ 85-95% Hrpeak with 3 mins AR @ 60-70% Hrpeak	12 Weeks	3
Mokhtarzade et al. (2017)	Cycle Ergometer	3 intervals with 2 mins rest between at 60-5 % Wattmax increasing by 5% every 2 weeks as well as an increase in intervals with 6 intervals by week 8- interval are approx 8 minutes	8 Weeks	3
Mueller et al. (2021)	Cycle Ergometer	HIIT: 4x4 min intervals at 80-90% HRR with 3 minutes of AR MICT: 40 minutes at 35-50% HRReserve	3 months in the lab and 9 months unsupervised at Home	HIIT: 3, MICT: 5

Table 2 (continued)

Study Title	Training Mode	Training Protocol	Training Duration	Training Frequency /Wk
Ochi et al. (2022)	Home based Exercise	Homebased session no other details provided	12 Weeks	3
Romain et al. (2019)	Treadmill	10 x 30 seconds intervals at 80-90% maxHr with 90 second active recovery at 50-65% max HR	6 months	2
Stavrinou et al. (2019)	Cycle Ergometer	10 x 60 seconds at 83% Wingate peak with 60 seconds recovery at 30 % Wingate peak	8 Weeks	2/ 3 dependent on group
Stavrinou et al. (2018)	Cycle Ergometer	10x 60seconds @ 83% Wpeak between intervals there was 60 seconds at 30% Wpeak	8 Weeks	2/3 dependent on group
Tew et al. (2019)	Cycle Ergometer	HIIT: 10 x 1 minute at 90% Wpeak and 1 min rest at 15% Wpeak MICT: 30 mins continuous at 35% WPeak	12 Weeks	3
Tew et al. (2017)	Cycle Ergometer	Week 1 : 8x2 min intervals with 2 minutes unloaded active rest RPE 7/10 Weeks2,3,4: participants chose either 2x8 mins or 4x4 min intervals with 2 minutes rest between.	4 Weeks	3
Woodfield et al. (2022)	Cycle Ergometer	10 x 1 min intervals at 90% Hrmax with 1minute AR between at 60 % Hr max	4 Weeks	On weeks 1&2: 4 sessions Weeks 3&4: 3 sessions

in HIIT compared to the control group (SMD: 0.473, CI= 0.043-0.902, p=0.031).

HIIT Vs MICT on overall QoL

The secondary analysis of 5 studies comparing HIIT against MICT demonstrated no significant difference in improvement between the two modes (SMD= -0.094, CI= -0.506-0.318, p=0.655).

Publication bias and heterogeneity

All analyses demonstrated significant statistical heterogeneity (I^2: overall QoL= 70.319%, physical QoL= 83.605%, mental QoL= 78.737% and HIIT vs MICT= 51.067%). Eggers Regression test demonstrated funnel plot asymmetry and therefore evidence of publication bias for the physical QoL domain (p=0.0085, Figure S1). Overall QoL, mental QoL, and HIIT vs MICT showed no evidence of publication bias.

Discussion

This work aimed to measure the effects of HIIT on physical, mental, and overall QoL in both clinical and non-clinical populations. The findings of this meta-analysis demonstrate statistically significant improvements in all domains of QoL across different instruments. As determined by Cohen's SMD effect thresholds (Cohen 1988), the improvements observed in this work are of a 'small' to 'medium' effect size. Specifically, physical QoL and mental QoL individually produced small effect sizes, while overall QoL elicited a medium effect size. Furthermore, HIIT appears as effective as MICT in improving overall QoL, offering a more time-efficient exercise option. As the largest-scale analysis to-date, these findings support earlier preliminary evidence in the potential utility of HIIT in improving QoL across different populations.

Several reviews and large-scale trials have supported the effectiveness of HIIT for improving physical, mental and overall domains of QoL in various populations, with particular research interest on its role in clinical groups such as those with cancer (Lavín-Pérez et al. 2021), atrial fibrillation (Reed et al. 2022) and heart transplant recipients (Yu et al. 2022). Furthermore, the capacity for HIIT to produce QoL improvements similar to that of MICT is also well-supported in the broad literature, with several meta-analyses demonstrating no significant differences between HIIT and MICT on QoL in clinical populations (Gomes-Neto et al. 2017, 2018; Lavín-Pérez et al. 2021; Anjos et al. 2022). Given the impairment in QoL in patients with debilitating chronic diseases, these findings may be of clinical importance. This is particularly true considering the poor adoption

Effects of HIIT on overall QOL, SMD, with 95% CI

Study name	Outcome	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Alarcón-Gomez et al., 2021	SF-36 Overall	0.862	0.485	0.235	-0.089	1.813	1.777	0.076
Atan & Karavelioglu 2020	SF-36 Overall	2.041	0.411	0.169	1.235	2.848	4.961	0.000
Ballin et al., 2019	SF-36 Overall	0.392	0.240	0.057	-0.078	0.861	1.634	0.102
Burn et al., 2021 A	HRQOL	0.469	0.300	0.090	-0.119	1.057	1.563	0.118
Burn et al., 2021 B	WEMBES	0.467	0.300	0.090	-0.121	1.055	1.556	0.120
Chrysohoou et al., 2014	MLHFQ	1.906	0.285	0.081	1.348	2.464	6.690	0.000
Connolly et al., 2020	WEMBES	0.933	0.430	0.185	0.090	1.775	2.169	0.030
Connolly et al., 2017	WEMBES	0.327	0.368	0.135	-0.393	1.048	0.891	0.373
Ghram et al., 2021	SF-36 Overall	0.133	0.409	0.167	-0.668	0.934	0.326	0.744
Malmo et al., 2016	SF-36 Overall	0.802	0.291	0.085	0.231	1.373	2.755	0.006
Mokhtarzade et al., 2017	MSqOL-54	1.073	0.340	0.115	0.407	1.739	3.159	0.002
Mueller et al., 2021	KCCQ	-0.056	0.184	0.034	-0.417	0.305	-0.306	0.760
Ochi et al., 2022	EQ-5D	0.044	0.289	0.083	-0.522	0.610	0.153	0.878
Stavrinou et al., 2019 (2/wk)	SF-36 Overall	0.657	0.454	0.206	-0.233	1.547	1.446	0.148
Stavrinou et al., 2019 (3/wk)	SF-36 Overall	0.908	0.471	0.222	-0.015	1.830	1.929	0.054
Tew et al., 2019 A	EQ-5D-5L	-0.520	0.415	0.172	-1.333	0.294	-1.252	0.210
Tew et al., 2019 B	IBDQ	-0.970	0.432	0.186	-1.816	-0.124	-2.247	0.025
		0.554	0.176	0.031	0.210	0.898	3.154	0.002

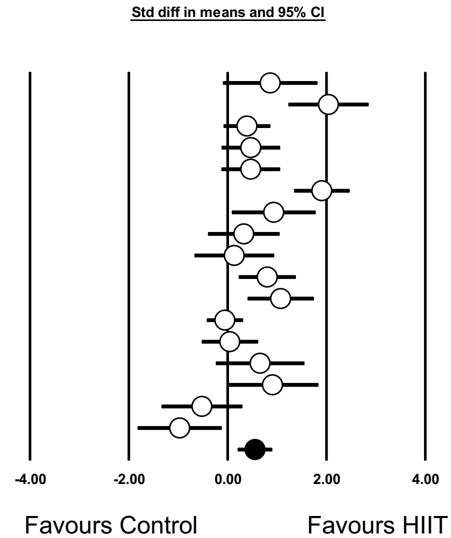

Fig. 2 Forest Plot representing HIIT and Overall QoL, SMD with 95% CI

Effects of HIIT on Physical QOL, SMD, with 95% CI

Study name	Outcome	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Adams et al., 2018	SF-36	0.260	0.257	0.066	-0.244	0.764	1.011	0.312
Alarcón-Gomez et al., 2021	SF-36	0.584	0.474	0.225	-0.346	1.513	1.231	0.218
Atan & Karavelioglu 2020	SF-36	2.313	0.431	0.186	1.468	3.158	5.367	0.000
Ballin et al., 2019	SF-36	0.560	0.242	0.059	0.085	1.034	2.313	0.021
Burn et al., 2021 A	HRQOL	0.000	0.296	0.088	-0.580	0.580	0.000	1.000
Engel et al., 2019	WHOQOL	0.244	0.449	0.201	-0.636	1.123	0.543	0.587
Madssen et al., 2014	HRQOL	0.000	0.286	0.082	-0.560	0.560	0.000	1.000
Malmo et al., 2016	SF-36	0.432	0.283	0.080	-0.123	0.987	1.525	0.127
Mokhtarzade et al., 2017	MSqOL-54	0.640	0.326	0.106	0.001	1.278	1.963	0.050
Mueller et al., 2021	KCCQ	-0.160	0.184	0.034	-0.522	0.201	-0.869	0.385
Romain et al., 2019	SF-12	-0.286	0.250	0.063	-0.776	0.205	-1.142	0.254
Stavrinou et al., 2018 (2/wk)	SF-36	0.935	0.465	0.216	0.024	1.847	2.011	0.044
Stavrinou et al., 2018 (3/wk)	SF-36	1.152	0.483	0.234	0.205	2.099	2.383	0.017
Woodfield et al., 2022	SF-36	0.115	0.254	0.064	-0.382	0.613	0.454	0.650
		0.405	0.151	0.023	0.110	0.700	2.687	0.007

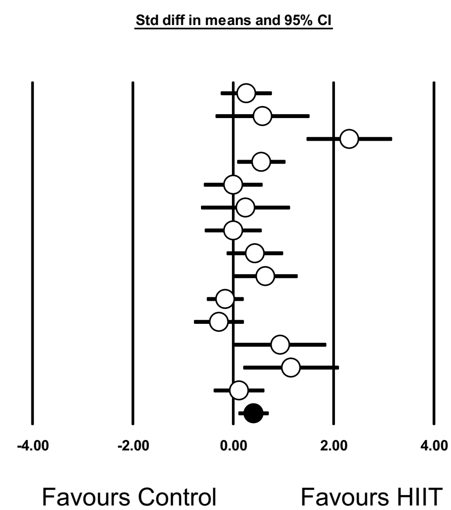

Fig. 3 Forest Plot representing HIIT and Physical QoL, SMD with 95% CI

and adherences rates to traditionally recommended MICT in these populations (Argent et al. 2018), highlighting the potential utility of HIIT as an alternative exercise intervention with similar QoL-enhancing capabilities.

In understanding the mechanistic underpinnings of QoL improvements, it is important to consider the probable confounding and interdependence between all domains of QoL, with improvements in any given single

Effects of HIIT on Mental QOL, SMD, with 95% CI

Study name	Outcome	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Adams et al., 2018	SF-36	0.821	0.267	0.071	0.299	1.344	3.081	0.002
Alarcón-Gomez et al., 2021	SF-36	0.508	0.472	0.223	-0.417	1.433	1.077	0.282
Atan & Karavelioglu 2020	SF-36	2.129	0.418	0.174	1.311	2.948	5.099	0.000
Ballin et al., 2019	SF-36	0.696	0.244	0.060	0.217	1.175	2.846	0.004
Burn et al., 2021 A	HRQOL	0.186	0.297	0.088	-0.395	0.767	0.627	0.531
Engel et al., 2019	WHOQOL	1.503	0.506	0.256	0.510	2.495	2.968	0.003
Madssen et al., 2014	HRQOL	-0.670	0.294	0.086	-1.245	-0.094	-2.281	0.023
Malmo et al., 2016	SF-36	0.174	0.281	0.079	-0.376	0.724	0.619	0.536
Mokhtarzade et al., 2017	MSqOL-54	1.043	0.339	0.115	0.380	1.707	3.082	0.002
Romain et al., 2019	SF-12	0.117	0.249	0.062	-0.372	0.606	0.469	0.639
Stavrinou et al., 2018 (2/wk)	SF-36	0.431	0.448	0.201	-0.447	1.308	0.961	0.336
Stavrinou et al., 2018 (3/wk)	SF-36	0.710	0.463	0.214	-0.197	1.616	1.534	0.125
Woodfield et al., 2022	SF-36	-0.948	0.267	0.071	-1.472	-0.424	-3.548	0.000
		0.473	0.219	0.048	0.043	0.902	2.158	0.031

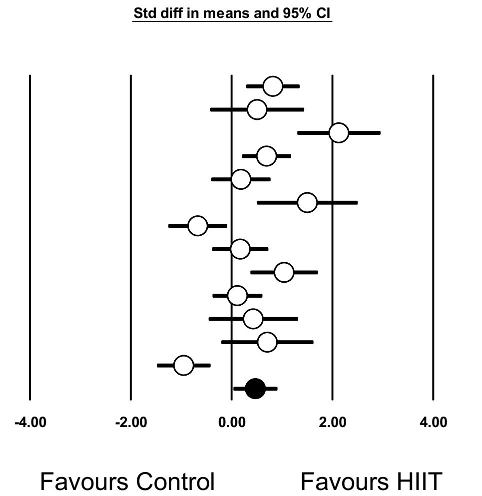

Fig. 4 Forest Plot representing HIIT and Mental QoL, SMD with 95% CI

domain likely translating into changes in all domains (Post 2014). Physically, the well-established physiological adaptations frequently seen following HIIT may translate into improvements, particularly in older groups and/or those suffering from debilitating chronic conditions, in the capacity to complete more activities of daily living. In clinical populations such as heart failure, QoL is profoundly impaired (in both preserved and reduced ejection fraction) (Hobbs et al. 2002; Stewart et al. 2010), largely owing to patient symptoms and limited functional capacity. Therefore, the frequently described improvements in cardiometabolic health and peak VO_2 (Batacan et al. 2017b) following HIIT may be of particular importance regarding the QoL of such patient groups, as has been demonstrated in previous exercise training studies (Edwards and O'Driscoll 2022).

Regarding mental QoL, these findings support that of a recent large-scale systematic review and meta-analysis (Martland et al. 2022) in clinical and non-clinical populations. This work from Martland et al. (2022) reported significant improvements in mental well-being, depression severity and perceived stress, with suggestions of sleep and psychological distress improvements. Alike the current analysis, Martland et al. (2022) found these improvements to be of a small to medium effect size. Combined with the findings of the present study, HIIT certainly appears an effective strategy to elicit improvements in psychological well-being. However, further research into populations with psychological disorders is warranted to establish the transferability of this data into specific clinical sub-groups.

Limitations

We found significant statistical heterogeneity across all analyses in this work. This is likely attributable to inter-study methodological differences such as the utilised QoL instruments and HIIT protocols, as well as wide population variation in the inclusion of clinical and non-clinical populations. We subsequently performed random-effects analyses in an attempt to account for this, and explored the Eggers regression tests for publication bias. We did indeed find publication bias for the physical QoL domain which should be appropriately considered in the interpretation of these results. Furthermore, some studies (Madssen et al. 2014; Malmo et al. 2016; Ellingsen et al. 2017; Mokhtarzade et al. 2017; Romain et al. 2019; Atan and Karavelioğlu 2020; Burn et al. 2021; Mueller et al. 2021; Ochi et al. 2022; Woodfield et al. 2022) measured QoL as a secondary outcome so may not have been appropriately powered.

Future implications

Only 5 studies included both HIIT and MICT QoL data. As such, future research is needed to assess the efficacy of HIIT compared to the traditionally recommended MICT. Additionally, larger-scale homogenous research is needed in specific populations before these findings can be extrapolated to specified clinical and non-clinical groups. Further research into varying HIIT protocols, with specific comparative data between sprint interval training and aerobic interval training protocols are needed to truly discern optimal HIIT prescription practices.

Conclusion

HIIT produces statistically significant improvements in physical, mental and overall QoL at a small to medium effect size across a range of QoL instruments in clinical and non-clinical populations. Furthermore, HIIT appears as effective as MICT in improving overall QoL, offering a more time-efficient non-pharmacological option. As the largest-scale analysis to-date, these findings support earlier preliminary evidence regarding the potential utility of HIIT in improving QoL across different populations.

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Author contributions All authors contributed to the study conception, design and search strategy. MG and JE conducted the systematic review and acquisition of data. JE and JOD performed the data analysis. MG, JE, JM, AG, SBL and JOD all assisted with the interpretation and written development of the manuscript. MG, JE, JM, AG, SBL and JOD all contributed to the drafting and revision of the final article. All authors approved the final submitted version of the manuscript.

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Declarations

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Consent to participate and publish All analysed studies were responsible for acquiring written informed consent from the respective participants.

Consent for publication All analysed studies were responsible for acquiring written informed consent from the respective participants.

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