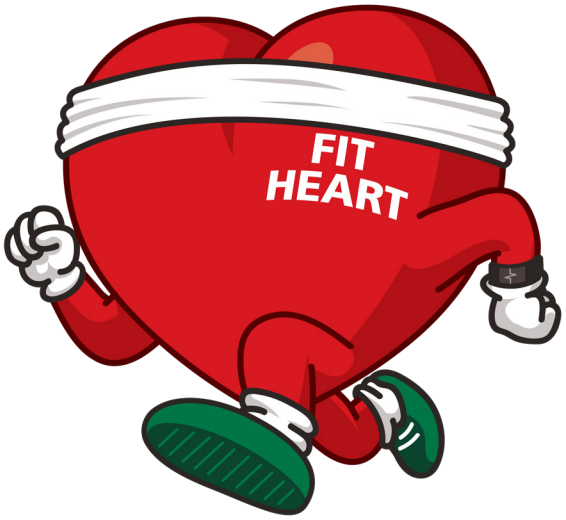

Feasibility of an Intervention Targeting Health through Exergaming as an Alternative to Routine Treatment

(FIT HEART) Report

Justice Health and
Forensic Mental Health Network

NSW GOVERNMENT

"Spirits and Aboriginal patients' journeys" – The artist is a Wiradjuri man from Wellington NSW, and the piece, commissioned specifically for Justice Health NSW, expresses the artist's experiences of health and wellbeing in concert with Justice Health NSW.

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Contents

Figures and Tables

Abbreviations

ADHD	Attention deficit/hyperactivity disorder
BPM	Beats per minute
BMI	Body mass index
CAPE-15	Community Assessment of Psychic Experiences - Positive 15-items Scale
DASA	Dynamic Appraisal of Situational Aggression
DASS-21	Depression Anxiety Stress Scale — Short Form
ECG	Electrocardiogram
FIT HEART	Feasibility of an Intervention Targeting Health through Exergaming as an Alternative to Routine Treatment
HbA1c	Glycosylated haemoglobin
HDL	High-density lipoproteins
HR	Heart rate
HREC	Human Research Ethics Committee
HRMax	Maximum heart rate
Justice Health NSW	Justice Health and Forensic Mental Health Network
LBH	Long Bay Hospital
LBH MHU	Long Bay Hospital Mental Health Unit
LDL	Low-density lipoproteins
MetS	Metabolic syndrome
METS	Metabolic equivalent of tasks
PRN	Pro re nata (as required)
PTSD	Post-traumatic stress disorder
RCT	Randomised control trial
RHR	Resting heart rate
SD	Standard deviation
SIMPAQ	Simple Physical Activity Questionnaire
UBACC	University of California, San Diego Brief Assessment of Capacity to Consent

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Most importantly, we gratefully acknowledge the participants, without whom the project would not have been possible.

Foreword

People with serious mental illness are at elevated risk of cardiovascular disease and diabetes. The need for interventions designed to promote increased physical activity is widely recognised. However, there are multiple barriers to implementing conventional physical activity programs in a secure inpatient setting that result from institutional or individual patient restrictions. These barriers include limited access to outdoor space and gym equipment. Additionally, people with serious mental illness can lack the motivation to engage in physical activity. Therefore, exploring novel interventions to increase physical activity within this population is essential.

There have been major developments in 'gaming' to improve health outcomes. Exergaming — which combines gaming and physical activity — has shown positive results in the literature. However, the acceptability and feasibility of such an intervention have not been fully explored within an inpatient mental health population.

The FIT HEART project aims to bridge this gap in the literature. The project explores the feasibility and acceptability of an exergaming intervention within a secure mental health facility. We hope the information gleaned from this study can be used to improve the cardiometabolic health of people with serious mental illness through the adoption of novel physical activity interventions.

Wendy Hoey
Chief Executive

Executive Summary

Introduction

The adverse metabolic effects associated with psychotropic medications used to treat mental illness are well documented. These medication side effects and lifestyle factors increase the risk of metabolic syndrome (MetS) and, in turn, type 2 diabetes and cardiovascular disease among people with a serious mental illness.

There are many challenges in implementing lifestyle interventions in a secure psychiatric inpatient setting. Environmental barriers to physical activity include restricted time in outdoor and communal spaces and limited access to exercise equipment. Secondary to low mood, negative symptoms and poor socio-occupational functioning, psychiatric inpatients lack the motivation and enthusiasm to engage in physical activity. There is a need for novel physical activity interventions that can overcome these barriers, suitable for patients in secure settings.

'Exergaming' as a form of physical activity has shown promising results in the literature. Previous research suggests that exergaming interventions are feasible and acceptable among psychiatric patients in an outpatient setting (1–5). However, the feasibility and acceptability of exergaming in an inpatient setting have not been investigated.

Methods

Aim and Design

The FIT HEART project investigated the feasibility, acceptability and potential effectiveness of exergaming to promote physical activity among patients of a secure mental health unit. The study employed a non-randomised, pre-test/post-test parallel-group design conducted at Long Bay Hospital Mental Health Unit (LBH MHU). Participants were allocated to either the intervention or the control group based on their ward.

Recruitment

Data collection commenced in June 2020 and concluded in May 2021, with two recruitment periods (June to September 2020 and January to March 2021). All participants admitted to LBH MHU were eligible for inclusion (provided they did not meet the exclusion criteria).

A total of 76 patients were admitted to LBH MHU during the recruitment periods:

- 19.7% (n = 15) were deemed not appropriate to approach and
- 13.2% (n = 10) were excluded due to either meeting the exclusion criteria (n = 2), imminent discharge or transfer from the LBH MHU (n = 7), or being unavailable to approach for consent (n=1).

In total, 51 patients (intervention n = 26, control n = 25) were eligible to be approached:

- 62.7% (n = 32) declined to participate and
- 37.3% (n = 19) consented to the screening process.

Several participants were discharged from LBH MHU at various times throughout the recruitment/ intervention period. The total number of participants in each group at each stage of the project were:

- Baseline: intervention n = 5; control n = 8;
- Mid-intervention: intervention n = 3; control n = 5;
- Post-intervention: intervention n = 3; control n = 4.

In total, 24 Justice Health and Forensic Mental Health Network staff at LBH MHU were approached to participate in the staff acceptability survey, with 19 surveys received, indicating a response rate of 79.2%.

Intervention

Participants in the intervention group were allocated a wrist-worn accelerometer (Fitbit Charge 3) to wear on weekdays when out of their cell. They began one week prior to the intervention period and concluded one week post-intervention. They also received a 12-week exergaming program that included three 30 minute exergaming sessions per week, plus a 10-minute warm-up.

Participants in the control group were also allocated wrist-worn accelerometers (Fitbit Charge 3) to wear on weekdays when out of their cell for 12 weeks. These participants received 'routine treatment', defined as the standard model of care provided at LBH MHU.

Measures

The following outcomes were measured during the study:

- Feasibility and Acceptability: measured through a questionnaire administered post-intervention and upon discontinuation from the study, recruitment rates, attendance and duration of exergaming sessions and compliance with wearing the Fitbit.
- Physical Health Outcomes: measured through a questionnaire, anthropometric measures, a three-minute step test and pathology testing.
- Mental Health Outcomes: measured through questionnaires and psychological assessment scales.

Data Analysis

All data were transferred to IBM SPSS Statistics v26. Due to the small sample size, statistical analysis has not been conducted. Frequencies, means, standard deviations and ranges have been reported throughout the report.

Ethical Approval

The FIT HEART study was approved by the Justice Health and Forensic Mental Health Human Research Ethics Committee (HREC) (Ref: G381/17), the Aboriginal Health and Medical Research Council HREC (Ref: 1465/18) and the Corrective Services New South Wales Ethics Committee (Ref: D19/0104371). The study was also registered with the Australia New Zealand Clinical Trials Registry on 12 February 2019 (ACTRN12619000202167).

Key Findings

Intervention Participants

- 70.7% of exergaming sessions offered were attended.
- 84.8% of heart rate readings obtained during the exergaming sessions were within the participants' moderate-intensity target heart rate range.
- 80% of participants reported issues with the gaming system.
- 100% of participants found the use of the exergaming system a pleasant experience.
- 80% of participants found the activities entertaining.
- 80% of participants reported an improvement in either their physical or mental health since using the gaming system.

All Participants

- 100% of participants reported that they enjoyed being in the study.
- 7.7% of participants reported that the Fitbit was uncomfortable to wear.
- 46.2% of participants reported spending less time sitting while wearing the Fitbit.

Staff

- The intervention was deemed acceptable by staff across all of the constructs measured.

Limitations

Small Sample Size

Due to the small sample size, statistical analysis could not be performed. Therefore, we cannot demonstrate what effect the intervention had on the participants' physical and mental health outcomes and whether any variances at post-intervention resulted from the intervention or other factors. The small sample also means the results obtained may not be generalisable to the wider population.

Food Intake

The intervention did not contain a component on nutrition. No information was obtained concerning participants' food items through the buy-up system.

Validity of the Intensity Data

A resting heart rate was obtained for only 33.3% of the intervention group of participants that completed the program. Although a resting heart rate was detected in 100% of the control participants, this did not occur until Week 10 of the project. As such, the results around intensity should be treated with caution, as we are unsure what the effect of the intervention has been in this important respect. Other studies have found significant measurement differences when comparing wrist-worn and research-grade accelerometers.

Implications

Exergaming as a physical health intervention was deemed highly acceptable by the participants within the program and the staff at LBH MHU. No major adverse events were associated with the intervention. Exergaming was shown to elevate participants' heart rates above their normal daily routine and resting heart rate, consistent with the literature on exergaming. In addition, exergaming did not have a negative effect on depression, anxiety or stress, which is also consistent with the existing literature on exergaming.

Conclusion

Promotion of physical activity among mental health patients is extremely important due to their increased risk of MetS. Both participants and staff found exergaming highly acceptable. Off-the-shelf exergaming systems are relatively inexpensive and could be a good way to help promote physical activity within a secure mental health unit.

Introduction

The adverse metabolic effects associated with psychotropic medications used to treat mental illness are well documented. Clinically significant weight gain, disturbances in glucose and lipids and hypertension are commonly observed following initiation of these medications (6–8). People with serious mental illness also engage in less physical activity and more sedentary behaviours than the general population (9). Other lifestyle factors, such as poor diet and smoking, are also prevalent within this population (10). These medication side effects and lifestyle factors increase the risk of metabolic syndrome (MetS) and, in turn, type 2 diabetes and cardiovascular disease among people with a serious mental illness. The prevalence of MetS is 58% higher among those treated with psychotropic medication than the general population (11).

Evidence for the role of physical activity in improving health outcomes and reducing psychiatric symptoms is growing. Systematic reviews and meta-analyses of the literature suggest that exercise interventions can effectively improve cardiorespiratory fitness, reduce cardiometabolic risk (12–14) and reduce psychotic and depressive symptoms (9, 15, 16). Despite this, there are many challenges to implementing lifestyle interventions in a secure psychiatric inpatient setting. Environmental barriers to physical activity include restricted time in outdoor and communal spaces and limited access to exercise equipment. Secondary to low mood, negative symptoms and poor socio-occupational functioning, psychiatric inpatients often lack the motivation and enthusiasm to engage in physical activity. There is a need for novel physical activity interventions suitable for patients in secure settings to overcome these barriers.

'Exergaming' as a form of physical activity has shown promising results in the literature. Exergaming, or active video gaming, combines physical activity and gaming by utilising the player's movement to control the game. Increased energy expenditure, heart rate and oxygen consumption have been demonstrated in laboratory-based experimental studies of the acute effects of exergaming (17–18). Depending on the game's nature and the extent of lower-body involvement, an exertion level equivalent to 'moderate-intensity' exercise has been observed (19). Increased energy expenditure, improved cardiovascular fitness and increased muscle strength have been observed in exergaming intervention studies, in addition to decreases in body weight, waist circumference and body fat percentage (20–22). Positive effects on mood, motivation to exercise and cognitive functioning have also been demonstrated (7, 22–25). There is limited research into the use of exergaming in a psychiatric population. However, pilot data on feasibility, acceptability, adherence and safety support its integration into physical activity programs for people with schizophrenia (1–5, 24, 26).

While previous research suggests that exergaming interventions are feasible and acceptable among psychiatric patients in an outpatient setting (1–5), no equivalent research has been conducted in an inpatient setting. The clinical effectiveness of such interventions to improve the cardiovascular health of this particular patient population is also yet to be investigated. The few studies investigating the health benefits among psychiatric populations have typically used a predominantly outpatient sample. These studies include outcomes such as the amount and frequency of physical activity and functional fitness (e.g., balance, strength, flexibility and mobility) rather than cardiorespiratory fitness measures and cardiometabolic parameters (1–3). One study that utilised exergaming within an inpatient forensic population focused on whether exergaming resulted in a change in patients' engagement in physical activity (27).

Aims

The FIT HEART project investigated exergaming's feasibility, acceptability, and potential effectiveness to promote physical activity among secure mental health unit patients.

Methods

Study Design

The project was conducted as a quasi-experimental, two-arm pilot study comparing a physical activity intervention (exergaming) with 'routine treatment'. The study, conducted at Long Bay Hospital Mental Health Unit (LBH MHU), employed a non-randomised, pre-test/post-test parallel-group design. Participants were non-randomly allocated to either the intervention or the control group based on their ward.

Setting

The project was conducted in the sub-acute units of the LBH MHU. The LBH MHU is a 40-bed inpatient facility for patients requiring involuntary treatment under the Mental Health and Cognitive Impairment Forensic Provisions Act 2020. Patients are transferred to LBH MHU from correctional centres in New South Wales.

Sampling

All patients admitted to the sub-acute units of LBH MHU were identified as potential participants, except for those that met the following exclusion criteria:

1. Unable to provide informed consent due to acute mental illness, severe cognitive impairment or severe intellectual disability, as assessed by the University of California, San Diego Brief Assessment of Capacity to Consent (UBACC) tool (28).
2. Have insufficient fluency in the English language to provide informed consent and complete the pre-and post-test interviews.
3. Unable to participate or be issued an accelerometer due to high-security risk (e.g., prone to self-harm or acute paranoid delusions) as determined by the treating team.
4. Have a physical contraindication to exercise as determined by a medical officer's assessment.

Recruitment

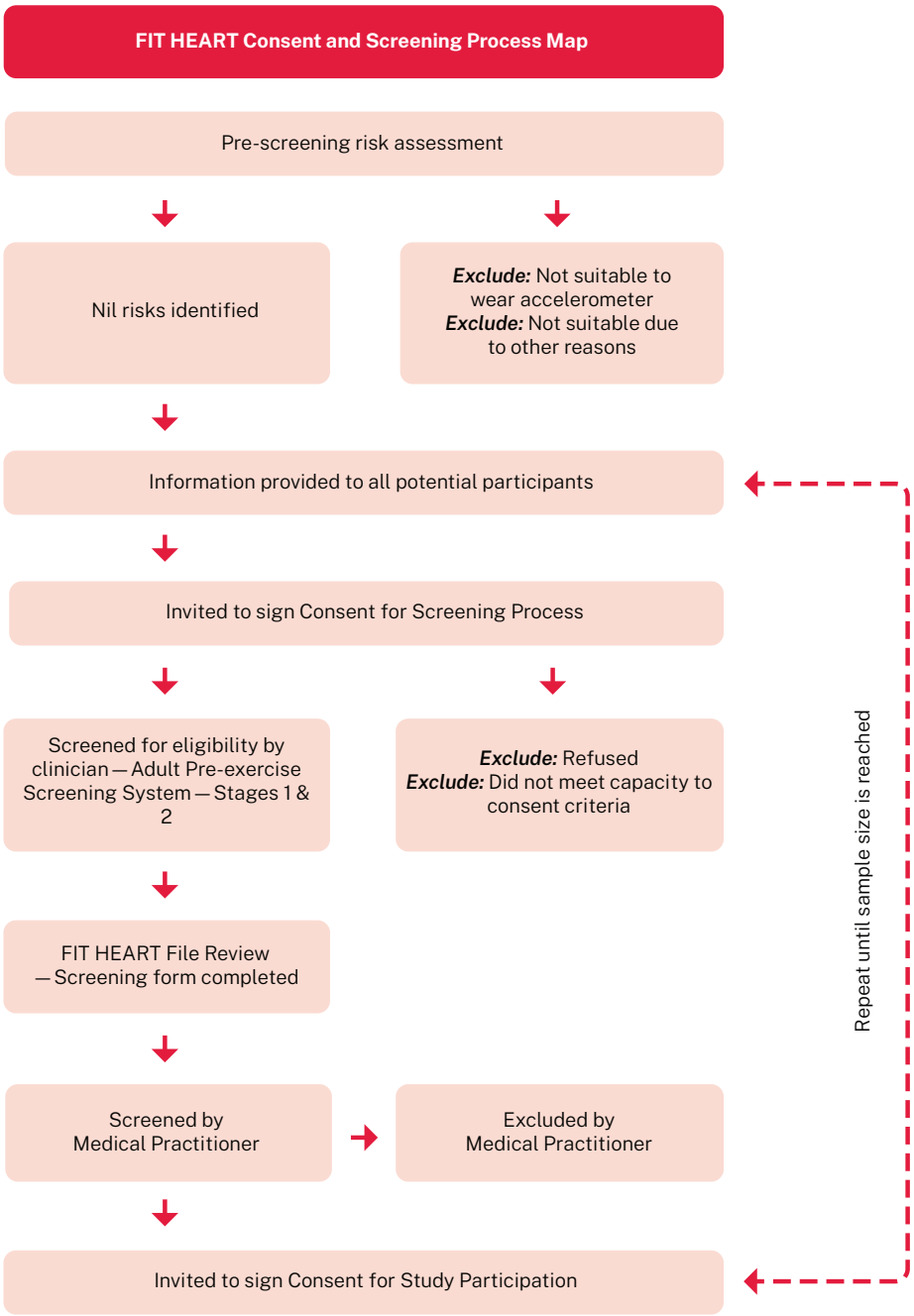
Participants

Recruitment and data collection commenced in January 2020. However, due to the COVID-19 pandemic, face-to-face contact was suspended in March 2020. Data collection recommenced in June 2020 and concluded in May 2021, with two recruitment periods (June to September 2020 and January to March 2021). Participants enrolled before the suspension were re-recruited if they were still in the unit and interested in participating. Re-recruited participants repeated the baseline assessments and recommenced the intervention period from the beginning.

A total of 76 patients were admitted to LBH MHU during the recruitment periods. Every patient admitted to the intervention and control units underwent a pre-screen assessment completed by a nursing team member to determine if their inclusion in the study (specifically them being issued an accelerometer) posed a security and safety risk. Those patients for whom participation was determined to be inappropriate (intervention n = 7; control n = 8) were not approached (19.7% of patients). A further ten patients were excluded because their discharge from Long Bay Hospital (LBH) was imminent (n = 6), they had insufficient English (n = 2), they were transferred (n = 1), or they were on a management plan (n = 1).

Patients eligible to be approached (intervention n = 26; control n = 25) were provided with information on the project and asked if they would like to participate. Those who declined (62.7%: intervention n = 18; control n = 14) were thanked for their time. Those interested were invited to undergo a three-step screening process to determine their eligibility to be included in the study, presented in Figure 1. A total of eight participants in the intervention group and 11 in the control group agreed to be screened for eligibility (37.3%).

FIGURE 1
FIT HEART Consent and Screening Process



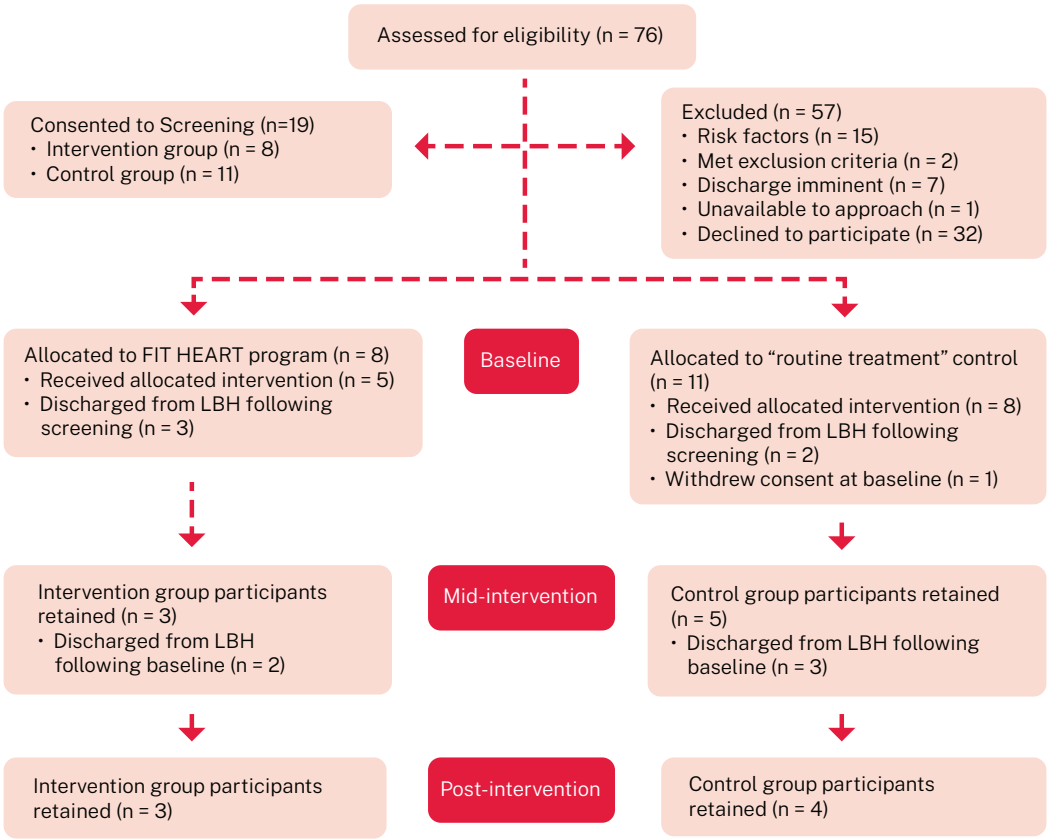
Before beginning the screening process, participants were asked to provide written consent. Their capacity to provide informed consent for the screening process was assessed using the UBACC. Participants were asked eight questions to assess their understanding of the project. A response guide was developed, and research team members assessed participants' answers to the questions against the response guide. Participants were required to score two points for each question to be deemed to have capacity. All participants who consented to the screening process were deemed to have the capacity to consent. The screening process involved the following steps:

- **Step 1:** Participants completed a screening questionnaire (Adult Pre-exercise Screening System Screening Tool) to identify any medical conditions that may increase the risk of an adverse event.
- **Step 2:** A research team member reviewed the patient's medical file to identify any medical and psychiatric conditions, past and present medications, and electrocardiography (ECG) results.
- **Step 3:** A medical officer reviewed the screening questionnaire and medical file review results. The officer then granted or rejected medical clearance for the patient to engage in the physical activity program.

All patients who were screened were medically cleared to participate. Participants were asked to provide further written consent to participate in the study, and the UBACC was repeated to ensure each participant was still able to consent. All participants who consented to the study were deemed to have the capacity to consent. Participants were placed in the control and intervention groups based on their resided ward.

The average time between the screening and baseline assessments was 4.5 days (range 0–12 days). Some participants across both groups were discharged before the baseline assessments (intervention n = 3; control n = 2). Figure 2 details the number of participants at each stage of the program. All participants who completed the baseline questionnaire but discontinued their participation were also asked questions regarding the project and the acceptability of the intervention (intervention group only).

FIGURE 2
CONSORT Diagram



Staff

In total, 24 Justice Health and Forensic Mental Health Network (Justice Health NSW) staff at LBH MHU were approached to participate in the staff acceptability survey. Staff were given a brief overview of the survey and provided with the information sheet, consent form and survey. We received 19 surveys back, indicating a response rate of 79.2%.

Intervention

Before the project commenced, all games to be utilised were tested by members of the research team. The games were tested to ensure moderate-intensity exercise could be achieved and ensure facilitators of the exergaming sessions were familiar in case participants asked questions about specific games. One game was excluded as the intensity was too high during the testing process.

Participants in the intervention group were allocated a wrist-worn accelerometer (Fitbit Charge 3) to wear on weekdays when out of their cell. Fitbit wearing began one week prior to the intervention and concluded one week post-intervention. The intervention group also received a 12-week exergaming program that included three 30-minute exergaming sessions per week, plus a 10-minute warm-up. These sessions utilised activity-based video games on the Microsoft Xbox Kinect game system. The Xbox Kinect is a hands-free system that uses a motion-detected camera to detect full-body motion. Other commercially available systems use hand-held controllers, which can cause injury or could potentially be used as a weapon. Exergaming sessions were conducted in the ward's common area, utilising the ward television. During the 12 week program, the Dynamic Appraisal of Situational

Aggression (DASA) was conducted to ensure participants were in an appropriate state to receive the exergaming session. The DASA is a seven-item screening tool to identify psychiatric patients at risk for engaging in inpatient violence within 24 hours (29). For any participant who scored three or above on the DASA, their session would not be conducted, but where possible, it would be rescheduled at a later time. All participants scored zero on the DASA across the intervention period.

Participants in the control group were also allocated wrist-worn accelerometers (Fitbit Charge 3) to wear on weekdays when out of their cell for 12 weeks. These participants received 'routine treatment', defined as the standard model of care provided in LBH MHU.

During the intervention period, all participants were provided with weekly progress reports that included data obtained from the Fitbits, including the number of steps taken, resting heart rate and calorie expenditure. Feedback from participants resulted in the inclusion of distance walked in the progress reports.

Measures

The study had two primary objectives:

- to determine whether the FIT HEART program is a feasible intervention for improving physical activity levels among patients in a secure mental health unit
- to assess whether participants who receive the FIT HEART program demonstrate greater improvements in physical activity levels and clinical physical health measures than those who receive routine treatment.

The following outcomes were measured to determine the extent to which these objectives were achieved:

Feasibility and Acceptability

The feasibility and acceptability of the project's intervention to both patients and staff were measured through a questionnaire administered post-intervention and, where possible, upon discontinuation from the study. In addition, a number of progression criteria were established prior to the study commencing. These criteria would be used to determine whether the pilot study should progress to a larger randomised control trial (RCT). The progression criteria are detailed below in Table 1. Green (go) indicates that the criteria have been met and that progression to the RCT is possible without changes to the design or implementation of the intervention, amber (amend) indicates that some changes should be made to the protocol, and red (stop) indicates that the RCT should not proceed.

TABLE 1
Progression criteria

Progression Criteria	Green	Amber	Red
Recruitment % of eligible patients consenting to participation	≥ 50%	30–49%	< 30%
Retention % of recruited participants retained at post-intervention data collection time point with valid primary outcome data	≥ 80%	70-79%	< 70%
Protocol adherence % of recruited participants who adhere to allocated intervention % of recruited participants who comply with wearing an accelerometer	≥ 70% ≥ 90%	50–69% 70–89%	< 50% < 70%
Fidelity of intervention delivery % of intervention components delivered as per protocol	≥ 90%	70–89%	< 70%

Physical Health Outcomes

Various measures were utilised to determine whether exergaming benefits participants' physical health. The Simple Physical Activity Questionnaire (SIMPAQ) was administered at baseline, mid-intervention and post-intervention to measure changes in physical activity levels. It provides a snapshot of 24 hours that represents the preceding seven days and was specifically developed to assess physical activity among people with a mental illness (37). Anthropometric measures such as height, weight, blood pressure and waist circumference were taken at baseline and post-intervention for comparison. A 3-minute step test was used to determine baseline to post-intervention changes in cardiorespiratory fitness. In addition, pathology was taken to measure baseline to post-intervention changes in blood glucose levels, liver function and lipid profile.

Mental Health Outcomes

The effect of exergaming on mental health was assessed using psychological assessment scales to determine changes in depression, anxiety, stress (baseline, mid-intervention and post-intervention) and positive psychotic symptoms (baseline and post-intervention). Symptoms of depression, anxiety and stress were measured using the Depression Anxiety Stress Scale — Short Form (DASS-21). The DASS-21 is a self-report scale designed to measure negative emotional states of depression, anxiety and stress over the preceding seven days (35). Positive psychotic-like experiences were measured using the Community Assessment of Psychic Experiences Positive 15-items Scale (CAPE-P15). The CAPE-P15 is a 15-item self-report questionnaire that measures experiences similar to positive psychotic symptoms over the preceding three months (36).

Sociodemographic data (age, gender, ethnicity, education and incarceration history), perceived general health status, previous exergaming experience and psychiatric history were obtained via the baseline questionnaire.

Data Analysis

Fitbit data were transferred to Fitabase, a research data management platform that enabled minute-by-minute data extraction. All Fitabase files were updated to ensure that only data from when the participants were wearing the Fitbits were captured.

All data were transferred to IBM SPSS Statistics v26. Due to the small sample size, and pilot nature of the study, statistical analysis was not conducted. Frequencies, means, standard deviations (SD) and ranges are reported throughout the report. All data have been presented for participants until their discharge from LBH MHU.

Ethical Approval

The FIT HEART study was approved by the Justice Health and Forensic Mental Health Human Research Ethics Committee (HREC) (Ref: G381/17), the Aboriginal Health and Medical Research Council HREC (Ref: 1465/18) and the Corrective Services New South Wales Ethics Committee (Ref: D19/0104371). The study was also registered with the Australia New Zealand Clinical Trials Registry on 12 February 2019 (ACTRN12619000202167).

Results

Baseline

Demographics

Thirteen participants completed the baseline assessment (intervention 5; control 8). All participants were male, with a mean age of 37.5 years (SD 7.0; range 26–49 years). Demographics for the intervention and control groups are presented in Table 2.

TABLE 2
Demographics

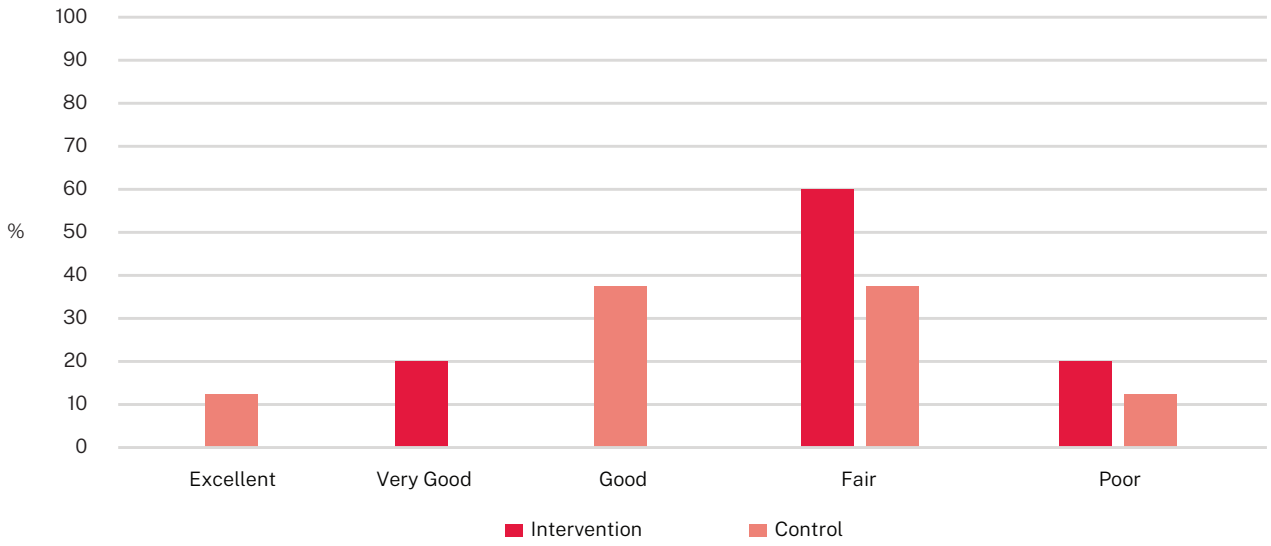
	Intervention (n = 5)	Control (n = 8)	Total (N = 13)
Age — mean (SD) — range	35.6 (8.9) 26.0–44.0	38.6 (5.9) 31.0–49.0	37.5 (7.1) 26.0–49.0
Born in Australia [n (%)]	n=5 (100.0)	n=7 (87.5)	N=12 (92.3)
Non-Aboriginal [n (%)]	n=5 (100.0)	n=7 (87.5)	N=12 (92.3)
Schooling — Year 11 or above [n (%)]	n=3 (60.0)	n=4 (50.0)	N=7 (53.8)
Secondary education qualifications [n (%)]	n=3 (60.0)	n=5 (62.5)	N=8 (61.5)
Marital Status — Single/Separated [n (%)]	n=3 (60.0)	n=7 (87.5)	N=10 (76.9)
Unemployed/Unable to work [n (%)]	n=4 (80.0)	n=6 (75.0)	N=10 (76.9)
Previous juvenile detention [n (%)]	n=1 (20.0)	n=1 (12.5)	N=2 (15.4)
Previous adult incarceration [n (%)]	n=3 (60.0)	n=7 (87.5)	N=10 (76.9)
Legal status at baseline — Correctional patient [n (%)]	n=4 (80.0)	n=6 (75.0)	N=10 (76.9)

General Health Status

Participants were asked to rate their health on a five-point scale (excellent, very good, good, fair, poor). Self-assessed health status is a commonly used measure of overall health and is a useful indicator of chronic disease risk and prevalence among the prison population (30).

Just under two-thirds (61.5%; n = 8) of the entire sample rated their health as fair or poor, with the intervention group more likely to report this than the control group (80% versus 50%) presented in Figure 3. Only a small proportion (15.4%; n = 2) of participants rated their health as excellent or very good.

FIGURE 3
Self-Reported Health Status



Previous Exergaming Experience

Participants in the intervention group (n = 5) were asked about their previous exergaming experience, including whether they have owned or used an exercise video game system. While 60% (n = 3) of participants reported previous exergaming experience, no participants reported using or owning the specific console used in the study (Xbox Kinect).

Mental Health and Psychiatric History

Participants were asked a series of questions about their previous mental health and psychiatric history. Questions included whether or not they had been told by a psychiatrist, psychologist or another clinician that they have any of a pre-specified list of conditions, where they were first diagnosed and if they had received any treatment. Treatment included medications, psychological therapies such as cognitive behavioural therapy or dialectical behaviour therapy, or medical intervention such as electroconvulsive therapy.

Of the total participants, 92.3% (n = 12) reported a known diagnosis. Of those who reported a known diagnosis, 80% (n=4) of the intervention group and 100% (n = 8) of the control group reported more than one previous diagnosis. Diagnosis results for each of the groups are presented in Table 3.

TABLE 3
Self-Reported Mental Health Diagnosis

	Intervention (n = 5)	Control (n = 8)
Schizophrenia [n (%)]	n=4 (80.0)	n=4 (50.0)
Other psychotic disorder [n (%)]	n=2 (40.0)	n= 3 (37.5)
Depression [n (%)]	n=2 (40.0)	n=5 (62.5)
Bipolar disorder [n (%)]	n=2 (40.0)	n=2 (25.0)
Anxiety [n (%)]	n=2 (40.0)	n=4 (50.0)
Personality disorder [n (%)]	n=0 (0.0)	n= 3 (37.5)
Alcohol abuse/dependence [n (%)]	n=0 (0.0)	n=0 (0.0)
Drug abuse/dependence [n (%)]	n=3 (60.0)	n=2 (25.0)
Attention deficit hyperactivity disorder [n (%)]	n=2 (40.0)	n=1 (12.5)
Post-traumatic stress disorder [n (%)]	n= 1 (20.0)	n= 3 (37.5)
Other mental illness [n (%)]	n=2 (40.0) Schizoaffective disorder	n=1 (12.5) Autism

Psychotic Disorders

A high percentage of participants in both the intervention (100%; n=5) and control (62.5%; n=5) groups stated they had been diagnosed with a psychotic disorder. Within the intervention group, the community was the most likely place of diagnosis for schizophrenia (50%; n=2) and other psychotic disorders (100%; n=2). Within the control group, a psychiatric unit was the most common place of diagnosis for schizophrenia (50%; n=2) and other psychotic disorders (66.7%; n=2).

Concerning treatment, all participants reported receiving medications, and no participants reported any medication interventions for a psychotic disorder. Psychological therapy differed depending on the diagnosis: for those with schizophrenia (intervention 50% n=2; control 25% n=1) and those with other psychotic disorders (intervention 100% n=2; control 0% n=0).

Mood Disorders

Mood disorders were also prevalent across both groups (intervention 60% n=3; control 75% n=6). Within the intervention group, depression was diagnosed in a psychiatric unit (50%; n=1) or prison (50%; n=1), whereas the majority of the control group reported diagnosis within the community (80%; n=4). For bipolar disorder, the intervention group reported being diagnosed in the community (100%; n=2), whereas the control group reported diagnosis in the community (50%; n=1) and a psychiatric unit (50%; n=1).

Depression treatment reported included medications (intervention 100% n=2; control 60% n=3), psychological therapy (intervention 100% n=2; control 20% n=1) and medical interventions (intervention 50% n=1; control 20% n=1). Treatment for bipolar disorder included medications (intervention 100% n=2; control 50% n=1) and psychological therapy (intervention 100% n=2; control 100% n=2).

Anxiety

Just under half (46.2%; n=6) of all participants reported being diagnosed with anxiety. Most participants with anxiety reported being diagnosed in the community (intervention 50% n=1; control 75% n=3). Treatment provided for anxiety included medications (intervention 100% n=2; control 25% n=1) and psychological therapy (intervention 100% n=2; control 50% n=2).

Personality Disorder

Only participants in the control group reported being diagnosed with a personality disorder, with most (66.7%; n=2) reporting they were diagnosed in the community. Treatment by medication was reported by 66.7% (n=2) of those diagnosed.

Drug Abuse/Dependence

Over one-third (38.5%; n=5) of participants reported being diagnosed with drug abuse/dependence. Most participants reported being diagnosed in the community (intervention 66.7% n=2; control 50% n=1).

Only participants in the control group (50%; n=1) reported receiving medications, and only participants in the intervention group (33.3%; n=1) reported receiving psychological therapies.

Attention Deficit Hyperactivity Disorder (ADHD)

Just under one-quarter (23.1%; n=3) of participants reported being diagnosed with ADHD, all reporting they were diagnosed in the community. All participants (n=2) in the intervention group reported receiving medications (control 0%; n=0), and all participants (n=1) in the control group reported receiving psychological therapy (intervention 0%; n=0).

Post-Traumatic Stress Disorder (PTSD)

Just under one-third (30.8%; n=4) of participants reported being diagnosed with PTSD. The community was the most likely diagnosis location for both groups (intervention 100% n=1; control 66.7% n=2). Treatment provided for PTSD included medications (intervention 100% n=1; control 33.3% n=1) and psychological therapy (intervention 100% n=1; control 33.3% n=1).

Other Mental Illness

Just under one-quarter (23.1%; n=3) of participants reported being diagnosed with a mental health condition that was not listed, including schizoaffective disorder and autism. All participants reported being diagnosed in the community, and all reported receiving medications. In addition, all participants that reported a diagnosis of schizoaffective disorder (n=2) reported receiving psychological therapy.

Current Psychiatric Diagnosis

In addition to asking participants about their psychiatric history, we obtained information about current diagnoses by reviewing participants' electronic medical records. The results are presented in Table 4. Overall, the most common diagnosis was schizophrenia (76.9%; n=10). Just under one-third (30.8%; n=4) of participants had more than one listed diagnosis.

TABLE 4
Current Diagnosis

	Intervention (n = 5)	Control (n = 8)
Schizophrenia [n (%)]	n=4 (80.0)	n=6 (75.0)
Schizoaffective disorder [n (%)]	n=1 (20.0)	n=0 (0.0)
Psychosis [n (%)]	n=0 (0.0)	n=1 (12.5)
Psychotic depression [n (%)]	n=0 (0.0)	n=1 (12.5)
Intellectual disability [n (%)]	n=0 (0.0)	n=1 (12.5)
Autism spectrum disorder [n (%)]	n=0 (0.0)	n=1 (12.5)
Opioid use disorder [n (%)]	n=0 (0.0)	n=1 (12.5)
Polysubstance use disorder [n (%)]	n=2 (40.0)	n=0 (0.0)

Current Medications

Participants' current medication regime was obtained at baseline and is presented in Table 5. Medications have been categorised under the class they belong to, and only PRN (as needed) antipsychotic medications have been reported. Just under two-thirds (61.5%; n=8) of participants were on two or more regular antipsychotic medications at baseline (intervention 80% n=4; control 50% n=4). Research into the use of antipsychotic polypharmacy and MetS is mixed. Some researchers report insufficient evidence of the harm of antipsychotic polypharmacy (31). Specifically, antipsychotic polypharmacy is not associated with an increased risk of MetS (32) and does not increase the prevalence and risk of MetS (33–34).

TABLE 5
Medications at Baseline

Medications	Intervention (n = 5)	Control (n = 8)
Antipsychotic — oral [n (%)]	n=5 (100.0)	n=4 (50.0)
Antipsychotic — depot [n (%)]	n=3 (60.0)	n=7 (87.5)
Antidepressants and mood stabilisers [n (%)]	n=3 (60.0)	n=3 (37.5)
Anticholinergics [n (%)]	n=3 (60.0)	n=3 (37.5)
Alcohol/nicotine/opioid dependence [n (%)]	n=0 (0.0)	n=3 (37.5)
Cardiovascular [n (%)]	n=3 (60.0)	n=1 (12.5)
Endocrine [n (%)]	n=1 (20.0)	n=2 (25.0)
Neurological [n (%)]	n=0 (0.0)	n=1 (12.5)
Gastrointestinal [n (%)]	n=1 (20.0)	n=3 (37.5)
Herbal remedies, vitamins and mineral supplements [n (%)]	n=2 (40.0)	n=2 (25.0)
PRN antipsychotic [n (%)]	n=2 (40.0)	n=2 (25.0)

Depression, Anxiety and Stress

Symptoms of depression, anxiety and stress in the preceding seven days were measured using the Depression Anxiety Stress Scale — Short Form (DASS-21) (35). Each of the 21 items on the scale is rated either 0 (never), 1 (sometimes), 2 (often) or 3 (almost always). Scores for each subscale are categorised into five severity ranges: normal, mild, moderate, severe and extremely severe. Higher scores on the DASS-21 emphasise the degree to which someone is experiencing symptoms: it is not intended as a diagnostic tool. The scoring guide, presented below in Table 6, is based on the longer 42-item version of the DASS (35).

TABLE 6
DASS-21 Scoring

	Depression	Anxiety	Stress
Normal	0-9	0-7	0-14
Mild	10-13	8-9	15-18
Moderate	14-20	10-14	19-25
Severe	21-27	15-19	26-33
Extremely Severe	28+	20+	34+

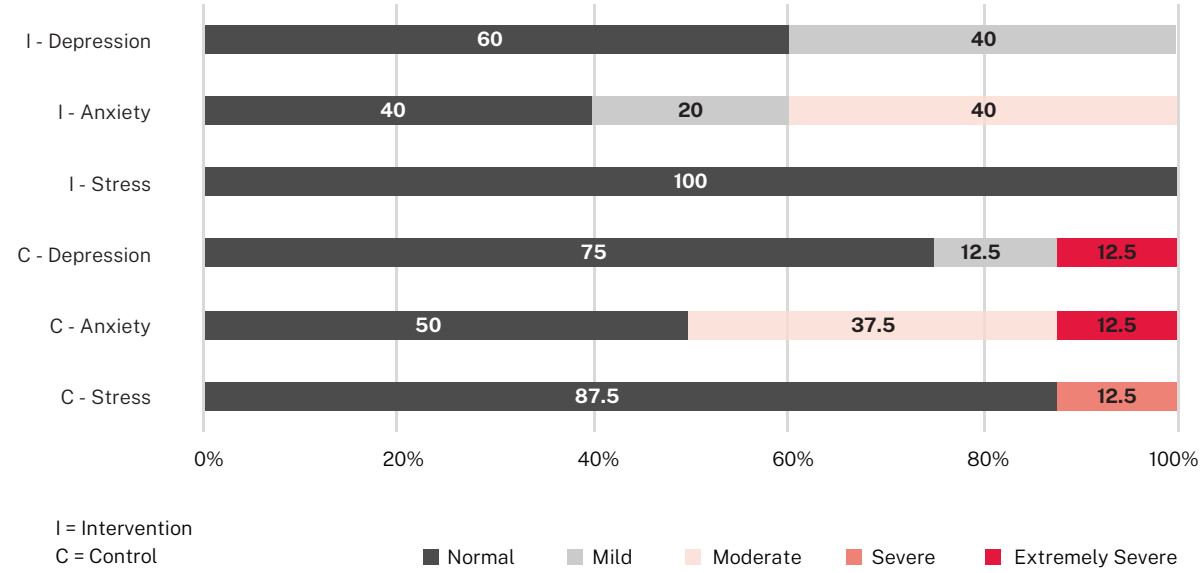
In order to interpret scores on the DASS-21, raw scores for each item are doubled. Mean transformed scores for each of the groups are presented in Table 7.

TABLE 7
Mean DASS-21 Scores

Mean scores (SD) (range)	Intervention (n = 5)	Control (n = 8)
Depression	6.0 (5.1) (0.0–12.0)	10.0 (2.4) (0.0–40.0)
Anxiety	8.0 (3.2) (4.0–12.0)	8.0 (7.5) (0.0–20.0)
Stress	6.8 (5.0) (0.0–14.0)	9.0 (8.2) (0.0–26.0)
DASS-21 Total	**20.8 (11.4) (4.0–34.0)**	**27.0 (26.9) (0.0–86.0)**

The mean scores from the DASS-21 indicate that the intervention group were experiencing normal levels of depression, mild levels of anxiety and normal levels of stress during the seven days preceding the baseline assessment. The mean scores from the control group indicate they were experiencing mild levels of depression, mild levels of anxiety and normal levels of stress. Figure 4 provides a breakdown of the scoring categories for each participant group.

FIGURE 4
DASS-21 Categories per Group



Positive Psychotic Symptoms

Positive psychotic-like experiences were measured using the Community Assessment of Psychic Experiences Positive Scale (CAPE-P15) (36). Persecutory ideations, bizarre experiences and perceptual abnormalities are the three subcategories analysed on the scale. Each of the 15 items is rated between 1 and 4. The possible scores include 1 (never), 2 (sometimes), 3 (often) and 4 (nearly always), with a CAPE-P15 total score ranging from 15 to 60.

Subcategory scores are persecutory ideations 5 to 20, bizarre experiences 7 to 28 and perceptual abnormalities 3 to 12. Low scores on each subscale indicate that a participant may never have or only sometimes experienced symptoms. In contrast, high scores indicate that they may have often or almost always experienced the symptoms within the last three months. As with the DASS-21, the CAPE-P15 was designed as a screening tool and not a diagnostic instrument. The mean scores for each of the groups are presented in Table 8.

TABLE 8
Mean CAPE-P15 Scores

Mean scores (SD) (range)	Intervention (n = 5)	Control (n = 8)
Persecutory ideations	7.0 (1.9) (5.0–10.0)	8.8 (4.1) (5.0–18.0)
Bizarre experiences	9.6 (3.4) (7.0–15.0)	9.5 (5.5) (7.0–23.0)
Perceptual abnormalities	5.0 (3.1) (3.0–10.0)	3.6 (1.8) (3.0–8)
Total score	**21.8 (5.7) (16.0–30.0)**	**21.9 (11.2) (15.0–49.0)**

The mean CAPE-P15 scores across the subcategories are at the lower end of the range within both groups. The scores indicate that participants reported experiencing minimal positive symptoms in the three months prior to the baseline interview.

Physical Activity

Physical activity and inactivity levels were measured using the Simple Physical Activity Questionnaire (SIMPAQ) (37). The SIMPAQ uses an interview format to gather estimated time in bed, structured exercise participation and incidental or non-structured physical activity. Time the patient has been sedentary is calculated based on the hours remaining in the day. Mean hours of physical activity and inactivity for each group are presented in Table 9.

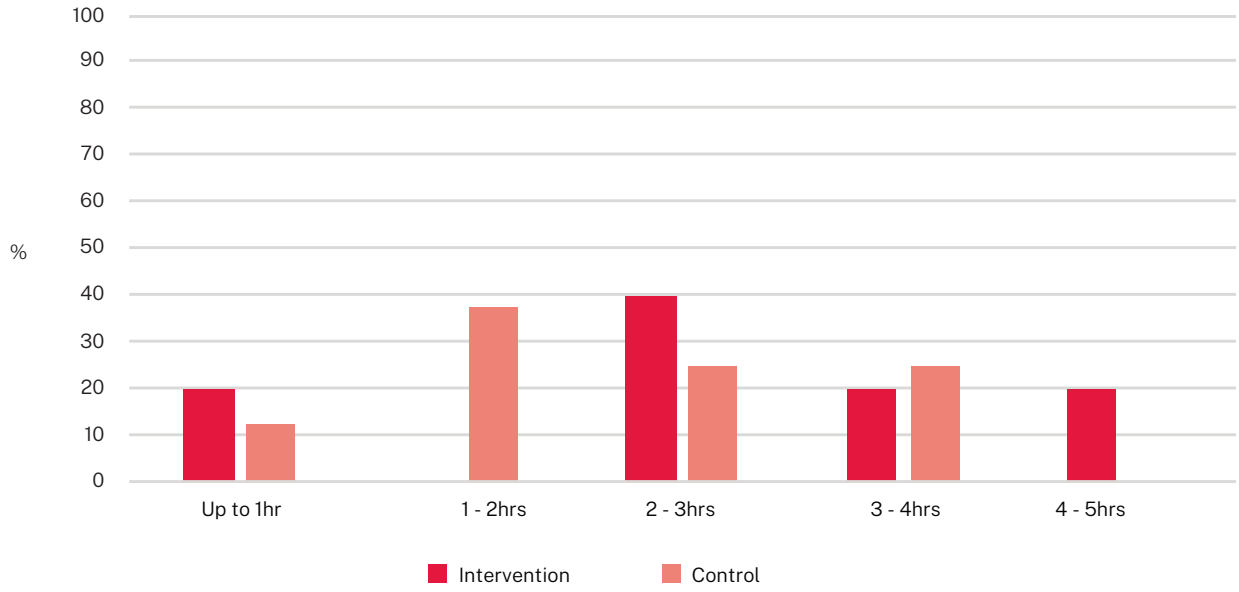
TABLE 9
Mean Active and Inactive Hours per Day

Mean hours per day (SD) (range)	Intervention (n = 5)	Control (n = 8)
Hours in bed	11.9 (1.0) (11.0–13.5)	11.0 (1.3) (9.0–12.5)
Sedentary hours	9.6 (2.2) (7.2–12.5)	10.9 (0.9) (9.0–12.1)
Total active hours:	**2.5 (1.5) (0.5–4.6)**	**2.1 (1.1) (0.3–3.5)**
Walking hours	2.3 (1.3) (0.5–4.0)	1.4 (1.1) (0.2–3.50)
Exercise hours	0.1 (0.1) (0.0–0.3)	0.4 (0.6) (0.0–1.50)
Other activity hours (cleaning, laundry)	0.1 (0.1) (0.0–0.3)	0.3 (0.5) (0.0–1.4)

Sedentary hours were high in both groups. Higher amounts of sedentary hours are associated with poorer health outcomes (38–39). One 2013 study identified that the risk for premature mortality significantly increased when adults sit for more than seven hours per day (40). All participants across both groups reported over seven sedentary hours per day.

Regular physical activity has important benefits for physical and mental health (39). All participants reported some form of activity each day, though the amount of time spent active varied. Figure 5 provides a breakdown of the active time range among the groups.

FIGURE 5
Active Hours per Day



Walking accounted for most (76.9%; n=10) of the participants' active hours per day, with few reporting higher exercise hours (7.7%; n=1), higher other activity hours (7.7%; n=1) or equal walking and exercise hours (7.7%; n=1). Just over half (53.8%; n=7) of participants reported engaging in exercise the week preceding the baseline interview (intervention 60% n=3; control 50% n=4). Self-reported exercise activities included push-ups/lunges, kicking a ball/soccer, table tennis, boxing, running and walking laps. Participants were asked to rate the intensity level of these activities using the OMNI Walk/Run Scale of Perceived Exertion (41). The scale ranges from 0 (extremely easy) to 10 (extremely hard). When engaging in low-intensity exercise, the perceived exertion score is expected to be 0 to 2, moderate-intensity exercise 3 to 6 and vigorous-intensity exercise is expected to score between 7 and 10. The average intensity rating for activities was 7 within the intervention group and 5 within the control group.

Physical Health Conditions

Information regarding participants' active health conditions was obtained from the participants' electronic medical records. Overall, 20% (n=1) of the intervention group and 50% (n=4) of the control group had active health conditions listed on their electronic health record. A breakdown of these conditions is provided in Table 10.

TABLE 10
Active Health Conditions

Active health conditions	Intervention (n = 5)	Control (n = 8)
Cardiovascular [n (%)]	n=0 (0.0)	n=2 (25.0)
Diabetes [n (%)]	n=0 (0.0)	n=1 (12.5)
Epilepsy [n (%)]	n=0 (0.0)	n=1 (12.5)
Vision [n (%)]	n=1 (20.0)	n=0 (0.0)
Gastrointestinal [n (%)]	n=0 (0.0)	n=1 (12.5)

Clinical Measurements

Several clinical measures were completed at baseline, including anthropometric measurements and a cardiovascular fitness test. A blood sample was also collected.

Anthropometric Measurements

All participants had anthropometric measurements completed, including height, weight, waist circumference and blood pressure. Mean results for each of the groups are presented in Table 11.

TABLE 11
Mean Anthropometric Measurements

Mean (SD) (range)	Intervention (n = 5)	Control (n = 8)
Weight	98.2 (14.7) (79.4–115.3)	98.4 (9.5) (79.3–108.2)
Body Mass Index (BMI)	31.6 (4.7) (26.1–37.1)	30.6 (4.5) (23.6–38.3)
Waist circumference	107.0 (15.4) (89.0–122.0)	107.0 (10.3) (87.0–121.0)
Average systolic blood pressure	121.0 (9.2) (108.0-134.0)	113.0 (11.7) (94.0-131.0)
Average diastolic blood pressure	78.0 (9.5) (68.0–94.0)	78.0 (6.9) (71.0–89.0)

The participants' Body Mass Index (BMI) scores were calculated from their height and weight. The mean scores indicate that participants were generally in the obese range. Most participants (92.3%; n=12) were in the overweight (pre-obese) category or above (100% intervention n=5; 87.5% control n=7).

There is some debate around whether the BMI is a good measurement, and several limitations have been raised (42). Therefore, the waist circumference results were also recorded in addition to the BMI results. A waist circumference measurement is a good indicator of central or abdominal obesity, with a waist circumference above 102 cm indicating a substantially increased risk of metabolic complications. Most participants (76.9%; n=10) had a waist circumference above 102 cm (60% intervention n=3; 87.5% control n=7).

The National Heart Foundation of Australia provides diagnostic categories for blood pressure classification in adults (43). Based on the mean results, the intervention group sits in the normal category and the control group in the optimal category. Overall, over two-thirds of (69.2%; n=9) participants had blood pressure in the optimal or normal categories (60% intervention n=3; 75% control n=6). A small proportion (20%; n=1) of the intervention group had a blood pressure reading in the mild hypertension range. All other participants (23.1%; n=3) were in the high normal range.

Cardiorespiratory Fitness Test

A modified YMCA Step Test (44) was conducted to measure cardiorespiratory fitness. The modified YMCA Step Test is used to predict a VO2 max score, a measure of oxygen consumption during exercise. The higher an individual's VO2 max, the more oxygen their body can use and the better their aerobic fitness. The test involved participants stepping up and down onto an aerobic step for three minutes to a metronome set to a cadence of 96 beats per minute. The height of the step was adjusted based on the participants' height (the step height range was 30–35 cm). The predicted VO2 max score was calculated based on the participant's heart rate measured 60 seconds post-test. Participants' heart rate

was monitored during the test, and the test would be ceased if a participant's heart rate reached 85% of their maximum heart rate (85% HRMax). In addition, the test was to be ceased if a participant looked unsteady, if they could not keep up with the timing (following three requests by the researcher), or at the participant's request.

Just over half (53.8%; n=7) of participants were able to complete the step test. Reasons for not completing the test included reported weakness/fatigue (33.3%; n=2), unable to complete due to medical reasons (33.3%; n=2), heart rate exceeding 85% HRMax (16.7%; n=1) and unable to maintain correct pace (16.7%; n=1).

The VO2 max category results for those who completed the test are detailed in Table 12. There are six categories ranging from very poor to superior, with category cut-offs determined by age.

TABLE 12
VO2 Max Category

	Intervention (n = 3)	Control (n = 4)
Very poor [n (%)]	n=0 (0.0)	n=0 (0.0)
Poor [n (%)]	n=0 (0.0)	n=0 (0.0)
Fair [n (%)]	n=2 (66.7)	n=2 (50.0)
Good [n (%)]	n=1 (33.3)	n=1 (25.0)
Excellent [n (%)]	n=0 (0.0)	n=1 (25.0)
Superior [n (%)]	n=0 (0.0)	n=0 (0.0)
Mean score (mls/kg/min) (SD) (range)	39.2 (3.9) (36.0–43.6)	41.1 (4.5) (36.3–46.6)

Pathology

Participants were asked to provide a sample of blood to test their glucose (via Glycosylated Haemoglobin [HbA1c] and random blood glucose level), lipids, liver (aspartate aminotransferase and alanine aminotransferase). The Roche Cobas b 101 point-of-care machine was utilised for all tests except the liver function test. A point-of-care machine was utilised to reduce discomfort to participants, as only a finger prick of blood is required and to reduce poor compliance with pathology testing, often observed in research projects (45).

Just over one-third (38.5%; n=5) of participants had all the tests completed. Reasons for non-completion of all tests included poor venous access, so only point-of-care tests were completed (30.8%; n=4), participants only consenting to point-of-care tests (15.4%; n=2), and only being able to obtain blood glucose readings due to participants' subsequent potential discontinuation from the project (15.4%; n=2). Due to the small number of participants who had the liver function tests completed (n=5), the liver function test results have not been reported. Table 13 provides the mean pathology results for each of the groups.

TABLE 13
Mean Pathology Results

Mean (SD) (range)	Intervention (n = 5)	Control (n = 6)
Total cholesterol	5.7 (0.8) (4.7–6.8)	5.1 (0.7) (4.3–5.9)
High-density lipoproteins (HDL)	1.1 (0.2) (0.8–1.3)	1.3 (0.1) (1.1–1.4)
Low-density lipoproteins (LDL)	2.8 (1.1) (1.0–3.8)	2.8 (0.6) (2.0–3.5)
Triglycerides	2.6 (1.5) (1.5–4.9)	2.2 (0.4) (1.7–2.9)
HbA1c	5.3 (0.3) (4.9–5.6)	5.3 (0.8) (4.6–6.8)
		Control (n = 8)
Blood glucose level	5.7 (1.6) (4.0–8.2)	5.6 (1.2) (3.8–7.9)

Lipid profile

High cholesterol and triglyceride levels and either increased LDL or decreased HDL increase a person's risk of cardiovascular disease (46). Healthy cholesterol and triglyceride levels (47) are:

- Total cholesterol below 5.5 mmol/L
- LDL 'bad cholesterol' below 2.0 mmol/L
- HDL 'good cholesterol' above 1.0 mmol/L
- Triglycerides below 2.0 mmol/L

The mean results from the intervention group indicate that overall, their total cholesterol, LDL and triglycerides were high, while HDL was normal. The mean results from the control group indicate that their cholesterol and HDL were normal, but their triglycerides and LDL were high.

Glucose

An HbA1c and a random blood glucose level were taken to test glucose levels in the blood. HbA1c reflects the average blood glucose level over the last 10 to 12 weeks (48), whereas random blood glucose provides readings for that point in time. An HbA1c result of below seven and non-fasting blood glucose between 4 and 8 are considered normal. The mean results indicate that both groups had normal HbA1c and blood glucose levels. All participants had an HbA1c level of below 7, and 84.6% (n=11) had a blood glucose level between 4 and 8.

Intervention Period — Weeks 0 to 6

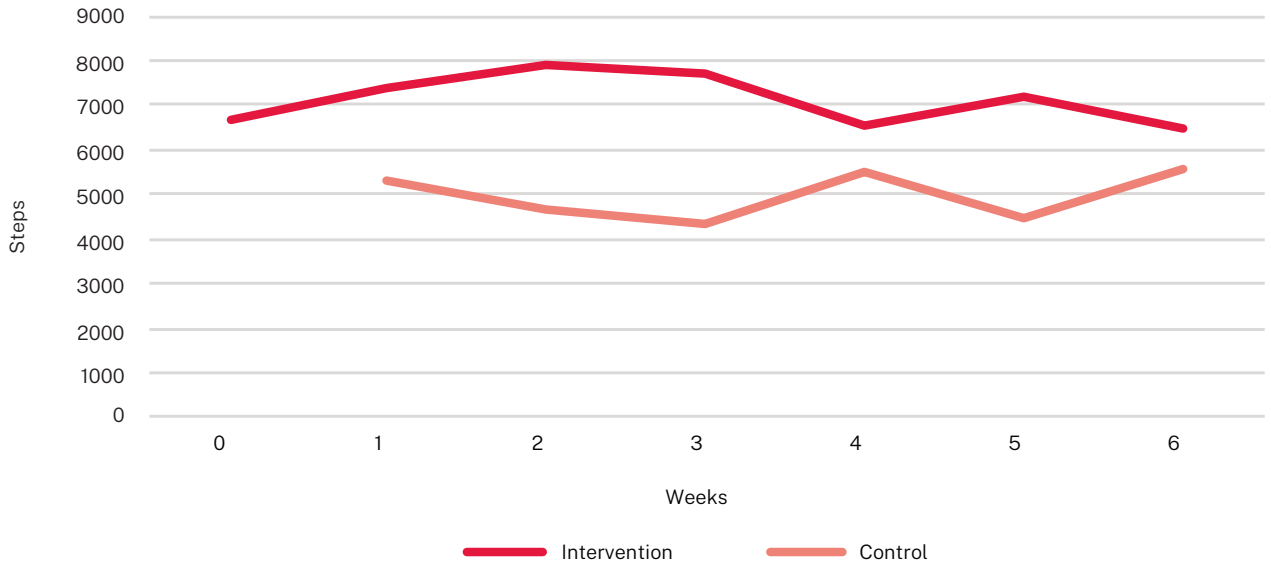
Participants were allocated Fitbits to wear following the completion of the baseline assessments. Participants wore the Fitbits while out of their cell (for an average of 4 hours per day). They did not wear them during lockdown periods or overnight. Data from the Fitbits were transferred to Fitabase, a research data management platform that enabled minute-by-minute data to be extracted. Five participants (intervention n = 2; control n = 3) were discharged from LBH during the first six weeks of the intervention period. Their data have been included until their discharge. By Week 4, the total numbers were three in the intervention group and five in the control group.

Levels of Activity

The activity participants undertook was captured through steps per day and the amount of time spent walking per day. Although the National Heart Foundation of Australia (49) recommend 10,000 steps per day to improve general health, it is estimated that less than 1 in 5 adults reach this target (50). In a study conducted by the Australian Bureau of Statistics (50), adults' average number of steps per day was 7,400.

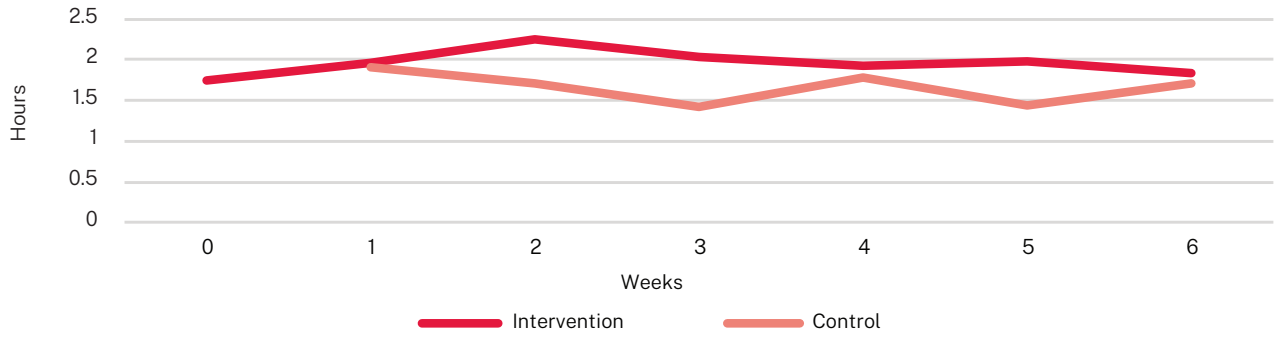
Figure 6 shows the average step count for each group across the weeks. The average step counts up to Week 6 were 7,149 steps per day in the intervention group (range 2,171–14,122) and 4,972 steps per day in the control group (range 1,900–9,700).

FIGURE 6
Average Steps per Day



The average time spent walking is presented in Figure 7. The mean walking hours per day up to Week 6 was 1.96 hours in the intervention group (range 0.74–4.18 hours) and 1.66 hours in the control group (range 0.71–2.59 hours).

FIGURE 7
Walking Hours per Day



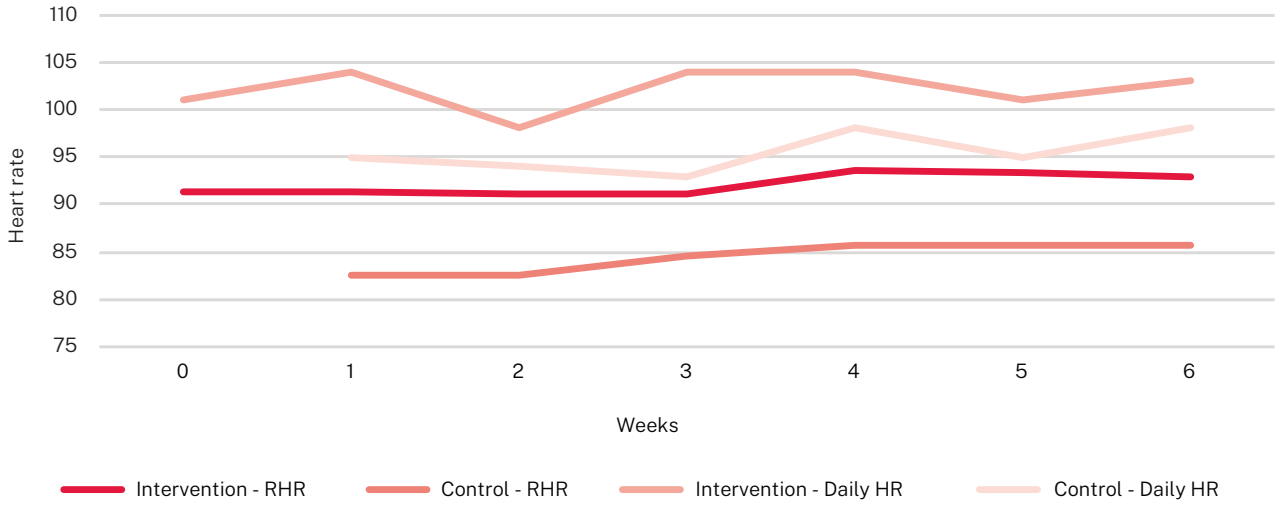
Intensity of Activity

The intensity of participants' activity was measured through heart rate changes, intensity levels, metabolic equivalents and the amount of time spent engaging in moderate/vigorous activity.

Heart rate

During the first half of the intervention period, a resting heart rate was obtained from the Fitbits for just over half (53.8%; n=7) of participants (40% intervention n=2; 62.5% control n=5). There could be many reasons for this, including that the participant did not sit down for extensive periods while wearing the Fitbit or their baseline heart rate was high. Therefore, the Fitbits could not detect when they were resting. Where resting heart rates were not available from the Fitbits, the heart rates obtained while completing the blood pressure readings at baseline were utilised. Figure 8 compares the average resting heart rate with the daily heart rates of each of the groups. The higher resting heart rate among the intervention group is likely due to a higher proportion of the group being on clozapine (40%; n=2 vs 12.5%; n=1), which is known to elevate heart rate (51) and a higher proportion (60%; n=3 vs 0%; n=0) having sinus tachycardia on their most recent ECG.

FIGURE 8
Average Resting Heart Rate (RHR) versus Daily Heart Rate

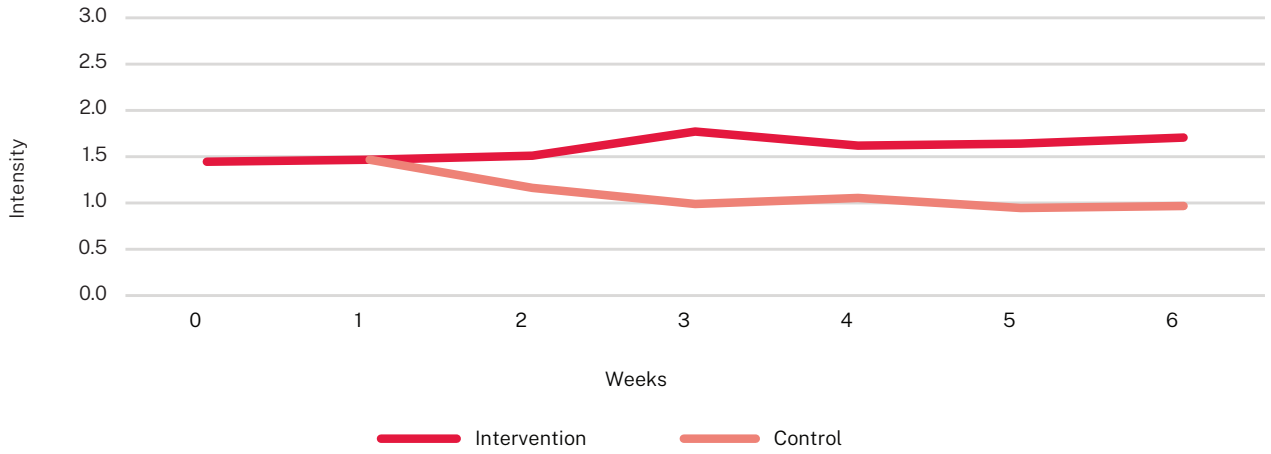


The average resting heart rate up to Week 6 was 92 beats per minute within the intervention group and 85 beats per minute within the control group. The average daily heart rate was 102 beats per minute within the intervention group and 95 beats per minute within the control group. These results indicate that participants' daily routines elevated their heart rate above their resting heart rate by 10.9% in the intervention group and 11.8% in the control group.

Average intensity

The intensity of activities was calculated via a proprietary algorithm owned by Fitbit. Intensity ranges from 0 to 3, with 0 indicating sedentary activity, 1 indicating light activity, 2 indicating moderate activity and 3 indicating vigorous activity. Figure 9 shows the average intensity of both groups. The average intensity up to Week 6 was 1.57 in the intervention group and 1.13 in the control group, indicating the intervention groups' average intensity was light to moderate. In contrast, the control group were closer to light intensity.

FIGURE 9
Average Intensity



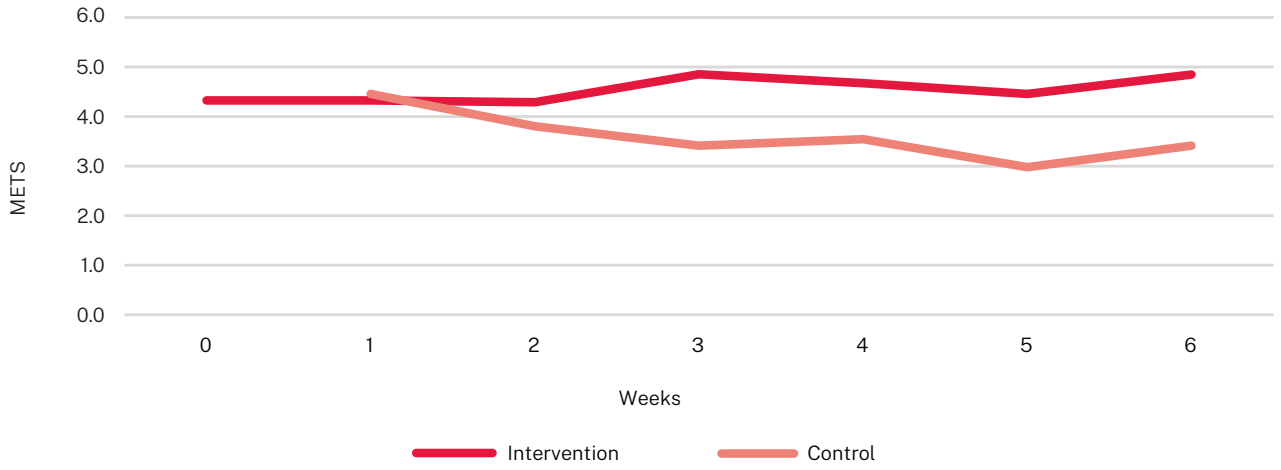
Over the first six weeks, the intervention group gradually increased intensity from 1.4 at Week 0 to 1.7 at Week 6. However, the control group started high (1.47) at Week 1 but reduced to 0.97 at Week 6.

Metabolic equivalent of tasks

Metabolic equivalent of tasks (METS) scores were calculated via a proprietary algorithm owned by Fitbit. One METS is defined as the amount of oxygen expended while at rest, with moderate-intensity exercise having a METS reading of between 3 and 6 (52). A reading in this range would mean that someone is exerting between 3 and 6 times more energy than they would if they were sitting.

Figure 10 shows the average METS reading for each of the groups. The average METS reading for the first half of the intervention period was 4.5 for the intervention group and 3.7 for the control group. These results indicate that both groups were in the moderate-intensity range. However, the intervention group are sitting higher in the moderate-intensity range.

FIGURE 10
Average METS Readings

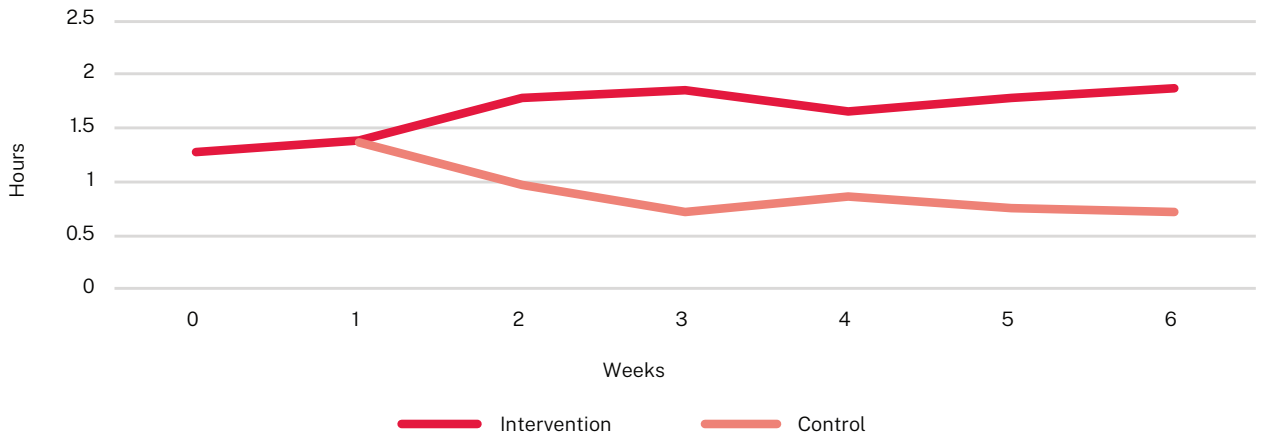


The average METS reading between the groups at Week 1 was similar (intervention 4.3; control 4.4). However, the control group trended down as the weeks progressed, whereas the intervention group increased.

Time spent doing moderate to vigorous activity

The Australian Government Department of Health recommends that adults accumulate 150 to 300 minutes (2.5 to 5 hours) of moderate-intensity physical activity or 75 to 150 minutes (1.25 to 2.5 hours) of vigorous-intensity physical activity (or an equivalent combination of moderate and vigorous activity) per week (53). Surprisingly, both groups' average hours spent engaged in moderate-vigorous activity per day would put them within that range (1.66 hours intervention; 0.90 hours control). However, the ranges varied among the participants. The results ranged from 0.04 to 3.52 hours per day within the intervention group and from 0 to 2.61 hours within the control group. Figure 11 shows the average hours of activity across the weeks.

FIGURE 11
Moderate to Vigorous Activity Hours per Day



Across the weeks, the time spent doing moderate to vigorous activity increased in the intervention group (1.28 to 1.87 hours), whereas the control group's activity time decreased over this period (1.37 to 0.72 hours).

The drop in intensity, METS readings and time spent doing moderate to vigorous activity in the control group after Week 1 could result from initial excitement about having a Fitbit to wear and engaging in more activity than normal.

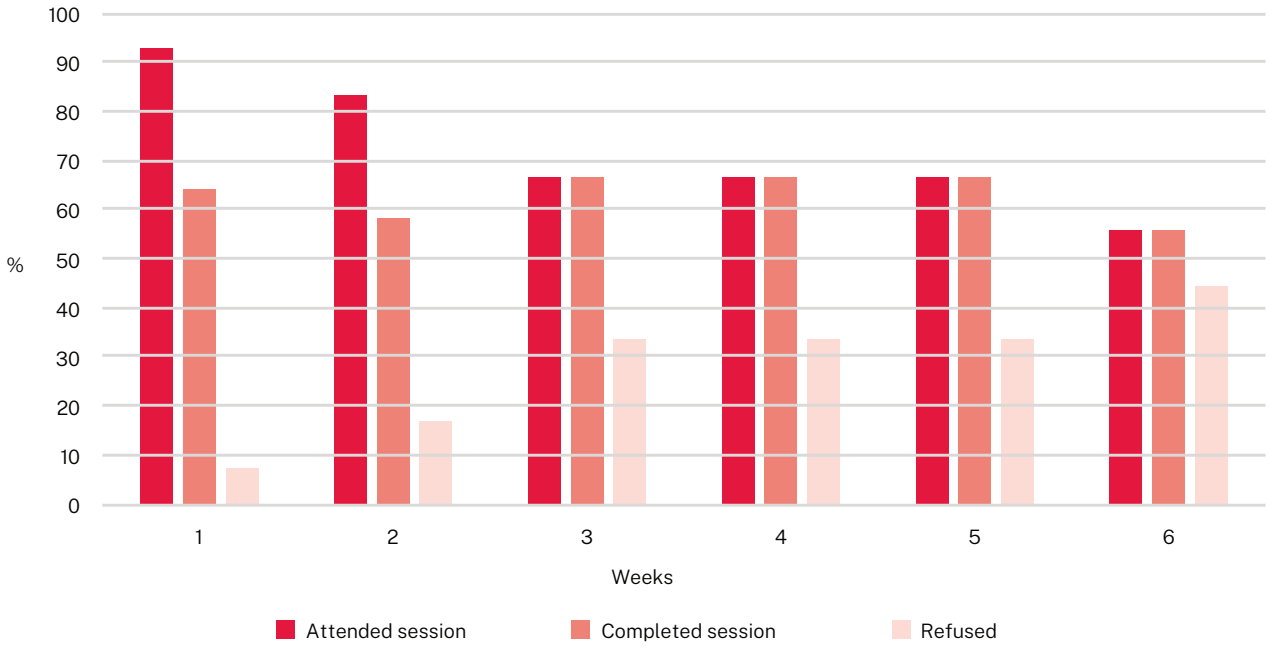
Exergaming Sessions

Participants in the intervention group were encouraged to complete three exergaming sessions per week. The sessions were scheduled to be 30 minutes in length, plus an additional 10-minute warm-up if participants had not been engaging in any activity prior to the scheduled session. The sessions were run in the common area, utilising the ward television.

After the warm-up period, at 10-minute intervals, participants' heart rates were checked, and they were asked to rate the intensity of the exergaming session on the OMNI scale of perceived exertion.

During Weeks 1 to 6, 62 exergaming sessions were scheduled. Overall, 74.2% of sessions were attended, and 62.9% were completed in full, shown in Figure 12. The average session length (of all sessions) was 38 minutes, with an average session length of 18 minutes for sessions not completed in full.

FIGURE 12
Exergaming Session Attendance and Non-Attendance



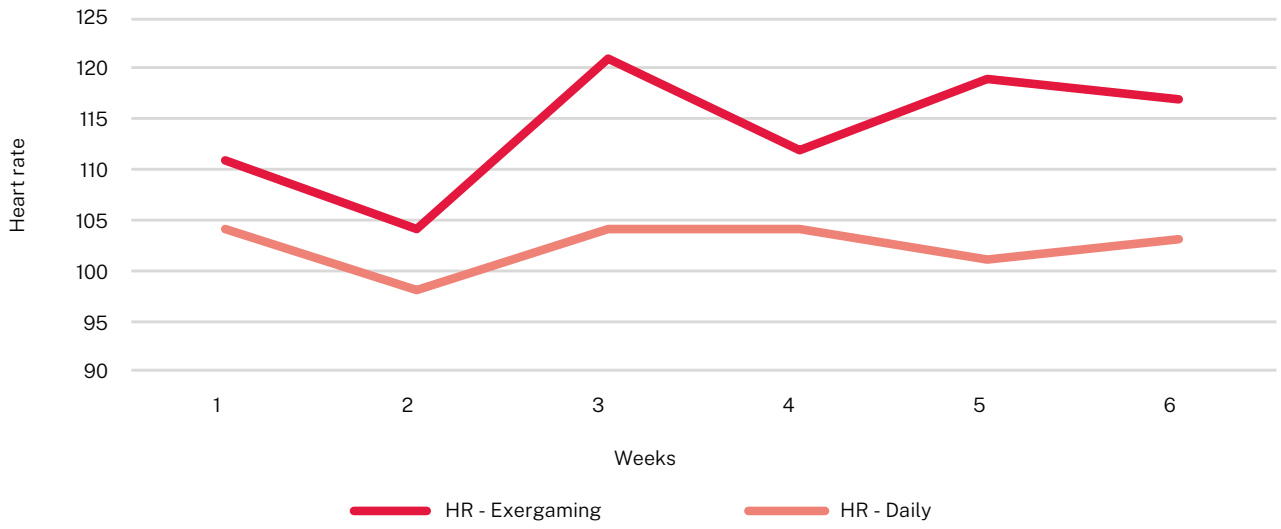
Reasons cited for non-completion of sessions included participants not wanting to play anymore (42.9%), needing to go for a walk due to medication side effects (28.5%) and attending other appointments (28.6%). Reasons cited for refusal of sessions included that participants did not feel like it (58.3%) and had knee pain (41.7%).

Sports-based games (Kinect Sports 1 & 2 and Motionsports Adrenaline) were the most commonly played in the first six weeks of the intervention (54.3%), followed by Joy Ride (19.6%) and Your Shape Fitness (8.7%). During intervention testing, dance games were deemed the highest in intensity. In 15.2% of exergaming sessions, participants played dance games. However, dance games were often included in the same session as other games due to the intensity.

A target heart rate range was determined to help identify whether participants were meeting the moderate-intensity exercise threshold. At a minimum, participants were required to reach 50% of their heart rate maximum. In 81.4% of readings, the participant's heart rate was considered moderately intensive (regardless of whether they completed the session).

The average heart rate during the exergaming sessions was 114 beats per minute (range 85–136 BPM), which is 11.77% higher than the daily average heart rate (102 BPM) and 23.91% higher than the resting heart rate (92 BPM). Figure 13 shows the average heart rate during the exergaming sessions compared to the intervention groups' daily heart rate.

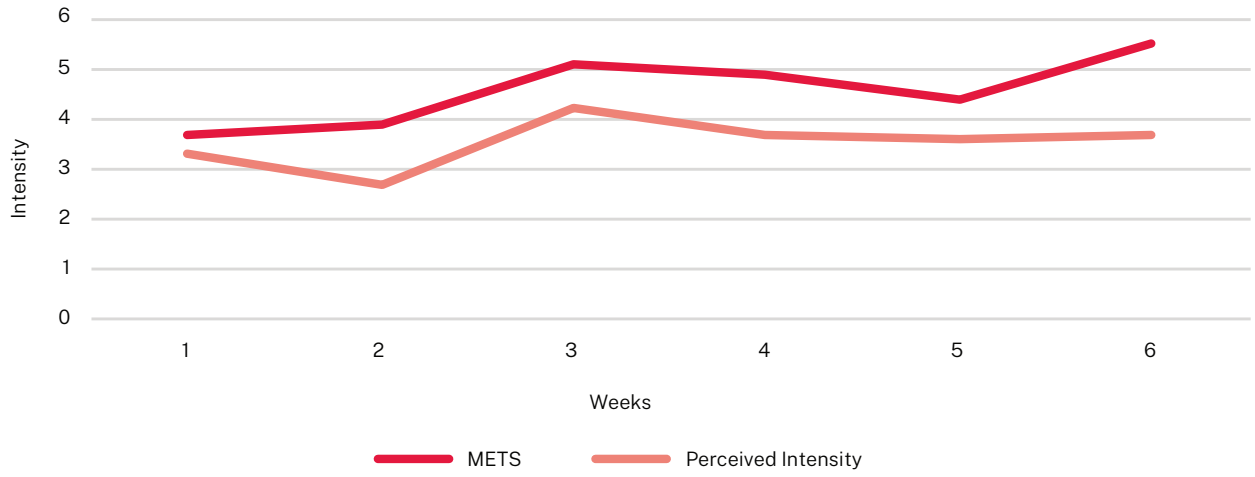
FIGURE 13
Daily Heart Rate versus Exergaming Heart Rate



Average heart rate readings in the exergaming sessions were higher than the average daily heart rate across all weeks. The increase in heart rate after Week 2 was probably the result of participants being encouraged to try more active games.

The average METS during the exergaming sessions and the average OMNI perceived exertion score is presented in Figure 14. The average METS across the first half of the intervention period was 4.3 (range 2.3–8.5), and the average OMNI score was 3.5 (range 1–6).

FIGURE 14
Average METS and Perceived Intensity



Again, the increase in METS and perceived exertion scores after Week 2 was probably the result of participants being encouraged to try more active games. The average METS across all weeks is within the moderate-intensity range (3–6).

A perceived exertion score of between 3 and 6 is considered moderately intensive. Other than a slight decrease at Week 2, the average scores indicate that participants generally perceived they were doing moderate-intensity exercise.

Mid-Intervention

A mid-intervention questionnaire was completed at the beginning of Week 7. In total, 8 participants remained in the program at mid-intervention (intervention n = 3; control n = 5).

Depression, Anxiety and Stress

The DASS-21 was repeated to explore any depression, anxiety, and stress experiences changes. The mean results for each group are presented in Table 14.

TABLE 14
Mean DASS-21 Scores at Mid-Intervention

Mean (SD) (range)	Intervention		Control	
	Baseline (n = 5)	Mid (n = 3)	Baseline (n = 8)	Mid (n = 5)
Depression	6.0 (5.1) (0.0–12.0)	2.7 (4.6) (0.0–8.0)	10.0 (2.4) (0.0–40.0)	12.4 (13.7) (0.0–36.0)
Anxiety	8.0 (3.2) (4.0–12.0)	3.3 (3.1) (0.0–6.0)	8.0 (7.5) (0.0–20.0)	11.2 (11.5) (2.0–30.0)
Stress	6.8 (5.0) (0.0–14.0)	0.0	9.0 (8.2) (0.0–26.0)	9.6 (9.2) (0.0–24.0)
Total DASS-21 score	**20.8 (11.4) (4.0–34.0)**	**6.0 (6.0) (0.0–12.0)**	**27.0 (26.9) (0.0–86.0)**	**33.2 (33.4) (2.0–90.0)**

The mean scores from the DASS-21 indicate the intervention group decreased from mild levels of anxiety at baseline to normal levels at mid-intervention. Levels of depression and stress remained in the normal range across the two observation periods. All mean scores within the intervention group decreased from baseline to mid-intervention. The mean scores from the control group indicate they went from experiencing mild levels of anxiety at baseline to moderate levels at mid-intervention and that levels of depression remained mild and stress remained normal across the two observation periods. All mean scores within the control group increased from baseline to mid-intervention.

Physical Activity

Self-reported activity

Changes in self-reported active and inactive hours were also explored at mid-intervention. The mean results for each of the groups are presented in Table 15.

TABLE 15
Mean Active and Inactive Hours per Day at Mid-Intervention

Mean hours per day (SD) (range)	Intervention		Control	
	Baseline (n = 5)	Mid (n = 3)	Baseline (n = 8)	Mid (n = 5)
Hours in bed	11.9 (1.0) (11.0–13.5)	10.8 (0.3) (10.5–11.0)	11.0 (1.3) (9.0–12.5)	11.6 (1.0) (10.5–13.0)
Sedentary hours	9.6 (2.2) (7.2–12.5)	10.0 (2.1) (7.8–11.7)	10.9 (0.9) (9.0–12.1)	10.4 (1.2) (9.1–12.0)
Total active hours:	**2.5 (1.5) (0.5–4.6)**	**3.1 (2.0) (1.3–5.2)**	**2.1 (1.1) (0.4–3.5)**	**2.0 (1.5) (0.3–4.0)**
Walking hours	2.3 (1.3) (0.5–4.0)	2.3 (1.5) (1.0–4.0)	1.4 (1.1) (0.2–3.5)	1.6 (1.0) (0.3–3.0)
Exercise hours	0.1 (0.1) (0.0–0.3)	0.4 (0.3) (0.2–0.7)	0.4 (0.6) (0.0–1.5)	0.0 (0.1) (0–0.1)
Other activity hours	0.1 (0.1) (0.0–0.33)	0.4 (0.5) (0.0–1.0)	0.3 (0.5) (0.0–1.4)	0.4 (0.5) 0.4–3.5)

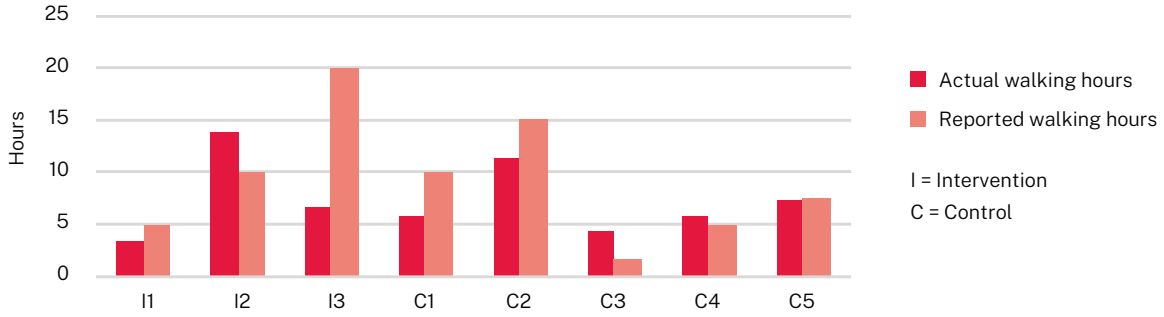
At mid-intervention, the intervention group reported fewer hours in bed, and increased active hours per day. However, they also reported more sedentary time. The control group reported more hours in bed, less sedentary hours and less active hours per day.

The intervention group was more likely to report exercise activities at mid-intervention than the control group (100%; n=3 vs 40%; n=2), mostly due to completing the exergaming sessions. In addition, the intervention group reported spending more time during the day exercising than the control group (24 minutes vs 1.8 minutes).

Self-reported versus actual walking/active time

Self-reported data from the SIMPAQ were compared with data obtained from the Fitbits at Week 6. Figure 15 provides a breakdown of self-reported walking time over the preceding week on the SIMPAQ and walking time detected by the Fitbit. Half (50%; n=4) of the participants overestimated their walking time, 25% (n=2) underestimated and 25% (n=2) came close to estimating their walking time. Of those who overestimated their walking time, the average difference was 5.8 hours (range 1.7–13.4 hours).

FIGURE 15
Self-Reported versus Actual Walking Time



In addition to walking time, active hours from the SIMPAQ were compared to active hours from the Fitbit. Any minute that recorded an intensity of light or above was considered active time. Again, half (50%; n=4) of the participants overestimated their active time. However, a larger proportion (37.5%; n=3) were closer to estimating their actual active time (see Figure 16). Of those that overestimated their active hours, the average difference was 8.8 hours (range 3.1–14.5 hours).

FIGURE 16
Self-Reported versus Actual Active Hours

Comments

Participants were asked whether they had any comments about the project or the intervention. The intervention group participants were also asked whether they felt uncomfortable or 'on show' completing the intervention in the common area.

None of the participants in the intervention group reported that they felt uncomfortable completing the exergaming sessions in the common area. Overall, all participants reported that they had enjoyed the program so far, and no participants reported any issues with wearing the Fitbit. Most participants were positive about the weekly progress reports they received, although one participant reported they did not understand it. Some participants reported that they felt that the Fitbits had resulted in changes in behaviour, such as walking more.

Intervention participant: 'It's been interesting, something different. Check heart rate occasionally for curiosity. Weekly reports are interesting — read, review and discard. My resting heart rate is dropping. Find sessions easier. Good variety of games'.

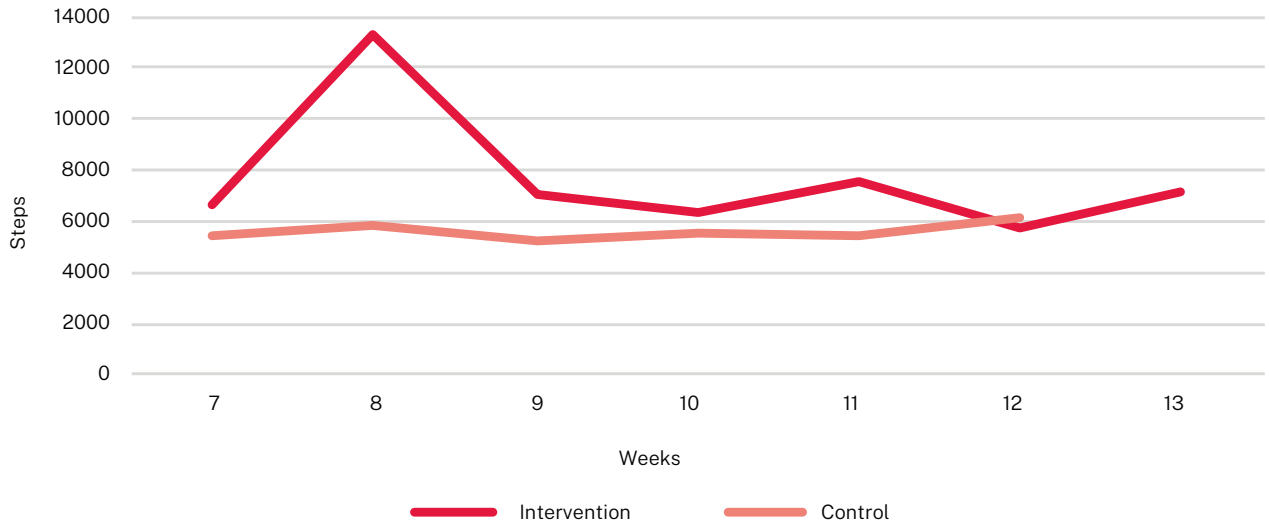
Control participant: 'I wear to compete with the other boys. Would like distance to be added to report. Wearing the Fitbit makes me want to do more steps'.

Intervention Period — Weeks 7 to 12/13

Levels of Activity

The average number of steps across the second half of the intervention period was slightly higher across both groups. The average steps per day was 7,685 for the intervention group (an increase of 536 steps) and 5,584 for the control group (an increase of 612 steps). Week 8 was the only time during the intervention period where one of the groups exceeded an average of 10,000 steps per day (see Figure 17). The range across the second half of the intervention was 537–18,007 steps per day in the intervention group and 2,452–9,935 in the control group.

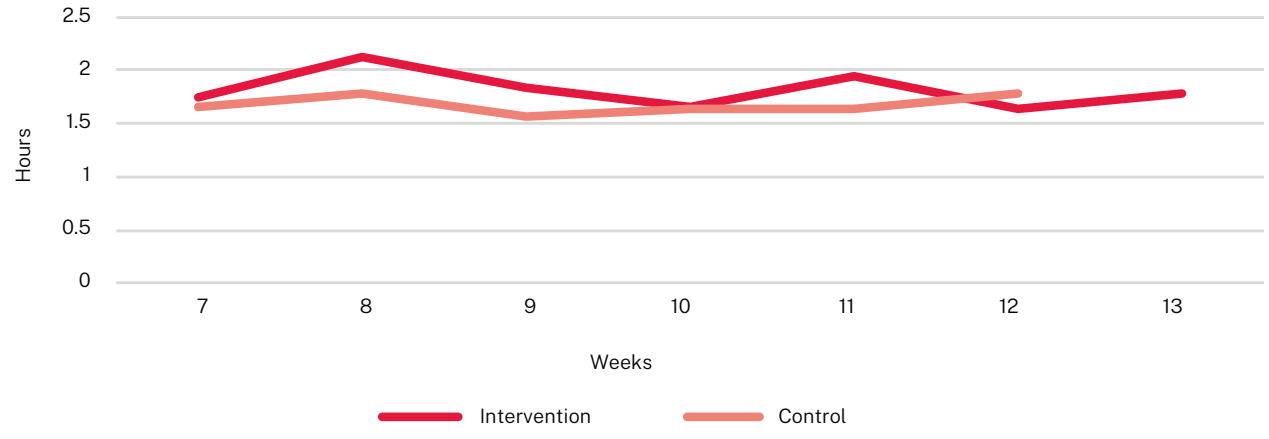
FIGURE 17
Average Steps per Day



Week 12 was the only time during the intervention period where the control group recorded a higher average step count per day than the intervention group.

Both groups saw a slight decrease in walking hours across the second half of the intervention period. The intervention group averaged 1.81 walking hours per day (a decrease of 0.15 hours) and the control group averaged 1.68 walking hours per day (a decrease of 0.02 hours). The range within the groups was 0.32–3.51 hours in the intervention group and 0.83–2.61 hours in the control group, as shown in Figure 18.

FIGURE 18
Walking Hours per Day

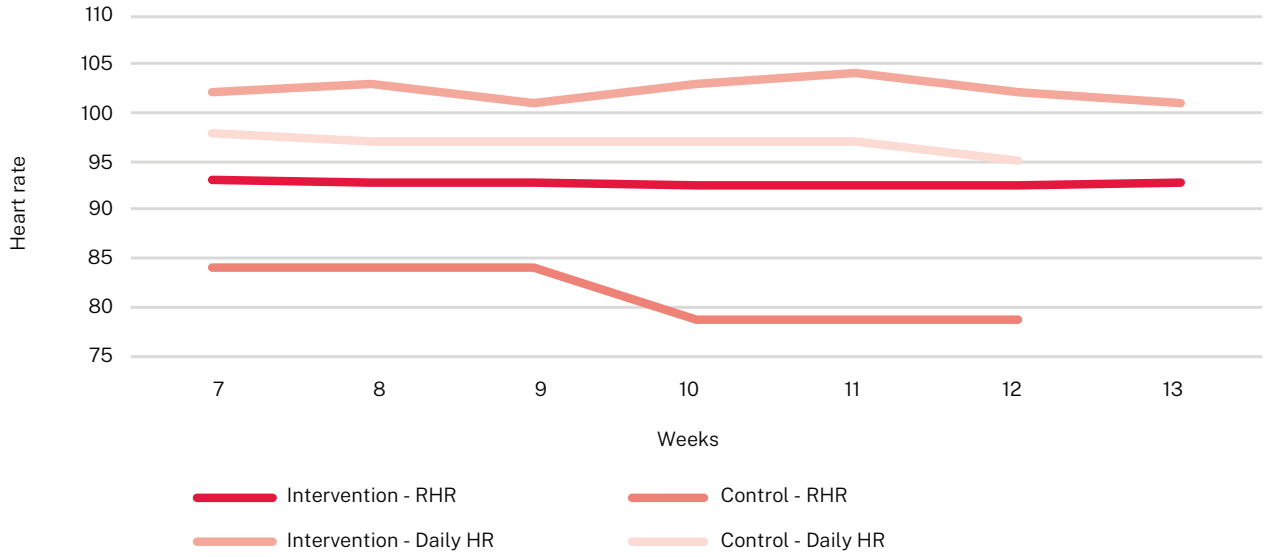


Intensity of Activity

Heart rate

Fitbit captured the resting heart rate for 33.3% (n=1) of the intervention group and 100% (n=5) of the control group across weeks 7 to 13. However, it wasn't until Week 10 that the final resting heart rate was captured in the control group, which is the reason for the drop observed in Figure 19.

FIGURE 19
Average Resting Heart Rate (RHR) versus Daily Heart Rate

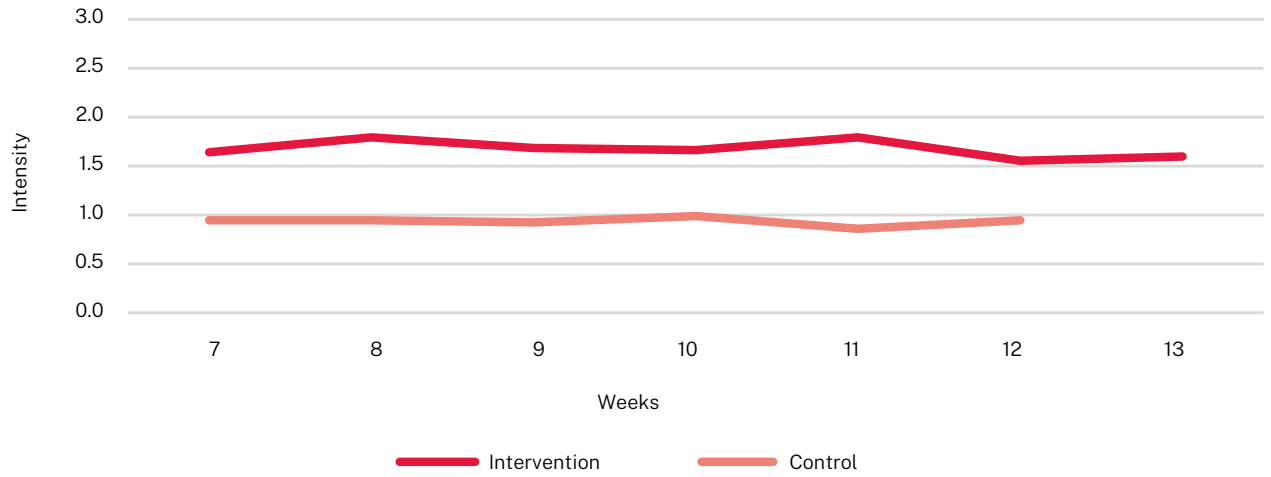


There were minimal changes in the resting and daily heart rates between the first and second half of the intervention period. The average resting heart rate went up slightly from 92 to 93 beats per minute within the intervention group; however, the average daily heart rate remained the same (102 BPM). Within the control group, the average resting heart rate went down from 85 to 81, while the average daily heart rate went up from 95 to 97 beats per minute. Given that the resting heart rate for only one intervention participant was captured for Weeks 7-13, the results may not accurately represent actual changes within group.

Intensity

Across the second half of the intervention period, the intensity readings remained quite consistent, as presented in Figure 20. The average intensity was 1.68 among the intervention group and 0.94 among the control group. These readings indicate that the intervention group was generally closer to the moderate-intensity range and the control group closer to the light-intensity range.

FIGURE 20
Average Intensity

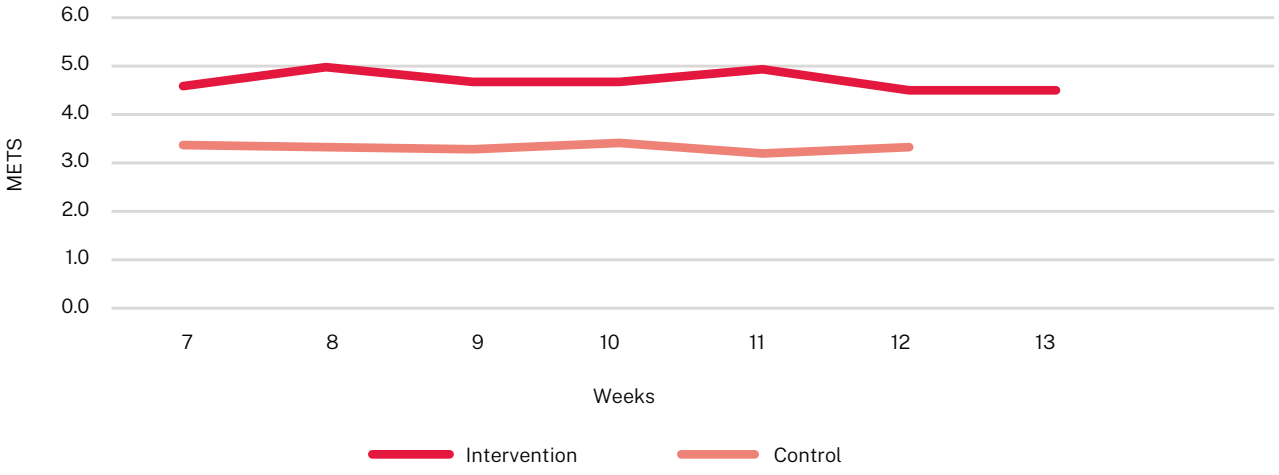


The average intensity in the second half of the intervention period was slightly higher in the intervention group when compared to the first half (increasing from 1.57 to 1.68). In contrast, the average intensity of the control group decreased slightly (from 1.13 to 0.94).

METS

The average METS were also quite consistent across the second half of the intervention period, presented in Figure 21. The intervention group's average METS was slightly higher when comparing the first and second half of the intervention periods (increasing from 4.5 to 4.7). In contrast, the average METS of the control group decreased slightly (from 3.7 to 3.3).

FIGURE 21
Average METS

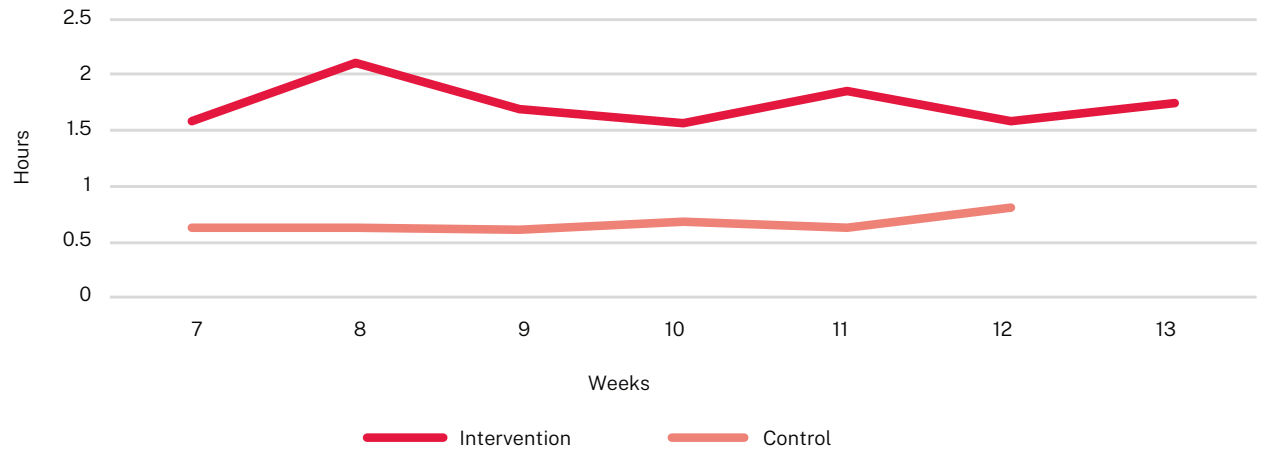


The average METS across the weeks indicate that both groups were in the moderate-intensity range. However, the control group sat lower within the range.

Time spent doing moderate to vigorous activity

The time spent doing moderate to vigorous activity per day remained high across the second half of the intervention period, particularly among the intervention group, as shown in Figure 2.2.

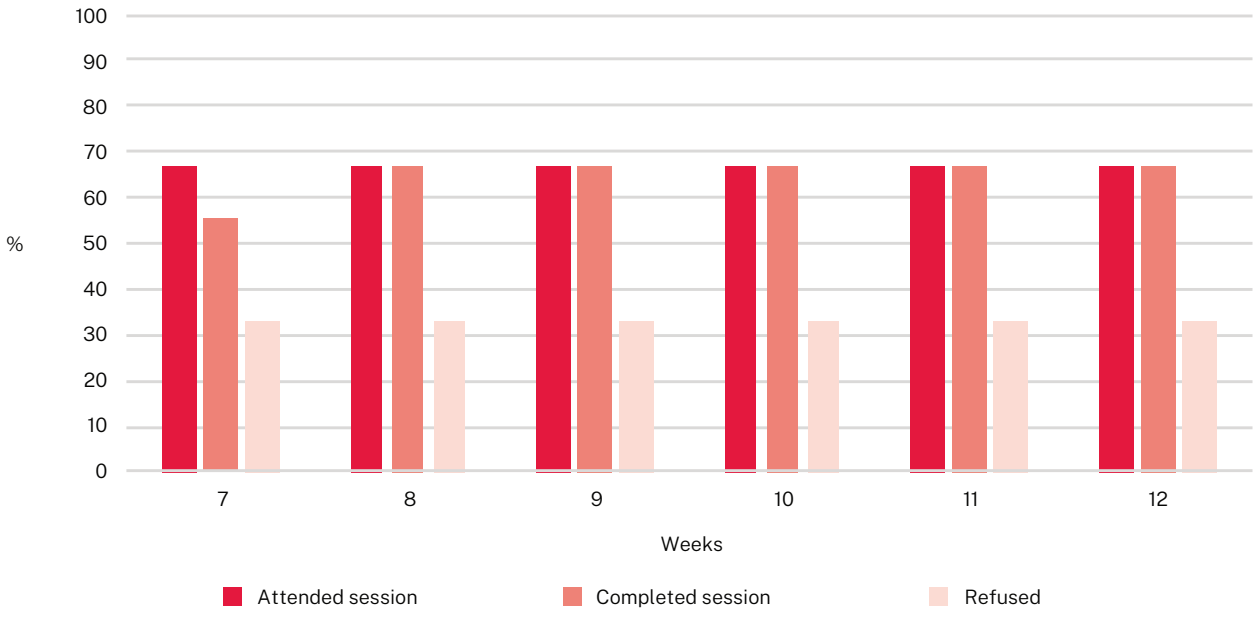
FIGURE 22
Moderate to Vigorous Activity Hours per Day



Exergaming Sessions

During the second half of the intervention period, 54 exergaming sessions were scheduled. Overall, participants attended 66.7% of the sessions, and 64.8% were completed in full (see Figure 23), which indicates that a higher proportion of sessions were completed in full compared to the first half of the intervention period (62.9%). The average session length of all sessions was 42 minutes, with the average session length of sessions not completed in full being 20 minutes.

FIGURE 23
Attendance and Non-Attendance at Exergaming Sessions



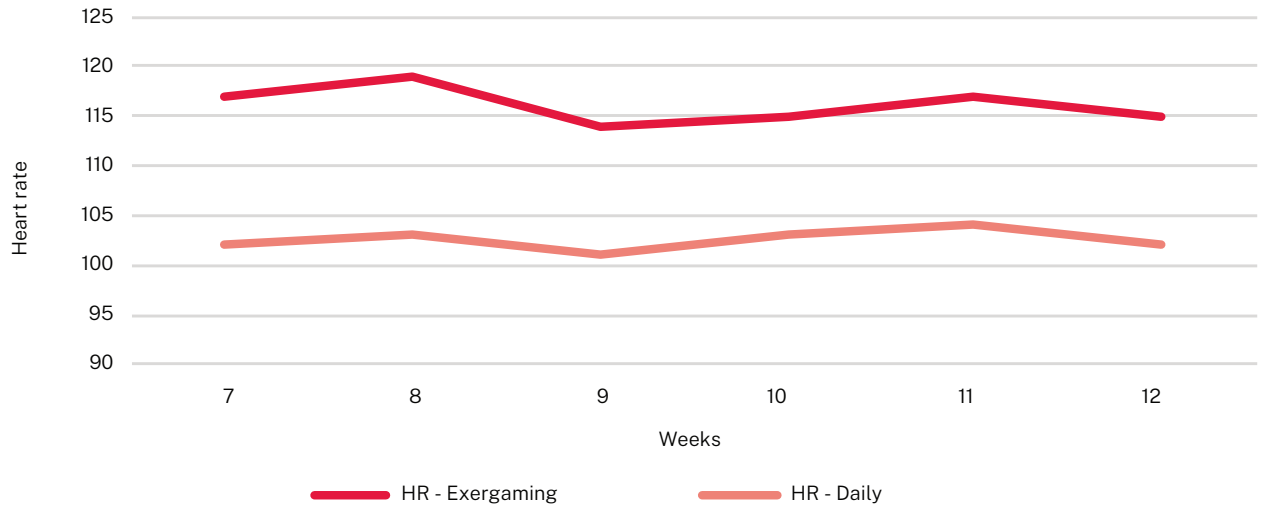
The sole reason for the non-completion of sessions was ward/participant interruptions (100%), and the reason cited for refusals was knee pain (100%).

Again, sports-based games (Kinect Sports 1 & 2 and Motionsports Adrenaline) were the most commonly played (50%), followed by Your Shape Fitness (38.9%) and Motion Explosion (11.1%). Dance-based games were played in 8.3% of sessions. As mentioned earlier, they were again mostly played in combination with another game.

Heart rates obtained during the exergaming sessions indicate that in 88.9% of readings, the participants' heart rate was in the moderate-intensity zone (at least 50% of their heart rate maximum). Interestingly, from Weeks 10 to 12, one participant's heart rate readings were not all consistently within the moderate-intensity zone, even though there were no major changes in the games chosen. This outcome could indicate an improvement in fitness levels.

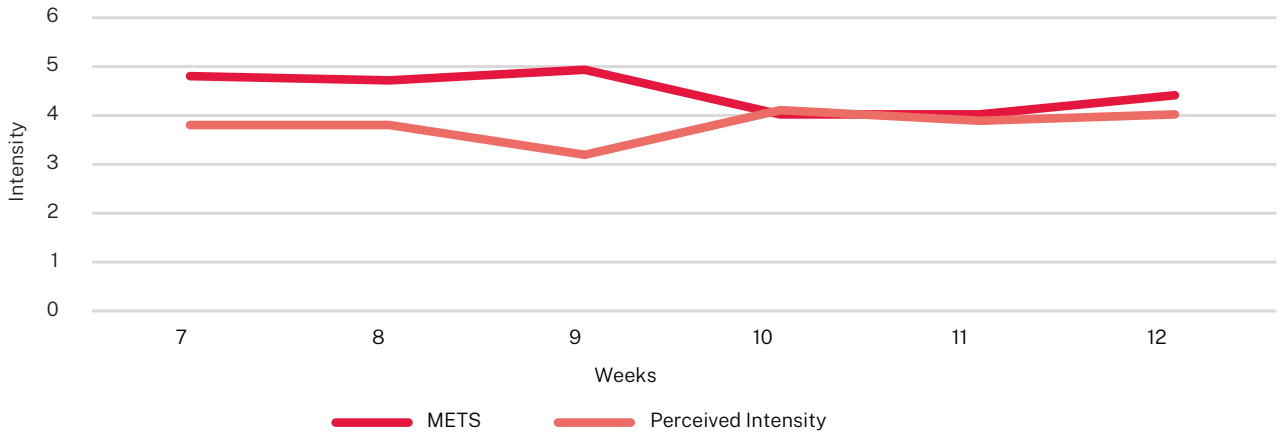
Average heart rate readings from the exergaming sessions are presented in Figure 24. Again, the average exergaming heart rate (116 BPM; range 97–134) was higher than the daily average heart rate (102 BPM) observed within the intervention group (a 13.73% increase). The average exergaming heart rate was 26.09% higher than the resting heart rate within the group (93 BPM).

FIGURE 24
Daily Heart Rate versus Exergaming Heart Rate



The average METS and perceived exertion scores were quite similar when comparing the two halves of the intervention period. The average METS of 4.5 shows an increase of 0.2, and the average perceived exertion score was 3.8, an increase of 0.3 from the first half of the intervention period, shown in Figure 25.

FIGURE 25
METS versus Perceived Exertion



Interestingly, at Week 9, the METS reached their highest peak of 4.9 during this half of the intervention period, yet conversely, the perceived exertion score was the lowest during the time frame at 3.2.

Post-Intervention

In total, seven participants (intervention n = 3, control n = 4) completed the post-intervention questionnaire. One participant from the control group who completed their discontinuation questionnaire at Week 9 of the intervention period has been included in the post-intervention results, where data were available.

Depression, Anxiety and Stress

Both groups saw a decrease from baseline to post-intervention in mean scores across all of the domains of the DASS-21. The mean scores are presented in Table 16.

TABLE 16
Mean DASS-21 Scores Baseline to Post

Mean (SD) (range)	Intervention		Control	
	Baseline (n = 5)	Post (n = 3)	Baseline (n = 8)	Post (n = 5)
Depression	6.0 (5.1) (0.0–12.0)	0.7 (1.2) (0.0–2.0)	10.0 (2.4) (0.0–40.0)	8.4 (12.2) (2.0–30.0)
Anxiety	8.0 (3.2) (4.0–12.0)	4.0 (3.5) (2.0–8.0)	8.0 (7.5) (0.0–20.0)	7.2 (10.8) (0.0–26.0)
Stress	6.8 (5.0) (0.0–14.0)	0.0	9.0 (8.2) (0.0–26.0)	6.0 (8.3) (0.0–20.0)
Total DASS-21 score	**20.8 (11.4) (4.0–34.0)**	**4.7 (4.6) (2.0–10.0)**	**27.0 (26.9) (0.0–86.0)**	**21.6 (30.6) (6.0–76.0)**

The mean scores from the DASS-21 indicate that the intervention group decreased from mild levels of anxiety at baseline to normal levels at post intervention and depression and stress remained in the normal ranges across the two observation periods. The mean scores from the control group indicate the participants went from experiencing mild levels of depression and anxiety at baseline to normal levels at post intervention. Levels of stress remained in the normal ranges across the two observation periods.

Figure 26 details the percentage of the groups in the different DASS-21 categories post-intervention.

FIGURE 26
DASS-21 Categories at Post-Intervention

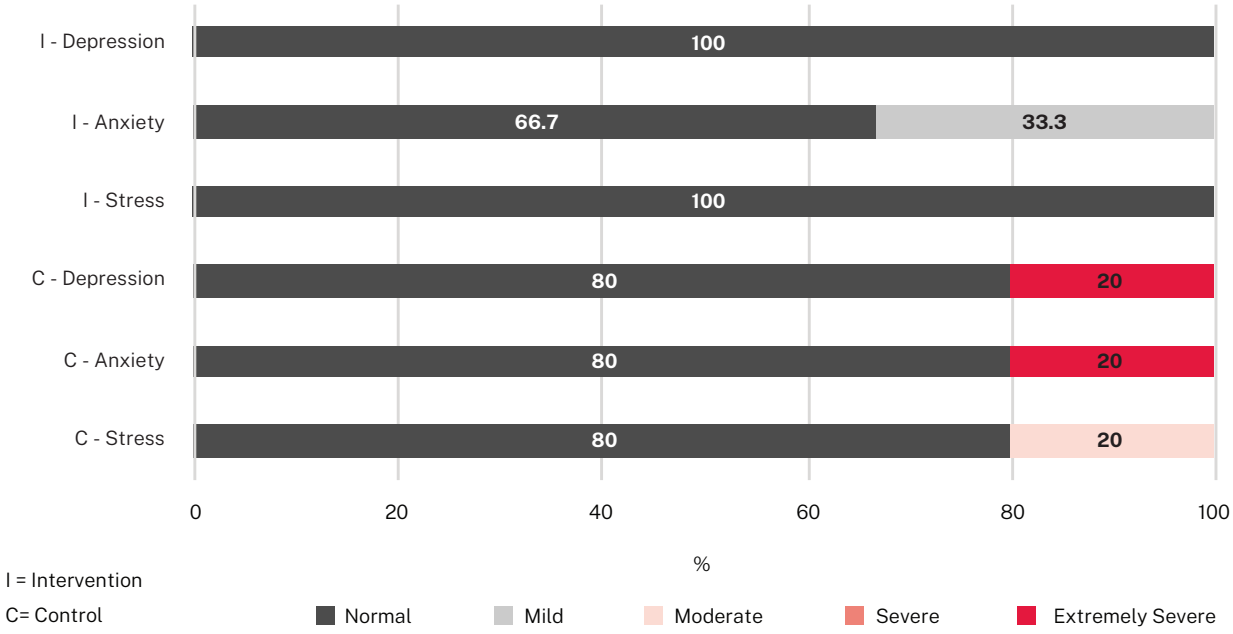
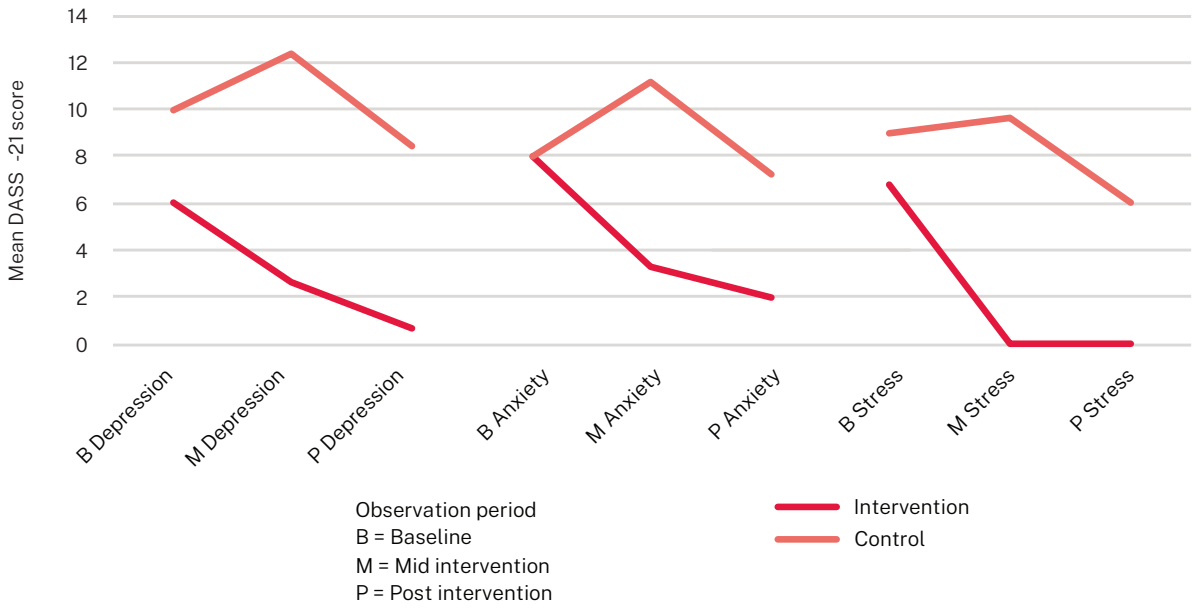


Figure 27 shows changes in the mean DASS-21 scores across the three observation periods (baseline, mid and post-intervention). The intervention groups' depression and anxiety scores decreased across the three observation periods. Stress decreased from baseline to mid-intervention and then remained the same. Conversely, the control group saw either no changes or increased scores from baseline to mid-intervention before decreasing at post-intervention.

FIGURE 27
DASS-21 Changes from Baseline to Mid-Intervention to Post-Intervention



Positive Psychotic Symptoms

The mean CAPE-P15 scores from baseline to post-intervention for each of the groups are presented below in Table 17.

TABLE 17
Mean CAPE-P15 Scores

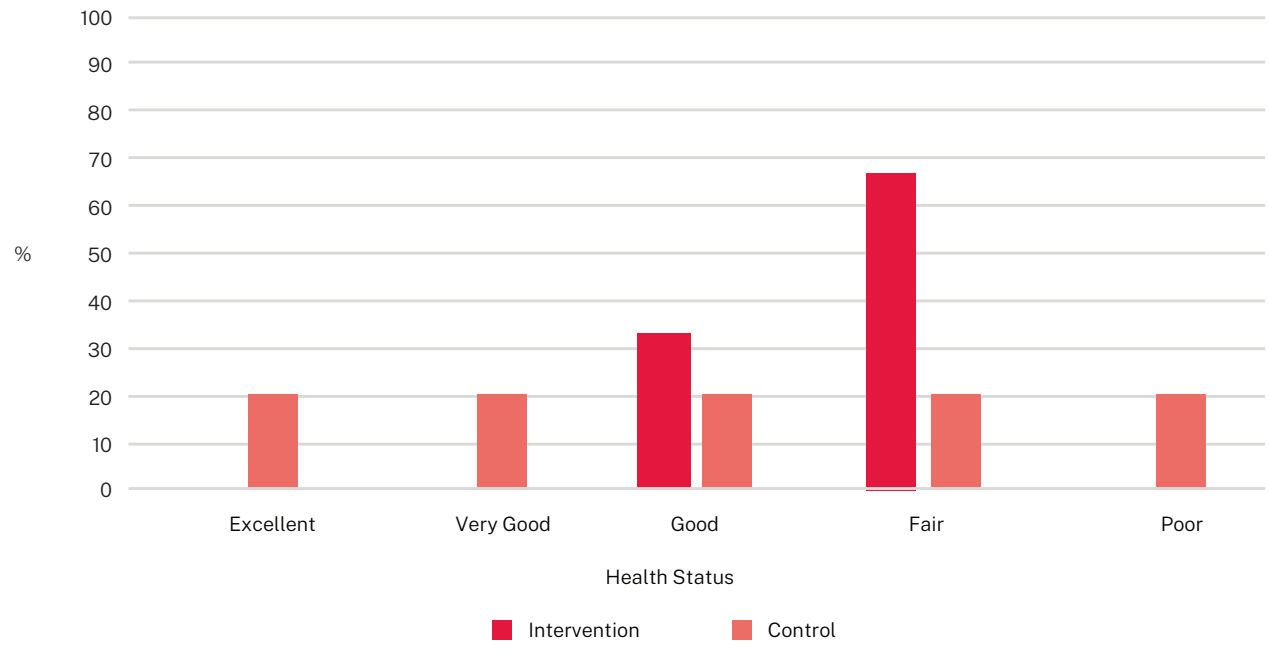
Mean (SD) (range)	Intervention		Control	
	Baseline (n = 5)	Post (n = 3)	Baseline (n = 5)	Post (n = 4)
Persecutory ideations	7.0 (1.9) (5.0–10.0)	6.3 (1.2) (5.0–7.0)	8.8 (4.1) (5.0–18.0)	9.0 (5.0) (5.0–16.0)
Bizarre experiences	9.6 (3.4) (7.0–15.0)	9.0 (2.6) (7.0–12.0)	9.5 (5.5) (7.0–23.0)	11.0 (5.7) (7.0–19.0)
Perceptual abnormalities	5.0 (3.1) (3.0–10.0)	5.0 (3.5) (3.0–9.0)	3.6 (1.8) (3.0–8.0)	5.8 (2.8) (3.0–9.0)
Total CAPE-P15 score	**21.8 (5.7) (16.0–30.0)**	**20.3 (4.9) (17.0–26.0)**	**21.9 (11.2) (15.0–49.0)**	**25.8 (12.6) (16.0–44.0)**

The intervention group saw decreases across all of the domains, except perceptual abnormalities which saw no changes. All the scores in the control group increased across the two observation periods.

General Health Status

The participant's self-rated health status at post intervention is presented below in Figure 28.

FIGURE 28
Self-Rated Health Status



Overall, 50% of participants reported no change to their health status (66.7% intervention; 40% control), 37.5% (33.3% intervention; 40% control) reported an improvement and 12.5% (20% control) reported a decline in their health status at post-intervention.

Physical Activity

Fitbit data

Data obtained from the Fitbits over the intervention period indicate that the intervention group were doing more activity per day and at a higher intensity than the control group. Mean results for the entire intervention period are detailed in Table 18. Interestingly, the average step count for the intervention group was similar to averages observed in the general population, despite the short data collection hours per day.

TABLE 18
Mean Fitbit Results for the Entire Intervention Period

Overall mean results (SD) (range)	Intervention (n = 2)	Control (n = 6)
Resting heart rate (BPM)	81.0 (12) (70.0–95.0)	79.0 (11.7) (66.0–101.0)
	(n = 5)	**(n = 8)**
Daily heart rate (BPM)	102.0 (7.8) (81.0–118.0)	96.0 (8.4) (79.0–111.0)
Steps per day	7,388 (4,379) (537–18,007)	5,234 (2,233) (1,900–9,935)
Intensity	1.6 (0.9) (0.0–3.0)	1.1 (0.5) (0.0–2.0)
METS	4.6 (1.8) (1.6–7.1)	3.5 (3.5) (2.0–6.1)
Number of hours moderate/vigorous activity per day	1.7 (1.1) (0.0–3.5)	0.8 (0.6) (0.0–2.6)
Walking hours per day	1.9 (0.9) (0.3–4.2)	1.7 (0.5) (0.7–2.6)

Self-reported physical activity

At post-intervention, the intervention group reported less hours in bed, less sedentary hours and more active hours per day. The control group reported more hours in bed, but less sedentary and more active hours per day, as shown in Table 19. Half of the participants (33.3% intervention; 60% control) reported more active time post-intervention than at baseline.

TABLE 19
Mean Active and Inactive Hours per Day at Post-Intervention

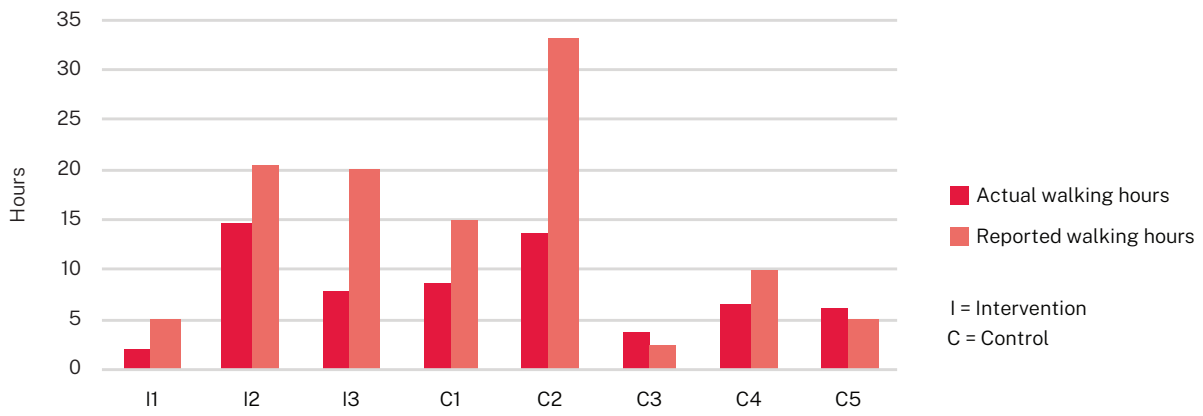
Mean hours per day (SD) (range)	Intervention		Control	
	Baseline (n = 5)	Post (n = 3)	Baseline (n = 8)	Post (n = 5)
Hours in Bed	11.9 (1.0) (11.0–13.5)	11.7 (0.3) (11.5–12.0)	11.0 (1.3) (9.0–12.5)	11.5 (1.0) (10.5–12.5)
Sedentary hours	9.6 (2.2) (7.2–12.5)	9.2 (2.0) (7.8–11.5)	10.9 (0.9) (9.0–12.1)	9.5 (2.3) (6.6–12.0)
Total active hours:	**2.5 (1.5) (0.5–4.6)**	**3.1 (1.8) (1.0–4.2)**	**2.1 (1.1) (0.4–3.5)**	**3.0 (2.4) (0.5–6.9)**
Walking hours	2.3 (1.3) (0.5–4.0)	3.0 (1.8) (1.0–4.1)	1.4 (1.1) (0.2–3.5)	2.5 (2.2) (0.5–6.0)
Exercise hours	0.1 (0.1) (0.0–0.3)	0.0 (0.1) (0.0–0.1)	0.4 (0.6) (0.0–1.5)	0.0 (0.03) (0.0–0.1)
Other activity hours (cleaning, laundry)	0.1 (0.1) (0.0–0.3)	0.1 (0.1) (0.0–0.2)	0.3 (0.5) (0.0–1.4)	0.5 (0.5) (0.0–1.0)

Only a small percentage of participants (intervention 33.3%; control 20%) reported exercise activities post-intervention, which is a substantial decline from mid-intervention (intervention 100%; control 40%). Most participants in the intervention group did not continue with any form of exercise once the exergaming sessions ended, despite intervention participants being advised that they could request an exergaming session in Week 13.

Self-reported versus actual walking/active time

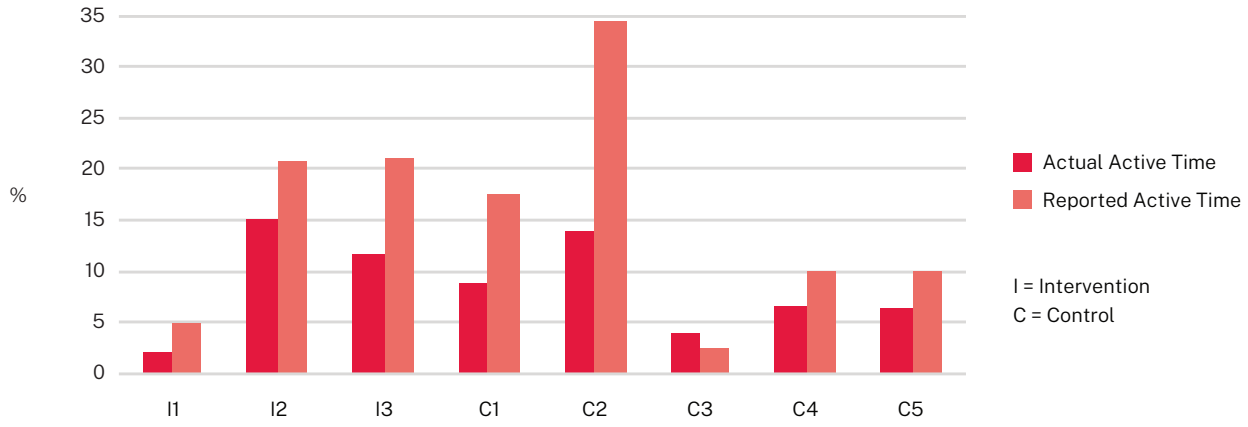
Self-reported data from the SIMPAQ were compared with data obtained from the Fitbits at the last week of the intervention period. Figure 29 provides a breakdown of self-reported walking time on the SIMPAQ and walking time detected by the Fitbit. More participants at post-intervention (75%) overestimated their walking hours over the preceding week compared to at mid-intervention (50%). Of those that overestimated their walking hours, the average difference was 8.3 hours (range 3.0–19.3 hours).

FIGURE 29
Self-Reported versus Actual Walking Hours



Actual active time reported on the SIMPAQ was compared to active hours detected by the Fitbit at the last week of the intervention period. Again, more participants (87.5%) at post-intervention overestimated their active hours compared to mid-intervention (50%), as in Figure 30. Of those that overestimated their active hours, the average difference was 7.8 hours (range 3.0–20.5 hours).

FIGURE 30
Self-Reported versus Actual Active Hours



Clinical Measurements

All clinical measurements completed at baseline were also completed at post-intervention.

Anthropometric Measurements

The mean results for each of the groups are presented in Table 20. Overall, the intervention group saw increases in all measurements, except systolic blood pressure, and the control group saw increases in all measurements, except diastolic blood pressure.

TABLE 20
Mean Anthropometric Measurements

Mean (SD) (range)	Intervention		Control	
	Baseline (n = 5)	Post (n = 3)	Baseline (n = 8)	Post (n = 5)
Weight	98.2 (14.7) (79.4–115.3)	106.9 (9.2) (98.1–116.5)	98.4 (9.5) (79.3–108.2)	105.9 (7.5) (98.6–115.9)
BMI	31.6 (4.7) (26.1–37.1)	34.7 (3.0) (32.3–38.0)	30.6 (4.5) (23.6–38.3)	31.7 (3.2) (27.7–34.7)
Waist circumference	107.0 (15.4) (89.0–122.0)	116.3 (8.0) (108.0–124.0)	107.0 (10.3) (87.0–121.0)	110.0 (3.7) (106.0–115.0)
Average systolic blood pressure	121.0 (9.2) (108.0-134.0)	120.0 (12.9) (107.0–132.0)	113.0 (11.7) (94.0-131.0)	118.0 (11.2) (106.0–134.0)
Average diastolic blood pressure	78.0 (9.5) (68.0–94.0)	80.0 (4.7) (76.0–85.0)	78.0 (6.9) (71.0–89.0)	77.0 (13.3) (65.0–99.0)

Within the intervention group, of the participants that completed the program:

- 66.7% (n=2) decreased weight (mean 0.87 kg; range 0.93–2.87 kg) and 33.3% (n=1) increased weight (1.2 kg)
- 33.3% (n=1) saw a decrease in their BMI (1.0), 33.3% (n=1) saw no change and 33.3% (n=1) saw an increase in their BMI (0.94)
- 33.3% (n=1) saw a decrease in their waist circumference (5 cm), 33.3% (n=1) saw no change and 33.3% (n=1) saw an increase in their waist circumference (2 cm).

Within the control group, of the participants that completed the program:

- 100% (n=5) increased weight (mean 4.22 kg; range 0.58–9.5 kg)
- 100% (n=5) increased their BMI (mean 1.32; range 0.3–3)
- 80% (n=4) saw an increase in their waist circumference (mean 4.5 cm; range 3–6 cm) and 20% (n=1) saw a decrease (4 cm).

Cardiorespiratory Fitness Test

Only one-quarter (25%) of participants completed the cardiorespiratory fitness test post-intervention (intervention 33.3%; control 20%). Reasons for not completing the test included reported weakness (intervention 33.3%; control 20%), having a medical condition (intervention 33.3%; control 20%), participant refusal (control 20%), or there being no time to complete before discharge (control 20%). Of the participants that completed the test, both saw an increase in their VO2 max scores. The VO2 max score increased from 38.0 to 39.68 (fair to good) for the intervention group participant and from 36.3 to 49.5 (fair to superior) for the control group participant.

Pathology Results

The number of participants that completed pathology testing post-intervention varied among the groups. Only 40% of the control group completed all the pathology tests post-intervention. This was secondary to refusals (20%), no time to complete before discharge (20%) and tests not completed at baseline (20%). Mean results for each of the groups are presented in Table 21.

TABLE 21
Mean Pathology Results

Mean (SD) (range)	Intervention		Control	
	Baseline (n = 5)	Post (n = 3)	Baseline (n = 6)	Post (n = 2)
Total cholesterol	5.7 (0.8) (4.7–6.8)	4.9 (1.3) (3.8–6.3)	5.1 (0.7) (4.2–5.9)	5.5 (1.3) (4.6–6.4)
HDL	1.1 (0.2) (0.8–1.3)	0.9 (0.2) (0.8–1.1)	1.3 (0.1) (1.1–1.4)	1.1 (0.3) (0.9–1.3)
LDL	2.8 (1.1) (1.0–3.8)	2.3 (0.9) (1.2–2.9)	2.8 (0.6) (2.0–3.5)	3.2 (0.9) (2.5–3.9)
Triglycerides	2.6 (1.5) (1.5–4.9)	3.2 (2.3) (1.9–5.8)	2.2 (0.4) (1.7–2.9)	2.7 (0.0) (2.6–2.7)
	(n = 5)	(n = 3)	(n = 6)	(n = 3)
HbA1c	5.3 (0.3) (4.9–5.6)	5.6 (0.3) (5.2–5.8)	5.3 (0.8) (4.6–6.8)	5.0 (0.3) (4.6–5.2)
	(n = 5)	(n = 3)	(n = 8)	(n = 5)
Blood glucose	5.7 (1.6) (4.0–8.2)	4.6 (1.1) (3.8–5.8)	5.6 (1.2) (3.8–7.9)	5.8 (1.0) (4.2–6.7)

The mean results from baseline to post-intervention indicate that the intervention group had high cholesterol that decreased to normal, HDL went from borderline normal to low, and LDL and triglycerides remained high. The mean results from the control group indicate the participants went from having normal cholesterol levels at baseline to borderline high levels at post-intervention and that there were no changes to HDL (remained normal), LDL (remained high) and triglycerides (remained high). The HbA1c and blood glucose results remained normal within both groups.

Within the intervention group, two-thirds (66.7%) of participants saw changes to their lipid profile, including decreases in cholesterol, decreases in HDL or increases or decreases in LDL. Within the control group, all (100%) participants saw changes to their lipid profile, including increases in cholesterol or decreases in HDL.

Exergaming Intervention

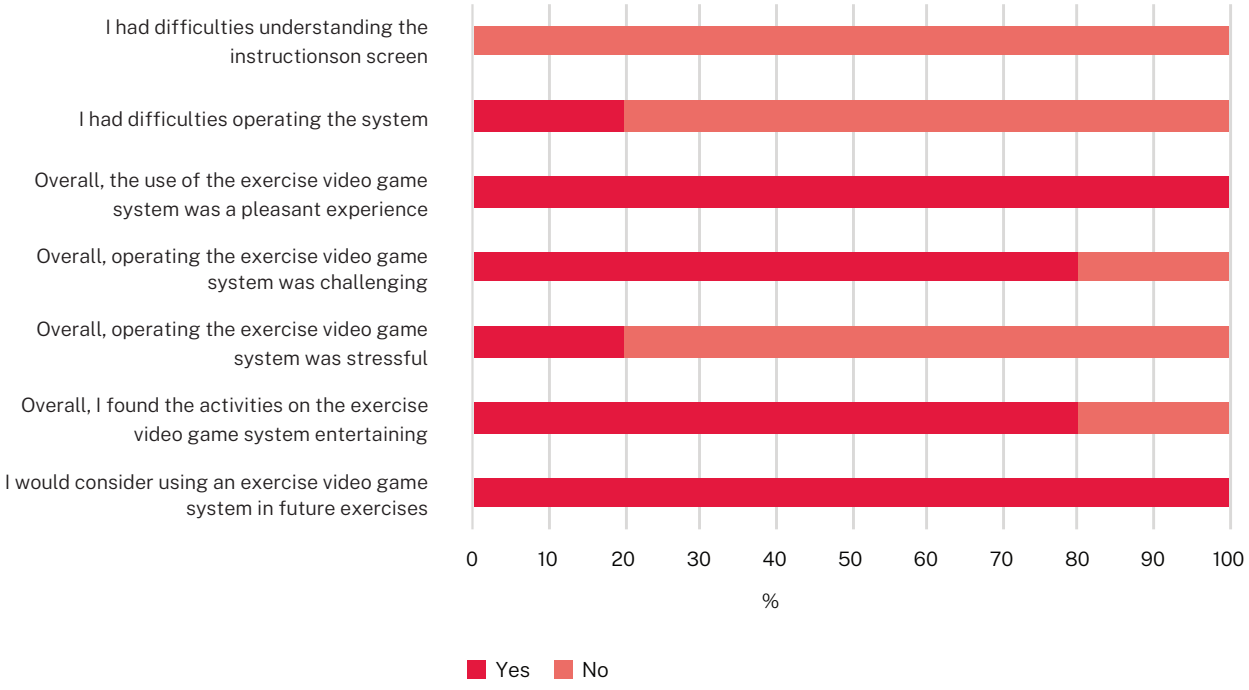
Overall, 70.7% of exergaming sessions offered were attended, with 63.8% completed in full. Among the participants that completed the program (n = 3), the mean number of sessions attended was 18 (range 3–36), with a mean session length of 39 minutes (range 8–50 minutes). The mean perceived exertion score across all sessions was 4, indicating that participants perceived they were undertaking moderate-intensity exercise. In addition, 84.8% of heart rate readings obtained during the exergaming sessions were within the participants' moderate-intensity target heart rate range. The mean heart rate reading during the exergaming sessions was 115 BPM (range 85–136), which is 12.75% higher than the daily average heart rate (102 BPM) and 25% higher than the resting heart rate (92 BPM) observed within the intervention group.

Two minor adverse events were reported during the intervention period, one directly related to the intervention. The event involved a participant falling a short distance to the floor when attempting to complete a lunge. No injuries were sustained, and the participant did not require any medical interventions.

Acceptability of the Exergaming Intervention

Regardless of whether they completed the full program, all participants (n = 5) that completed an exergaming session were asked questions regarding the acceptability of the intervention. The responses are presented in Figure 31.

FIGURE 31
Acceptability of the Exergaming Intervention

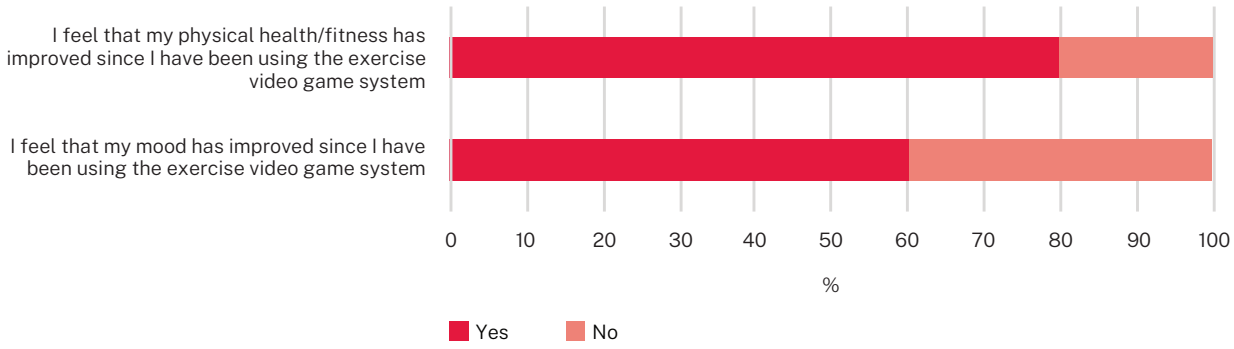


Overall, 80% of participants reported issues with the system, including difficulties operating the system, that the system was challenging and that it was stressful. However, none of the participants reported any difficulties understanding the gaming instructions on the screen.

In contrast, when participants were asked about their program experiences, 100% found the use of the exergaming system a pleasant experience and 80% found the activities entertaining. Concerning the future use of an exergaming system, 100% of participants said they would consider using it again in the future. These results indicate that exergaming was considered highly acceptable by the participants as an intervention. However, the system chosen was not.

Participants were also asked whether they thought there had been any changes in their physical health or mood since using the exergaming system, and the responses are summarised in Figure 32. Overall, 80% of participants reported an improvement in at least one of the domains, with 60% reporting improved physical health and mood.

FIGURE 32
Self-Reported Changes in Physical Health and Mood



Interestingly, of the three participants that completed the program, only one-third (33.3%) reported that their mood had improved since using the system, with two-thirds (66.7%) reporting that their physical health had improved. This outcome could indicate that the physical health benefits were more evident to participants.

Staff Acceptability

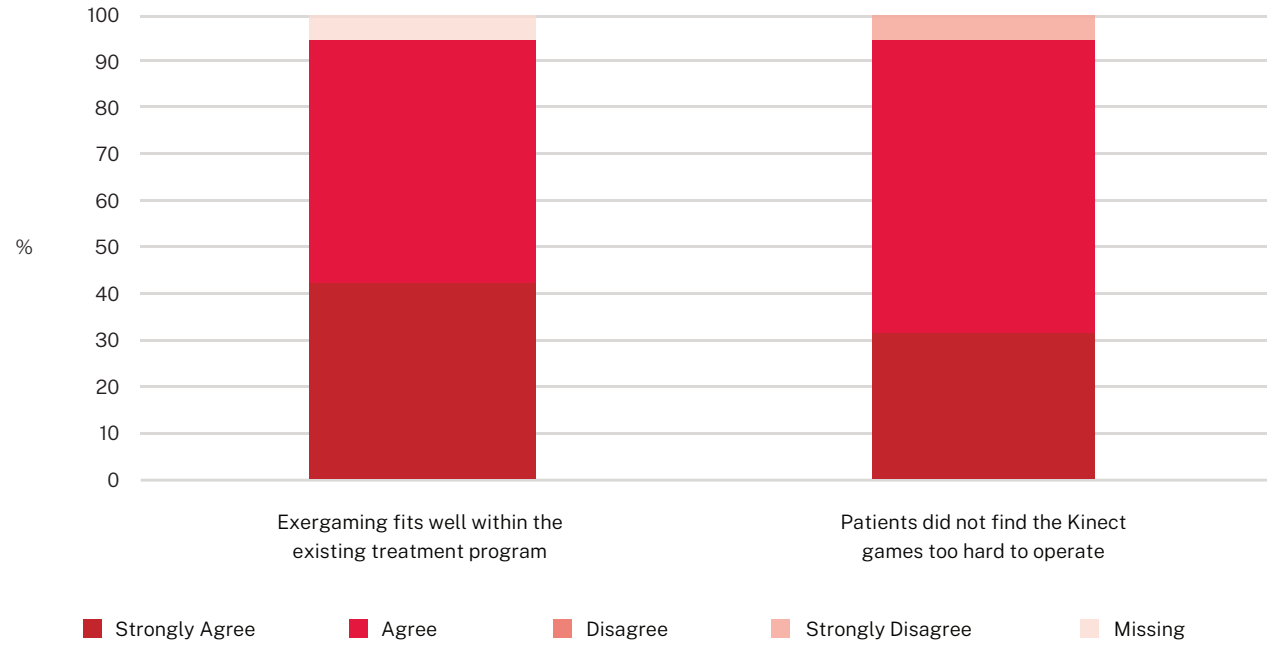
The staff acceptability survey was developed based on the theoretical framework of acceptability proposed by Sekhon and colleagues (54). The framework (v1) contained six constructs — burden, attitude, ethical consequences, opportunity costs, experience and intention — that can be used to measure the acceptability of a healthcare intervention.

In total, 19 staff members completed the staff acceptability survey. All were Justice Health NSW staff members and included registered nurses, clinical nurse specialists, managers and psychiatrists.

Burden

The construct of burden relates to the amount of effort required for the intervention (54). In the survey, questions on burden asked whether the program was a burden within the existing program and whether it was a burden to the patients. Overall, 94.7% of staff felt that the exergaming program fitted well within the existing program. Only a small proportion (5.3%) of staff felt that patients found the games too hard to operate, as shown in Figure 33.

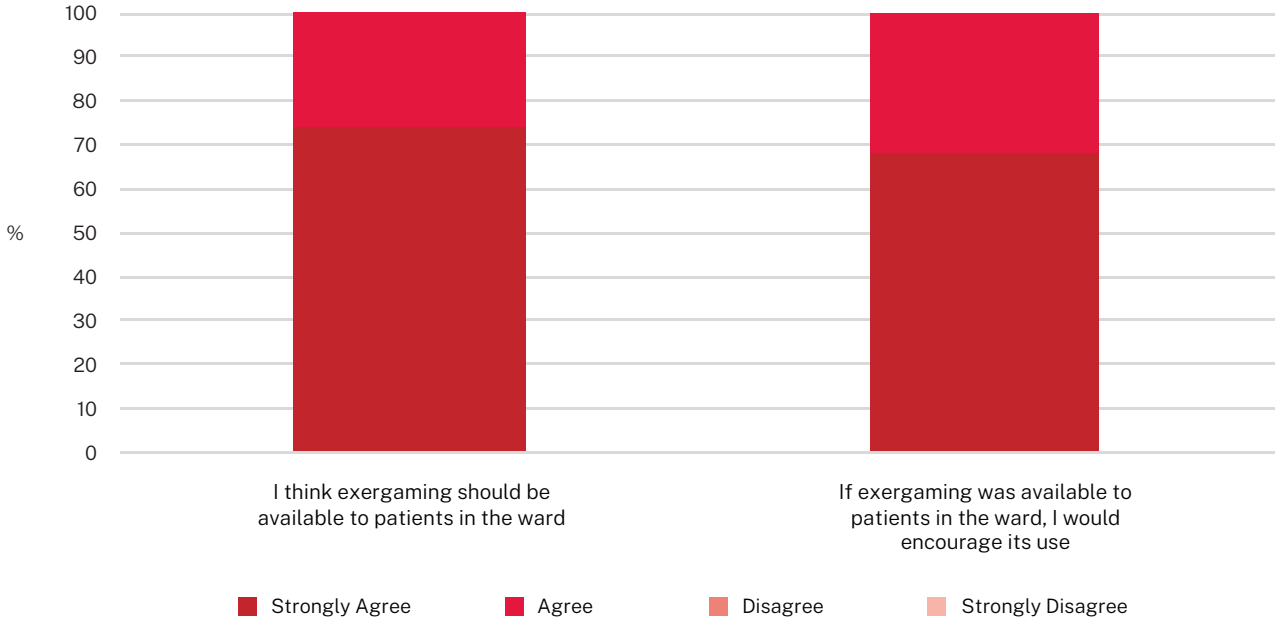
FIGURE 33
Burden



Attitude

The attitude construct relates to how an individual feels about the intervention (54). Overall, staff were positive about the intervention, with 73.7% and 68.4% strongly agreeing with statements around whether exergaming should be available and whether they would encourage its use, as shown in Figure 34.

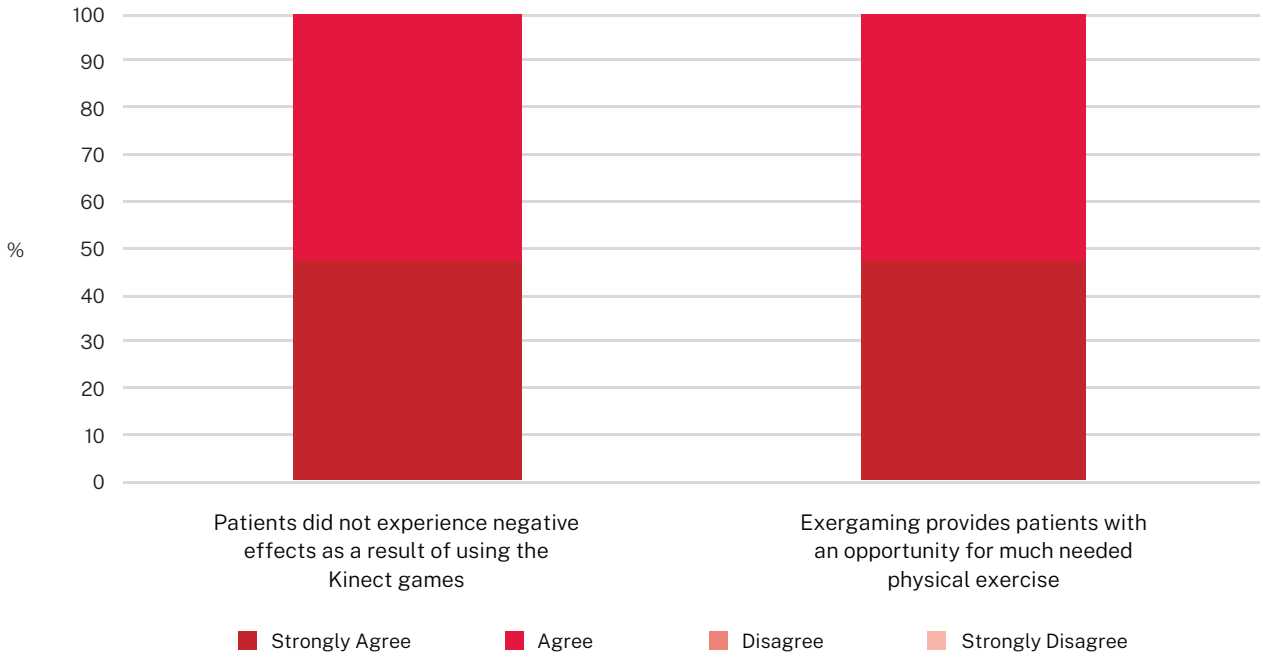
FIGURE 34
Attitude



Ethical consequences

The construct of ethical consequences is normally reported from the perspective of side effects related to an intervention (54). Within the survey, staff were asked about negative side effects and whether the intervention provided an opportunity for physical exercise. All of the respondents felt that participants did not experience negative effects due to the intervention and that the intervention provided patients with an opportunity for much needed physical activity. Overall, almost half (47.4%) of the respondents strongly agreed to these statements, as Figure 35 demonstrates.

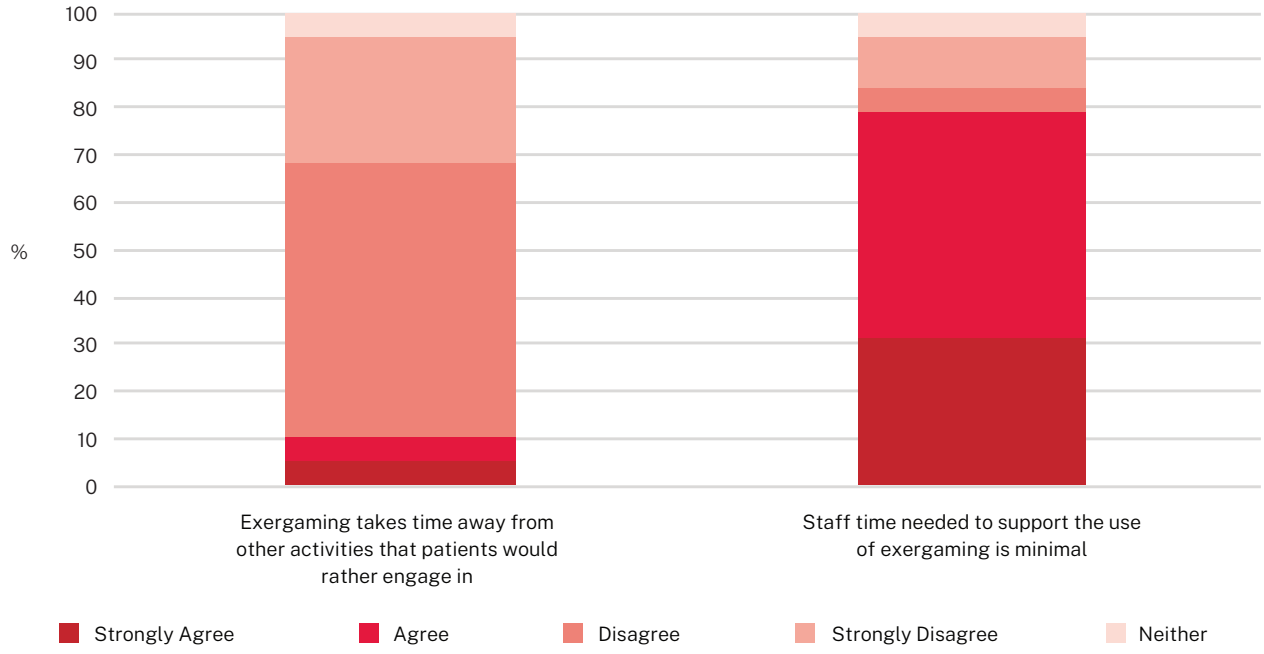
FIGURE 35
Ethical Consequences



Opportunity costs

The construct of opportunity costs relates to the extent to which other things have to be given up to engage in the intervention (54). The staff survey contained questions related to time for both patients and staff. Regarding patient time, 10.6% of staff felt that the intervention took time away from other patient activities. In addition, 15.8% disagreed that staff time to support the use of the intervention was minimal. One respondent clarified that they disagreed with this statement as they felt more staff time should be utilised. Overall, most respondents felt that the amount of patient and staff time given up was acceptable or minimal, as demonstrated in Figure 36.

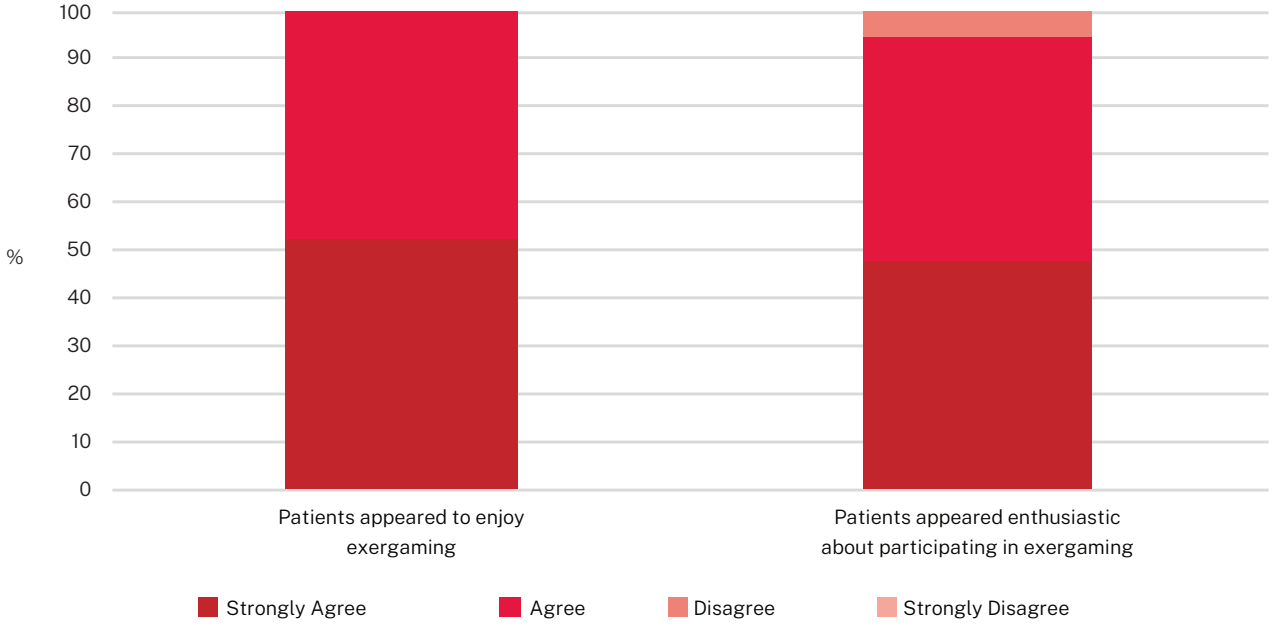
FIGURE 36
Opportunity Costs



Experience and intention

The construct of experience relates to participants' intervention experience, and intention relates to motivational factors that influence behaviour (54). Overall, all respondents felt that patients appeared to enjoy the intervention, with 52.6% strongly agreeing with the relevant statement. Regarding enthusiasm about participating in the intervention, the overwhelming majority (94.7%) of respondents felt that patients appeared enthusiastic about participating, as shown in Figure 37.

FIGURE 37
Experience and Intention



Comments

Staff were asked to provide comments concerning the acceptability of the intervention. Staff were also asked for any observations or recommendations about the project. Overall, staff felt that it was a beneficial physical activity program that the patients enjoyed. One staff member mentioned that it was great to see patients that were normally 'low profile' on the ward participate and 'gain confidence'. Other positive comments included:

'Due to lack of allied health services at the MHU [Mental Health Unit] it is very difficult to ensure patients have access to therapeutic activities. Exergaming can provide an additional program for the patients to improve activity and therapeutic engagement. I highly recommend this'.

'It was an excellent program for the patients who are at high risk of developing metabolic syndrome. Most patients in MHU are reluctant to exercise, but because of this program they felt encouraged and supported. All my patients gave positive feedback about the FIT HEART program and proudly told me about their improved physical fitness and weight loss. It also assisted them in engaging better with the treating teams. In my opinion this program should be expanded and all patients should have access to it. It helps improve their physical and mental well-being'.

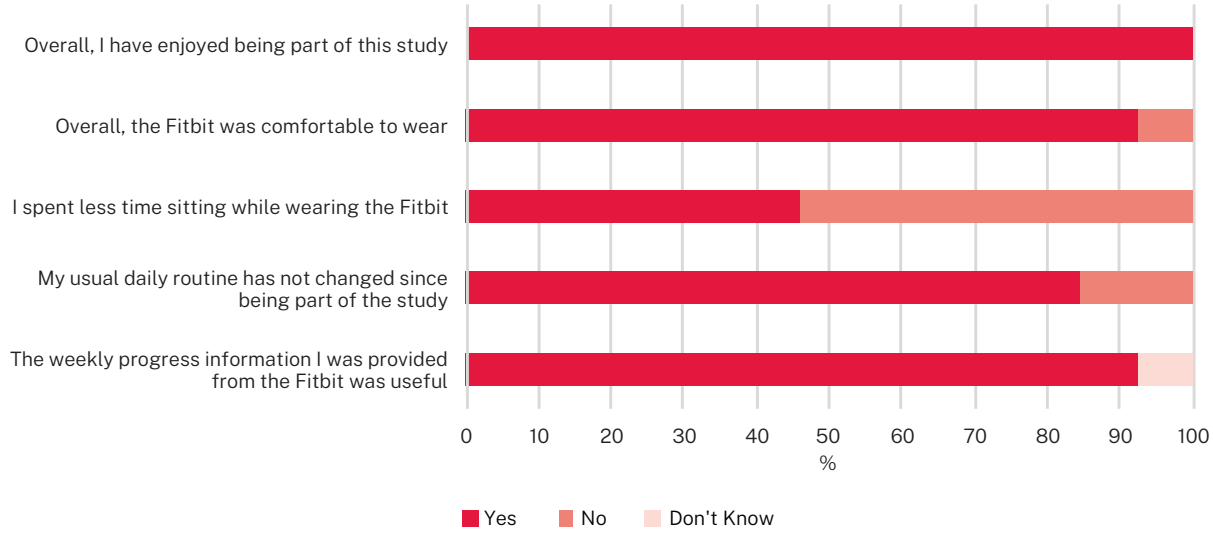
'Particularly impressed when one patient actually did lose weight and appearance improved. Unfortunately was amotivated and did not continue with regime once program ceased. Possibly need to ascertain how to encourage patients to maintain FIT HEART long term'.

'Patients using the games use the lounge area. I suggest a section for game use only. Patients may feel intimidation about using the common area. In the promotion of this activity I think it would encourage more positive response and involvement if it had its own area of use'.

Participants' Research Experiences

All the participants who completed the baseline assessment were asked questions regarding their experiences in the study. All participants reported that they enjoyed being in the study, with only a small proportion (7.7%; n=1) of participants reporting that the Fitbit was uncomfortable to wear, as shown in Figure 38.

FIGURE 38
Study Experience



Just under half (46.2%; n=6) of the participants reported spending less time sitting while wearing the Fitbit. However, this was more likely to be reported by the intervention group (60%; n=3) than the control group (37.5%; n=3). High proportions of both groups (80% intervention n=4; 87.5% control n=7) reported that their daily routine had not changed since being in the study.

Only a small proportion (7.7%; n=1) of participants refused to wear their Fitbit at times during the intervention period. The number of times a participant refused to wear the Fitbit compared to the number of times the Fitbits were offered to participants throughout the program was around 1%, indicating high acceptability of wrist-worn accelerometers.

Feedback: 'Things That You Liked About the Study'

Participants were asked what they specifically liked about the study. Some (n=6) participants stated they liked seeing how many steps they were doing, and a number (n=4) reported that it was something different/interesting. Examples of comments include:

Intervention participant: 'Playing on the Xbox, getting exercise and getting healthier'.

Control participant: 'Getting help with fitness, more encouragement'.

Feedback: 'Things That You Didn't Like About the Study'

Participants were also asked whether there was anything they did not like about the study. Overall, most (n=9) participants reported that there was nothing that they did not like. One participant from the intervention group reported that they found the exercise routine difficult at times. Another reported they did not like playing the games. One participant in the control group reported that they did not like taking the Fitbit on and off.

Additional Feedback

Finally, participants were asked whether they had any further comments regarding the project:

Intervention participant: 'Really good — novel way of keeping fit'.

Control participant: 'I enjoyed the study and hope that people can benefit from it in the future. It was run quite responsibly'.

Recruitment and Retention

Of the sample population, 19.7% were deemed not suitable to be approached, mostly because they were too unwell. A further 13.2% of the sample population were not approached as they either did not meet the inclusion criteria (5.3%) or were due to be discharged (7.9%).

At baseline, recruitment rates of eligible participants were 25.5% (19.2% intervention group; 36% control group). The retention rates from baseline to post-intervention were 53.9% (60% intervention group; 44.4% control group).

Protocol Adherence and Fidelity of Intervention Delivery

The FIT HEART program attendance rate was 70.7%. Of the recruited participants, compliance with wearing an accelerometer was very high (99.0%). There was only one participant, who on a few occasions during the 12 week intervention period, declined to wear his Fitbit. In addition, the fidelity of intervention delivery was high, with 97.2% of intervention components delivered as per protocol.

Feasibility

Based on the progression criteria established prior to the study commencing (see Table 1), it is not feasible for a larger FIT HEART RCT to be conducted in this setting. Although protocol adherence and the fidelity of intervention delivery were high, the recruitment and retention rates were well below the desired rates (Table 22).

TABLE 22
Feasibility outcomes

Progression criteria	
Recruitment	**25.5%**
Retention	**53.9%**
Protocol adherence	
Exergaming session attendance	**70.7%**
Compliance with wearing an accelerometer	**99.0%**
Fidelity of intervention delivery	**97.2%**

Discussion

The FIT HEART project is the first study to explore the feasibility and acceptability of an exergaming intervention within an inpatient mental health population, and as such has provided useful information around recruitment, retention and attendance rates and the acceptability of the intervention to patients and staff.

Feasibility

The FIT HEART recruitment rate was significantly lower than the rates reported in other studies. In a study of a 12-week physical health intervention in a prison psychiatric unit in Spain, the recruitment rate was reported to be 95% (56). In other prison-based studies, recruitment was reported as 75% (57) and 87% (58). Recruitment rates to physical activity interventions among participants with a mental health condition and within a forensic population varied from 27.5% to 94% (9, 59–61), as did recruitment within the general population, with rates from 25% to 95% (16, 55, 59). Although data were not obtained from patients that did not provide consent, comments obtained by researchers during the recruitment period included, 'I'm too old for that' and 'you don't play games in jail'. However, most just stated that they were not interested.

Although the retention rates did not meet the desired progression criteria, the FIT HEART retention rates are consistent with the literature. In physical health interventions conducted within a prison, forensic mental health or mental health population, retention rates ranged from 50 to 88% (9, 13, 16, 56, 62–63). In the Spanish prison psychiatric unit study (56), the retention rate in the intervention group was 52%, which is lower than the 60% seen within the FIT HEART intervention group. Among the participants that were not retained in the Spanish study, 40% dropped out due to a lack of interest in the intervention. None of the participants in FIT HEART dropped out due to lack of interest, which is consistent with the literature on exergaming interventions. The literature reports little to no drop-out due to lack of interest (25, 64–68).

The FIT HEART program attendance rate was consistent with the literature on physical health interventions. Attendance rates were reported as between 57 and 75% within a prison population. Within a forensic or mental health population, attendance rates were between 28 and 74% (9, 16). The attendance rates reported in the Spanish prison study (56) were slightly higher than FIT HEART at 78%.

Feasibility was measured based on progression criteria that were established prior to the study commencing. Overall, two of the four criteria were not met, indicating that it is not feasible to continue to a larger RCT.

Acceptability

Exergaming as a physical health intervention was deemed highly acceptable by the participants in the project and by the staff. Some participants refused to complete a couple of aspects of the project, including pathology, the modified YMCA Step Test and, less frequently, wearing the Fitbit. However, all participants were positive about their experiences. Throughout the project, none of the participants withdrew due to disinterest in the intervention or the project, a good indicator of acceptability.

Limitations

Several limitations need to be discussed.

Small Sample Size

Due to the small sample size, statistical analysis could not be performed. Therefore, we cannot demonstrate what effect the intervention had on the participants' physical and mental health outcomes. In addition, we cannot demonstrate whether any variances at post-intervention resulted from the intervention or other factors, such as medication. Of the participants who completed the program, 100% of the intervention group and 80% of the control group had their medications changed during the intervention period. This included changes in antipsychotic medications (62.5%) and medications for mood (37.5%), weight loss (25%), hypertension (12.5%), blood glucose (37.5%) and lipids (37.5%).

The small sample size also limits the generalisability of the results to the population of secure mental health unit patients.

Food Intake

Another limitation is that the intervention did not contain a component on nutrition, and no information was obtained concerning food items that the participants purchased through the buy-up system. The research team observed significant differences in what participants ordered. Some participants did not get buy ups and some ordered up to three bags of food each week. Purchased items included instant noodles, high sugar soft drinks, chocolate, lollies, biscuits, chips and flavoured coffee.

Validity of the Intensity Data

A resting heart rate was obtained for only 33.3% of the intervention participants that completed the program. Although a resting heart rate was detected in 100% of the control participants, this did not occur until Week 10 of the project. The results around intensity should be treated with caution, due to uncertainty as to what effect this had.

Other studies have found significant measurement differences when comparing wrist-worn and research-grade accelerometers. Dominick et al. (69) found that the Fitbit (not the same model used in FIT HEART) significantly underestimated the proportion of time in sedentary and light-intensity activity and overestimated METS and time spent in moderate and vigorous-intensity activity. A recent validation study of the use of commercially available accelerometers in exergaming also found that energy expenditure was overestimated when compared to research-grade accelerometers (70).

Implications for Practice and Future Research

Exergaming as a physical health intervention was deemed highly acceptable by the participants within the program and the staff at LBH MHU, and there were no major adverse events associated with it.

Exergaming was shown to elevate participants' heart rates above their normal daily routine and resting heart rate, which is consistent with the literature on exergaming.

In addition, exergaming was shown to elevate participants' heart rate to a moderate-intensity level.

Exergaming did not have a negative effect on depression, anxiety or stress, consistent with the literature on exergaming. However, information obtained about the actual system utilised in this project suggests that most participants had issues with operating the system. Such issues may not arise with the use of a different system.

Conclusion

Promotion of physical activity among mental health patients is extremely important due to their increased risk of metabolic syndrome. Exergaming was shown to be highly acceptable to both participants and staff.

The data obtained in this study are consistent with the literature on energy expenditure in exergaming. Off-the-shelf exergaming systems are relatively inexpensive and could be a good way to help promote physical activity within a secure mental health unit.

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