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Associations of device-measured and self-reported physical activity with alcohol consumption: Secondary analyses of a randomized controlled trial (FitForChange)

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ABSTRACT

Background: Physical activity (PA) is increasingly used as an adjunct treatment for alcohol use disorder (AUD). Previous studies have relied on self-report measures of PA, which are prone to measurement error. In the context of a randomized controlled trial of PA for AUD, we examined: (1) associations between device-measured and self-reported PA, (2) associations between PA measurements and alcohol use, and (3) the feasibility of obtaining device-measured PA data in this population.
Method: One-hundred and forty individuals with clinician-diagnosed AUD participated in a 12-week intervention comparing usual care (phone counselling) to yoga-based exercise and aerobic exercise. Device-measured PA (Actigraph GT3x), self-reported PA (International Physical Activity Questionnaire) and alcohol consumption (Timeline Follow Back Method) were assessed before and after the trial. Effects of the interventions on PA levels were assessed using linear mixed models.
Results: In total, 42% (n=59) of participants returned usable device-measured PA data (mean age= 56±10 years, 73% male). Device-measured and self-reported vigorous-intensity PA were correlated (β= −0.02, 95%CI= −0.03, −0.00). No associations were found for moderate-intensity PA. Compared to usual care, time spent in device-measured light-intensity PA increased in the aerobic exercise group (Δ= 357, 95%CI= 709, 5.24). Increases in device-measured light-intensity PA were associated with fewer standard drinks (Δ= −0.24, 95%CI= −0.03, −0.44), and fewer heavy drinking days (Δ= −0.06, 95%CI=-0.01, −0.10).
Conclusion: Increases in light-intensity/habitual PA were associated with less alcohol consumption in adults with AUD. Self-reported PA data should be interpreted with caution. Incentives are needed to obtain device-measured PA data in AUD populations.

1. Introduction

Alcohol use disorder (AUD) is estimated to affect 14.8% of men and 3.5% of women in the European region (WHO, 2018). Treatment options include psychological counselling, pharmacotherapy, and 12-step facilitation treatment (the alcoholics anonymous model). Typically, treatments are administered via specialist clinics, however, brief interventions in primary healthcare settings are increasingly advocated and utilized (Nilsen and Andreasson, 2022). These approaches are effective, yet relapse rates remain high, ranging between 50% and 80% within one year of initial treatment (Sliedrecht et al., 2019). These sub-optimal clinical outcomes highlight the need to broaden the array of effective adjunct treatments for AUD.

General population studies have shown a positive association

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between alcohol consumption and physical activity (PA) levels (French et al., 2009; Piazza-Gardner and Barry, 2012). However, studies involving those with clinician-diagnosed AUD indicate that these individuals are *less* physically active and spend more time being sedentary than age-gender-matched controls (Hallgren et al., 2021b; Lisha et al., 2013; Vancampfort et al., 2019). Moreover, they are more likely to be affected by somatic health problems associated with physical inactivity, including cardiovascular disease, type-2 diabetes, and metabolic syndrome (Vancampfort et al., 2016a, 2016b). Depression, anxiety, and stress-related disorders are also more prevalent (Puddephatt et al., 2022; Palmisano and Pandey, 2017). Due to the multimorbidity associated with AUD, PA is increasingly being used as an adjunct treatment (Thompson et al., 2020). Recent reviews suggest that supported exercise interventions (i.e., structured PA) are associated with reductions in alcohol use, improvements in mental health, and cardiorespiratory fitness (Ashdown-Franks et al., 2020; Thompson et al., 2020). These trials have advanced our understanding of how (and why) exercise helps to reduce alcohol cravings and use in AUD populations (Leasure et al., 2015). A notable limitation, however, is that previous trials have used self-report measures of PA, which are known to overestimate activity levels and underestimate sedentary time (Adams et al., 2005). In recent years, there has been a proliferation in the use of device-measured PA due to their relative accuracy, while self-reports may underestimate real associations (Prince et al., 2020).

To address this issue, we conducted a randomized controlled trial (RCT) 'FitForChange' incorporating both device-measured and self-reported PA outcomes (Gunillasdotter et al., 2022; Hallgren et al., 2021a). The effects of yoga-based exercise (stretching, bodyweight resistance, and balance movements) and aerobic exercise, were compared to usual care - phone-based counselling, which is shown to be equally effective as face to face treatment - (Gates and Alberella, 2015), among 140 non-treatment-seeking adults with clinician-diagnosed AUD. The main findings have been published elsewhere (Gunillasdotter et al., 2022). Briefly, compared to usual care, participation in supervised, group yoga or aerobic exercise was associated with clinically meaningful reductions in alcohol consumption (5–7 standard drinks/week) (Gunillasdotter et al., 2022). In a nested study, short bouts of aerobic exercise were associated with reductions in cravings for alcohol, improvements in mood states, and state anxiety (Hallgren et al., 2021a). Overall, findings indicated that supervised exercise is safe and feasible in this population, with effects on alcohol consumption equivalent to usual care (Gunillasdotter et al., 2022).

The current study uniquely reports secondary analyses from the FitForChange trial. The aims were to: (1) examine the effects of the PA interventions on device-measured and self-reported PA levels; and (2) examine associations (cross-sectional and prospective) between PA and alcohol consumption. As this is the first trial to assess device-measured PA among those with AUD, a third aim was to describe the feasibility of this approach.

2. Methods

2.1. Study design

Data are derived from a three-group, parallel, RCT was conducted at the Karolinska Institutet (KI) in Stockholm, Sweden. Approval was granted by the Regional Ethics Committee in Stockholm (DNR: 2017/1380–31) and the trial was prospectively registered with German Clinical Trials (http://www.drks.de) on 14 July 2017 (DRKS00012311). The trial protocol is publicly available (Hallgren et al., 2018). For these secondary analyses, where intervention effects were not the primary focus, data from all three groups were used to examine associations between PA levels and alcohol use.

2.2. Participants

In total, 140 participants were recruited between January 2018 and August 2019, via advertisements in a free local newspaper ('Mitt-I') distributed throughout Stockholm. Those eligible were allocated either to exercise-based interventions (yoga n=46; aerobic exercise n=49), or to treatment as usual (n=45). **Eligibility criteria** were as follows: (1) Clinician-diagnosed AUD (DSM-5, ≥2 criteria) *and* hazardous drinking during the past month, as defined by >7 standard drinks/week or >4 in a single drinking occasion for women; >14 standard drinks/week or >5 in a single drinking occasion for men (National Board of Health and Welfare, 2023); (2) resident in Stockholm County; (3) aged 18–75 years; and (4) physically inactive (self-reported as engaging in less than two structured exercise sessions [i.e., planned, purposeful exercise such as running, strength training, etc.] per week on average during the past three months). **Exclusion criteria**: hypertension (i.e. systolic >200 mm HG and/or diastole > 110 mm HG); having a somatic disease (e.g. history of heart disease, cancer, chronic obstructive pulmonary disease, or unstable blood glucose); mental illness (e.g. psychosis, bipolar disorder, suicidal risk); current regular exercise defined as two or more planned exercise sessions per week; currently in treatment for AUD; pregnancy or current use of illicit drugs. We defined 'non-treatment-seeking' as those who have not sought professional/medical help for their alcohol use during the past 12 months, and who indicated (during screening) a desire to manage their alcohol use autonomously.

2.3. Randomization and masking

Trial participants were assigned to either aerobic exercise, yoga, or treatment-as-usual (TAU) (1:1:1 group allocation) using a simple randomization list generated by an independent statistician using SAS version 9.4. Allocation was via sealed, opaque envelopes that were opened immediately after participants' baseline assessments.

2.4. Interventions

A full description of the intervention components is available elsewhere (Gunillasdotter et al., 2022; Hallgren et al., 2018). Briefly, participants randomized to the respective exercise interventions received a 12-week membership to a chain of fitness centres at 70 locations across Stockholm. Those allocated to aerobic exercise were asked to attend supervised exercise classes at least three times/week for 12-weeks. Yoga participants were also asked to attend yoga classes at least three times/week during the intervention period. Sessions were supervised by qualified fitness instructors. As a measure to improve adherence, participants were allowed to choose from a variety of group classes. In addition, participants were offered three 30-minute support sessions with a personal trainer (at weeks 1, 3, and 9) to monitor progress and optimize adherence. **Aerobic exercise** classes consisted of supervised group training sessions with 10–20 participants and of 60 minutes duration. Options available included cycling/spinning, aerobic training (whole body movements, including running and jumping), boxing-based exercise, and dance-based aerobic exercise. Participants could pick and choose from classes according to their individual preferences and could also opt for individual aerobic exercise sessions using a cross-trainer, treadmill, or stationary cycle. **Yoga classes** were also delivered in groups and were 60-minutes in duration. Sessions were suitable for beginner-to-intermediate level and involved physical postures that emphasised balance and flexibility, combined with breathing exercises. Participants could choose from Ashtanga and Hatha yoga (gentle physical postures), Les Mills Body Balance (a combination of yoga, Pilates, and Tai-chi), Yin Yoga, and Yin release (calm postures and breathing exercises). **Usual care** consisted of ~30-minute phone-based counselling sessions with a qualified addiction counsellor (e.g., psychologist or nurse). Sessions included advice on ways to reduce alcohol use and the treatment options available. The planned number of TAU sessions was n=3, however, the exact number varied depending on participant need. We acknowledge that what constitutes usual care will vary between countries and may include motivational interviewing and/or CBT.

2.5. Measures

2.5.1. Device-measured and self-reported physical activity

One week immediately before and after the 12-week intervention, all participants wore a tri-axial ActiGraph™ GT3X accelerometer (Actigraph Inc. Pensacola Florida, USA) to obtain individual device-measured PA level data. All participants were instructed to wear the device on the right hip for seven consecutive days during wake time (participants removed the device immediately before bedtime). Data were classified as valid if it consisted of at least 10 hours of wear-time on at least four days (Trost et al., 2005). The ActiLife software (version 6.13.3) was used to download and process all data. The signal was sampled at 30 Hz and processed in 60-second epochs (Migueles et al., 2017). Validated counts per minute cut-points were used to classify intensity into light PA, moderate PA, moderate-to-vigorous PA (MVPA), and vigorous PA (Sasaki et al., 2011). In addition, 200 counts per minute was used as the maximal cut point for sedentary time (Aguilar-Farias et al., 2014). Non-wear time was classified as sixty uninterrupted minutes of zero counts (Peeters et al., 2013). All device-measured PA outcomes were expressed as minutes per week. Self-reported PA levels were assessed with the International PA Questionnaire (IPAQ), which includes one question about time spent sitting (Craig et al., 2003). All PA variables were expressed as minutes per week.

2.5.2. Alcohol consumption

The 30-day Timeline Follow-Back method (TLFB) was used to assess changes in alcohol consumption (standard drinks/week). In Sweden, one standard drink contains 12 g of pure ethanol. The TLFB was also used to determine (1) the number of heavy drinking days (HDD), i.e., the days on which men consumed at least five standard drinks or women consumed at least four drinks during the 30-day period, (2) the number of sober days, and (3) hazardous drinking, defined as consumption exceeding 14 or nine standard drinks per week for men and women, respectively, and/or meeting the threshold for HDD. AUD severity was measured using the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (mild = 2–3, moderate = 4–5, severe ≥ 6 criteria) (DSM-5, 2013). Harmful use was assessed using the 10-item screening instrument Alcohol Use Disorders Identification Test (AUDIT). At the 13-week mark, the DSM-5 and the AUDIT were adjusted to assess the past three months.

2.6. Statistical analyses

Participant characteristics are shown using means and standard deviations (SD) for continuous variables, and the n/% for categorical variables. Both device-measured and self-reported PA is shown in minutes per/week for comparison with global PA recommendations (WHO, 2020). Parametric test assumptions were checked prior to analysis (normality, homogeneity of variance, linearity). Effects of the interventions on device-measured and self-reported PA were assessed using linear mixed effect models (LMMs) fitted for all PA intensities (including steps/week). Time, group, and the time x group interaction were included as fixed effects while accounting for random effects of each individual. Age and gender were included as covariates. Within group (pre- to post-intervention) changes in PA were assessed using paired sample t-tests. To examine the association between changes in PA and alcohol consumption, a change variable was calculated for all alcohol and PA variables (i.e., the difference between baseline and follow-up measurements). A linear regression model was created using alcohol consumption as the dependent variable and PA as the independent variable. Gender, age, wear time, and baseline level of the respective PA category and BMI were included as covariates in all linear regression models. The association between device-measured and self-reported PA was investigated using a linear regression, using device-measured PA as the dependent variable, and self-reported PA as the independent variable. For all regression models, estimates and their associated confidence intervals (CIs) were calculated. All analyses were conducted using R studio software version 4.2.1 8 (Team, 2022). For data wrangling the tidyverse package (Wickham. et al., 2019) was used and the linear mixed models were conducted using the lme4 package (Bates et al., 2015).

3. Results

3.1. Participant characteristics

Of the 140 participants recruited (entire study), 127 completed the follow-up assessment. At baseline, 109 participants returned the accelerometers and 90 had valid accelerometer data. At follow-up, 83 participants returned the accelerometers and 66 had valid data. In total, 59 participants had valid accelerometer data both at baseline and follow-up and were included in the complete case analyses for device-measured PA (Table 1). Of these, 73% were males (mean age = 56.2±10.2 years), 67.8% were tertiary educated, with a mean BMI of 27.5±4.7. The majority had moderately severe AUD (DSM5 criteria = 4.2±1.5), consumed 86.5±46.6 standard drinks of alcohol per month (~21 per week), and had 9.6±8.4 heavy drinking days/month. Compared to device-measured MVPA (355±153 minutes/week), participants under-reported their MVPA (133±98 minutes/week). Similarly, compared to device-measured sedentary time (3422±686 minutes/week, or ~8.1 hours/day) participants under-reported the amount of time spent sedentary (382.8±206 minutes/week) (Table 1).

3.2. Associations between device-measured and self-reported physical activity

At baseline, there was no association between device-measured and self-reported PA in any of the PA intensity categories. Changes in device-measured vigorous PA were associated with changes in self-reported PA (β= −0.02, −0.03 to −0.00, $p<0.05$) (Table 2).

3.3. Within group changes in device-measured and self-reported physical activity

Self-reported MVPA (Δ=172 minutes/week, 95%CI=32.4–311.6) and vigorous PA (Δ=77 minutes/week, 95%CI=23.2–130.8) increased among aerobic exercise participants (Table 3).

Device-measured PA remained largely stable (unchanged) across the trial. There was a non-significant increase in device-measured light PA among aerobic exercise participants (Δ=251 minutes/week).

3.4. Intervention effects on physical activity levels

Results from linear mixed models examining the intervention (group x time) effects on PA levels are shown in Table 4. Compared to TAU, the aerobic exercise group increased their self-reported VPA (Δ=96.5 minutes/week, 95%CI=170.1–22.8). Compared to yoga and TAU, respectively, the aerobic exercise group increased their device measured light PA: (Δ=340.9, 95%CI=11.0–670.9; Δ=357.2, 95% CI=709.9–5.2).

3.5. Associations between physical activity and alcohol consumption

At baseline, lower self-reported MVPA was associated with higher AUD severity (β= −0.00, 95%CI = −0.01– −0.00) and higher AUDIT total scores (β= −0.02, 95%CI = −0.03– −0.00) (Suppl. Table 1). There was no association between device-measured PA and alcohol

Table 1
Participant characteristics.

	All	Treatment as Usual	Aerobic Exercise	Yoga
	n=59	*n=18*	*n=17*	*n=24*
Personal				
Age (mean/SD)	56.25 (10.1)	55.22 (10.1)	53.00 (9.7)	59.33 (10.0)
Males, n (%)	44 (72.9)	16 (88.9)	12 (70.6)	15 (62.5)
Tertiary education, n (%)	40 (67.8)	12 (66.7)	13 (76.5)	14 (58.3)
BMI kg/m^2 (mean/SD)	27.50 (4.7)	26.69 (4.7)	28.91 (3.3)	27.09 (5.5)
Alcohol use				
DSM5 criteria (mean/SD)	4.20 (1.5)	3.94 (1.2)	4.41 (2.0)	4.33 (1.2)
Standard drinks/month	86.57 (46.6)	80.09 (44.8)	88.50 (45.1)	88.62 (51.4)
Heavy drinking days/month	9.67 (8.4)	9.00 (8.7)	10.88 (8.0)	9.04 (8.9)
Device-measured PA				
Steps/day (mean/SD)	8436.5 (2331.4)	9092.3 (2102.3)	8325 (2951.7)	8023.6 (1963.5)
Sedentary (mins/week)	3422 (686.7)	3304.9 (619.1)	3273.4 (743.8)	3615 (674.6)
Light PA (mins/week)	2264.6 (557.3)	2290.3 (514.3)	2236.7 (629.1)	2265.2 (558)
Moderate PA (mins/week)	339.9 (146.6)	355.4 (129.2)	367.3 (202.8)	308.8 (107.2)
MVPA (mins/week)	355.9 (153.9)	382.2 (148.9)	375.6 (206.6)	322.3 (107.8)
Vigorous PA (mins/week)	16 (33.2)	26.8 (45.1)	8.2 (15.7)	13.4 (30.8)
Self-reported PA				
Sedentary (mins/week)	382.8 (206.5)	395 (195.8)	331.7 (150.5)	410 (246.2)
Walking (mins/week)	172 (227.3)	139.2 (153.2)	145.8 (166.1)	215.2 (300.9)
Moderate PA (mins/week)	46.8 (76.8)	45.6 (89)	20.5 (38.3)	66.2 (84.3)
MVPA (mins/week)	70.4 (96.7)	74 (115.9)	31.2 (41.1)	95.6 (103.4)
Vigorous PA (mins/week)	23.6 (59.5)	28.3 (85)	10.5 (23.8)	29.3 (54.9)

Table 2
Associations between device-measured and self-reported physical activity.

	Sedentary	Steps	Light PA/walking	MVPA	Vigorous PA
	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
Baseline	0.12 (-0.64 – 0.88)	4.03 (-14.77 – 22.83)	-0.13 (-0.75 – 0.49)	0.23 (-0.18 – 0.64)	-0.04 (-0.18 – 0.10)
Change	0.07 (-1.04 – 1.18)	5.25 (-19.18 – 29.69)	-0.01 (-0.77 – 0.76)	-0.14 (-0.40 – 0.13)	**-0.02 (-0.03 – −0.00)***

* $p<0.05$

consumption at baseline. Over time, increases in device-measured light PA were associated with less alcohol consumption during the past 30 days (-32 standard drinks) (Δ=-0.24, 95%CI = −0.03, −0.44) and fewer standard drinks per/week (-8) (Δ=-0.06, 95%CI = −0.01, −0.10) (Suppl. Table 2).

4. Discussion

In the context of a recently completed RCT (FitForChange), we examined associations between device-measured and self-reported PA, associations between PA and alcohol use, and the feasibility of collecting device-measured PA data in adults with AUD. Despite receiving instructions on how to use the devices, including a mid-intervention reminder, more than half of the participants used them incorrectly or did not return them, indicating that additional incentives are needed when assessing device-measured PA in AUD populations. These could include financial rewards for compliance, or regular phone messages with reminders to wear them correctly (Oh et al., 2021). Although we excluded regular exercisers from the trial (i.e., those who engaged in structured exercise more than once per week), most of the study participants were physically active with a mean (device-measured) MVPA of 355 minutes/week; well in excess of the recommended 150 minutes/week (WHO, 2020). Of note, most of the MVPA was accumulated through moderate PA (e.g., moderate-intensity cycling, gardening, etc).

Table 3
Within group changes in physical activity (baseline to follow-up).

	TAU Δ minutes (95%CI)			Aerobic Exercise Δ minutes (95%CI)			Yoga Δ minutes (95% CI)		
	t	Low	High	*t*	Low	High	*t*	Low	High
Device-measured PA									
Sedentary	-1.3	-392.8	390.1	-1.9	-404.8	400.9	-41.6	-380.6	297.4
Light PA	-105.3	-355.4	144.7	251.9	-5.3	509.2	-89.0	-305.5	127.5
Moderate PA	-18.5	-99.7	62.7	-56.3	-139.9	27.2	13.4	-56.9	83.7
MVPA	-26.1	-109	56.6	-53.5	-138.8	31.7	15.3	-56.4	87.1
Vigorous PA	-7.6	-20.2	4.9	2.7	-10.2	15.7	1.9	-8.9	12.8
Self-reported PA									
Sedentary	21.6	-83.4	126.7	-33.5	-141.6	74.6	-71.2	-162.2	19.7
Walking	111.1	-57.8	280.1	82.6	-91.2	256.5	31.2	-115.1	177.5
Moderate PA	18.7	-93.9	131.4	95	-20.9	210.9	38.7	-58.8	136.3
MVPA	-0.6	-136.3	135	**172***	**32.4**	**311.6**	56.4	-61.1	173.9
Vigorous PA	-19.4	-71.7	32.8	**77***	**23.2**	**130.8**	17.7	-27.5	62.9

Note: all PA measures are in minutes/week
*$p<0.05$

Table 4
Intervention effects on physical activity levels.

	TAU vs Aerobic Exercise Difference in minutes (95%CI)	TAU vs Yoga Difference in minutes (95%CI)	Aerobic Exercise vs Yoga Difference in minutes (95%CI)
Device measured PA			
Steps/day	-249.49 (-1989.6 to 1490.6)	-740.46 (-2344.8 to 863.9)	-490.97 (-2122 to 1140.1)
Sedentary	0.59 (-550.6 to 551.8)	40.28 (-467.9 to 548.4)	9.68 (-477 to 556.3)
Light PA	**357.28 (709.32 to 5.24)***	-16.32 (-340.8 to 308.2)	**340.96 (11 to 670.9)***
Moderate PA	37.83 (-76.5 to 152.2)	-31.91 (-137.3 to 73.5)	-69.75 (-176.9 to 37.4)
MVPA	27.36 (-89.2 to 144)	-41.52 (-149 to 66)	-68.88 (-178.2 to 40.4)
Vigorous PA	-10.47 (-28.2 to 7.2)	-9.60 (-25.9 to 6.7)	0.87 (-15.7 to 17.5)
Self-reported PA			
Sedentary	55.20 (-92.7 to 203.1)	92.92 (-43.4 to 229.3)	37.72 (-100.9 to 176.4)
Walking	28.46 (-209.4 to 266.3)	79.94 (-139.3 to 299.2)	51.48 (-171.4 to 274.4)
Moderate P	-76.22 (-234.9 to 82.4)	-19.97 (-166.2 to 126.3)	56.25 (-92.5 to 205)
MVPA	-172.72 (-363.7 to 18.3)	-57.12 (-233.2 to 119)	115.60 (-63.4 to 294.6)
Vigorous PA	**-96.50 (-170.11 to -22.89)***	-37.15 (-105 to 30.7)	59.35 (-9.6 to 128.3)

Note: all PA measures are in minutes/week (except steps)
*$p<0.05$

This amount of MVPA contrasts with the generally lower levels of PA reported in previous inpatient studies (Vancampfort et al., 2019; Weinstock et al., 2020), highlighting a potential difference between treatment seeking and non-treatment seeking individuals (current study) with AUD.

Large discrepancies were observed between device-measured and self-reported PA. Consistent with studies in non-AUD populations, compared to device-measured sedentary time, participants under-reported the amount of time they spent sedentary/sitting (Prince et al., 2020). Unexpectedly, compared to device-measured MVPA, participants also under-reported their MVPA levels, which contrasts with previous research indicating that MVPA is typically over-reported (Adams et al., 2005). There are several possible explanations for this discrepancy. Some participants could have forgotten to report habitual/daily physical activities, considering them to be irrelevant or 'non-strenuous', resulting in an underestimation of MVPA. Others may have sought to minimize their PA levels to increase their chances of being accepted into the trial, while other participants may not have identified as being 'physically active' leading to similar underestimations of MVPA. A Swedish general population study found that middle-aged adults underestimated their MVPA levels by up to 100 minutes/day (Ekblom et al., 2015). Similarly, a pilot randomized trial in the UK found that the more physically active people were the more they over-estimated their PA levels when comparing self-report and device measured PA (Taylor et al., 2014). The study also showed that adding financial incentives may have increased compliance and the return of accelerometers. Regardless of the explanation, these discrepancies highlight the importance of utilising device-measures to obtain greater precision with the PA data in AUD populations. Also, in counselling, the detailed information from motion sensors constitutes valuable input in behaviour change and self-awareness, as small and perhaps non-intentional changes can be identified.

Compared to TAU, participation in aerobic exercise was associated with significant increases in self-reported MVPA and device-measured light PA. However, only the increases in light PA were associated with reductions in alcohol consumption. Previous acute and long-term trials of exercise for depression have shown that light-intensity PA is equally effective in reducing depressive symptoms compared to higher-intensity exercise (Meyer et al., 2016; Yu et al., 2023), with one prominent study (n=946) indicating that light-intensity PA may confer greater mental health benefits (Hallgren et al., 2015; Helgadottir et al., 2017). The current findings offer preliminary evidence that even among physically active individuals, habitual/light PA may play a role in reducing alcohol consumption, potentially by displacing time spent sedentary. This requires investigation in future studies. While vigorous exercise may be optimal to elicit the biological mechanisms purported to mediate the benefits of exercise on alcohol use (i.e., dopamine and opioid synthesis, neurogenesis, etc.) (Perry, 2016; Robison et al., 2018), increases in habitual PA, including light-intensity PA, may have relatively stronger affective and/or behavioural effects, as they are accumulated throughout the day and for longer periods than structured exercise, which is typically undertaken a few times per week for brief periods (Hallgren et al., 2016, 2021a).

The findings should be viewed in the context of related trials which have not reported device-measured PA. Roessler et al. (2017) compared the effects of outpatient treatment for alcohol dependence with TAU plus supervised group aerobic training (6-months), or TAU plus individual aerobic training (6-months) (Roessler et al., 2017). Results indicated no direct effect of exercise on alcohol use, however, PA was protective against excessive drinking following treatment. Brown et al. (2014) examined the effects of a 12-week moderate-intensity, group aerobic exercise intervention (n=25) or a brief advice to exercise intervention (n=23) – both as an adjunct to inpatient care (Brown et al., 2014). Those receiving group aerobic exercise reported fewer drinking and heavy drinking days, relative to the brief advice group. Weinstock et al. (2020) examined the utility of exercise as an intervention for sedentary non-treatment-seeking adults with AUD (Weinstock et al., 2020). Participants (n=66) received either a 4-month YMCA gym membership only or a 4-month YMCA gym membership plus a 16-week integrated motivational intervention for exercise. Significant reductions in drinking and alcohol-related consequences were noted over time but did not differ by study condition and were not related to changes in exercise. As noted, however, a limitation of these trials is that changes in PA were self-reported. The current study adds the observation that device-measured and self-reported PA levels were not correlated in this AUD population, and that increases in light PA were associated with reductions in alcohol use.

4.1. Implications for practice

The inverse association between light PA and alcohol use identified in this study suggest that clinicians treating AUD may be advised to screen PA habits and support increases in habitual PA, such as walking, particularly among those who are physically inactive. Such behavioral changes may lead to improvements in somatic health, which are shown to be impaired in those with AUD (Vancampfort et al., 2016a, 2020), and could elevate mood states and reduce anxiety, potentially lowering cravings for alcohol (Hallgren et al., 2017).

Strengths of the study include the use of device-measured PA, and our focus on non-treatment seekers who are rarely studied. Potential limitations include the relatively high non-return rates, which permitted only a sub-sample of the data to be examined. This method could lead to bias favoring the intervention; however, we observed no significant baseline differences between those who used the devices correctly and those who did not. Lastly, the Actigraph GT3X used in this study is a waist-worn device; newer wrist-worn devices may have better compliance and are recommended for future research.

In conclusion, the current study suggests that, while it is feasible to collect device measured PA data in non-treatment seeking AUD populations, additional incentives and the use of wrist worn devices may be necessary to optimize compliance. Increases in light/habitual PA (e.g., walking) may lead to reductions in alcohol use in adults with AUD. As many of those with AUD are physically inactive, PA habits should be routinely screened in clinical practice and increases in PA supported by appropriately trained professionals. The relationship between the optimal PA-dose and alcohol consumption is unclear and requires examination in future experimental studies.

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CRediT authorship contribution statement

Mats Hallgren: Writing – original draft, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Davy Vancampfort:** Writing – review & editing. **Örjan Ekblom:** Writing – review & editing, Resources, Methodology. **David W. Dunstan:** Writing – review & editing. **Emil Bojsen Moller:** Writing – review & editing, Formal analysis, Data curation. **Sven Andréasson:** Writing – review & editing, Supervision, Resources, Investigation, Funding acquisition.

Declaration of Competing Interest

There are no conflicts of interest to declare.

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Author disclosures

Authors have no disclosures to declare.

Supporting information

Supplementary data associated with this article can be found in the online version at: (insert here).

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.drugalcdep.2024.111315.

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