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The Stride program: Feasibility and pre-to-post program change of an exercise service for university students experiencing mental distress

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ABSTRACT

Rates of mental illness are disproportionately high for young adult and higher education (e.g., university student) populations. As such, universities and tertiary institutions often devote significant efforts to services and programs that support and treat mental illness and/or mental distress. However, within that portfolio of treatment approaches, structured exercise has been relatively underutilised and greater research attention is needed to develop this evidence base. The Stride program is a structured 12-week exercise service for students experiencing mental distress. We aimed to explore the feasibility of the program and assess pre- and post-program change, through assessments of student health, lifestyle, and wellbeing outcomes. Drawing from feasibility and effectiveness-implementation hybrid design literatures, we conducted a non-randomised feasibility trial of the Stride program. Participants were recruited from the Stride program (N = 114, M_{age} = 24.21 years). Feasibility results indicated the program was perceived as acceptable and that participants reported positive perceptions of program components, personnel, and sessions. Participants' pre-to-post program change in depressive symptomatology, physical activity levels, mental health-related quality of life, and various behavioural outcomes were found to be desirable. Our results provide support for the feasibility of the Stride program, and more broadly for the delivery and potential effectiveness of structured exercise programs to support university students experiencing mental distress.

1. Introduction

Mental illness is a broad term used to refer to illnesses that may affect a person's thinking, perception, mood, or behaviour. It has been reported that, across age groups, young adults (i.e., aged 18 to 25) often experience the highest rates of mental illness (McCance-Katz, 2019; McManus et al., 2016)—between 19.4 and 22.3% may experience anxiety disorders, between 8.3 and 12.4% may experience mood disorders, and between 7.1 and 18.4% may experience substance abuse disorders (Gustavson et al., 2018). The prevalence of mental illness among this population may be due, in part, to the transitions and 'life-changing' (see Luhmann et al., 2014) events that occur for many at this life stage and that present new stressors to young adults (Samouilhan & Seabi, 2010). These stressors can increase the risk of mental illness, and may include things such as developing financial independence, moving and living away from home, entering employment, and family or other relationship changes (Bulo & Sanchez, 2014). With particular relevance for our study, it is also recognised that young adults within post-secondary education institutions—including, for instance, colleges, universities, and technical institutions—may face additional stressors "(e.g., self-expectations, academic, transitioning to university, for a comprehensive list see: Hurst et al., 2013) not encountered by their non-student counterparts. The combination of stressors faced by young adult students has links to the development of mental illness (Lu, 1994) or mental

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distress—more broadly defined than mental illness, where a person may experience mental illness symptoms without being ill; and, for post-secondary students, mental illness can detrimentally impact their academic engagement (Kessler et al., 1995), academic productivity (Wang et al., 2007), and social relationships (Kessler et al., 1998).

The mental health challenges faced by students within tertiary institutions are well acknowledged—colleges and universities typically provide a range of supports and professional services designed to bolster students' mental health and treat or prevent mental distress (Browne et al., 2017). Support personnel or services often include on-campus medical professionals (e.g., general practitioners, mental health nurses, psychiatrists), psychologists, counsellors, and health promotion officers, teams, and programs. Several of these support services offer primary mental illness treatment options for students (i.e., pharmacotherapy or psychotherapy; American Psychological Association, 2015). However, researchers have reported that the capacity of these services is becoming increasingly stretched and that students may experience long waitlist times for treatment (Broglia et al., 2018). As such, there are several examples in the literature where tertiary institutions have offered further support to their students through additional programs or resources focused on treatment and prevention of mental illness or distress. Examples of interventions that have been successfully implemented in this respect include programs designed to improve student mental health literacy (Reavley et al., 2014), brief interventions for high-risk alcohol intake (Martens et al., 2007), and the use of mobile technology to improve mental health (Bendtsen et al., 2020). Despite this range of support personnel and initiatives, service utilisation is increasing and is beyond capacity in many instances. It is important, therefore, to continue to seek ways institutions may expand their portfolio of treatment strategies for mental distress (Oswalt et al., 2020).

Structured exercise programming is a well-established approach for supporting mental health and for complementing other mental illness treatment options. Exercise has been shown as beneficial to support young adults experiencing mental disorders (Pascoe et al., 2020)—structured exercise programming may play a role in the prevention and treatment of depression (Ravindran et al., 2016), anxiety (Stonerock et al., 2015), post-traumatic stress disorders (Hegberg et al., 2019), psychotic disorders (Mittal et al., 2017), and in reducing suicide attempts (Grasdalsmoen et al., 2020). Additionally, university students who regularly exercise (relative to those who do not) may experience, among other desirable outcomes, improvements in general well-being (Wickham et al., 2020), sleep quality and quantity (Gerber et al., 2014), and academic performance (Keating et al., 2013), along with a reduction in perceived stress and burnout (Baghurst & Kelley, 2014).

Despite the potential for exercise to complement other therapeutic interventions for students with mental illness, the literature documenting programs of this nature within tertiary education settings is not well developed. Few studies exist that document the structure, feasibility, and/or effectiveness of exercise or physical activity programs designed to support student mental health (see Ashdown-Franks et al., 2022; Keeler et al., 2019; Muir et al., 2020). The programs described in the above studies all use exercise as a component within the treatment of mental distress for students; they differ, however in their program components and implementation. These differences include, for example, entry or referral requirements (e.g., self-referred or medical referral), program length, session structure (e.g., exercise and behavioural therapy or exercise only), session length, session quantity (e.g., 6, 8, or 12 sessions), exercise choice (e.g., chosen or prescribed exercise), and peer involvement (i.e., use of students to deliver sessions or exclusively through an exercise professional; for a more detailed overview, see Jeftic et al., 2023). Despite these differences in program delivery, the interventions reported in these studies have provided preliminary evidence for positive mental health outcomes experienced by participants (i.e., students experiencing mental distress). The authors of these studies did not, however, couch their work within contemporary guidelines for effectiveness-implementation based research or report on adequately powered randomised controlled trials (Curran et al., 2012; Schulz et al., 2010). As such, there remains scope to advance our understanding of (a) how best to structure and implement such programs, (b) the feasibility of such programs, and (c) the primary and secondary outcomes that may be targeted in future trials of such programs, and (d) the magnitude of change on these outcomes that may be attributed to exercise program participation. With these considerations in mind, in this study we sought to present evidence regarding the feasibility (or implementation) and potential effectiveness (i.e., change over time on key outcomes) of an on-campus exercise program for university students experiencing mental distress or mental illness.

There are well-acknowledged recommendations designed to guide the conduct of feasibility studies focused on understanding clinical effectiveness and implementation strategies. Perhaps most notable for our investigation, Curran et al. (2012) provided a framework for identifying and designing 'effectiveness-implementation hybrid' studies. These authors outlined the ways through which investigators may frame feasibility efforts around a hybrid focus on both effectiveness (e.g., clinical outcomes) and implementation (e.g., delivery, acceptability, feasibility) considerations. Alongside Curran et al.'s model, there are also well-established guidelines for the conduct and reporting of feasibility and preliminary efficacy trials of health-related programs—allowing for accurate interpretation of the research and better trial replication (see Standards for Reporting Implementation Studies, Pinnock et al., 2017; CONsolidated Standards Of Reporting Trials—CONSORT—statement, (Eldridge, Lancaster, et al., 2016). By adhering to these recognised guidelines, it may be possible to improve the likelihood of successful future program implementation and scalability across tertiary institutions. At present though, there is little available evidence that draws from this methodological literature to document the effectiveness and implementation of exercise programming on tertiary campuses for student mental health. Accordingly, and in line with the recommended research stages involved in the development of complex interventions (Skivington et al., 2021), it is important to provide robust feasibility evidence for exercise programs of this nature. Work of this nature will not only help expand the evidence base with a view to the wider implementation of such programs, but also promises to offer important guidance for future randomised controlled trials.

Our study was couched within the Stride program—a peer-mentor-led exercise service that opened at The University of Western Australia in May 2020. We developed Stride as an adjunct treatment option for students experiencing mental distress or illness. In the design of the exercise program, we drew from best-practice exercise prescription principles (e.g., Vella et al., 2023), and the existing literature described above (Eldridge, Lancaster, et al., 2016; Pinnock et al., 2017). Stride is overseen by a Clinical Exercise Physiologist accredited by a relevant national accreditation body; entry within the program requires a referral from a support service or mental health professional, and students subsequently receive a free 12-week exercise program. Students referred to Stride complete a pre- and post-program mental and physical health assessment. Weekly exercise sessions are most commonly led by a postgraduate student in Clinical Exercise Physiology—in the most severe or high acuity cases, some students instead receive direct exercise mentoring from the coordinating Accredited Exercise Physiologist. The postgraduate students (or, in severe cases, the program coordinator) act as *mentors* within program and are referred to as such for the purposes of this study. The program was not designed as a primary *treatment* modality for mental illness but was and is intended as an adjunct support for students who are undertaking or waitlisted for other treatment, and to assist students with building positive physical activity and wellbeing strategies.

Our aim was to provide a comprehensive evaluation of the feasibility of the Stride program —and any pre-to-post program change participants experienced—using a framework based on a type 2 effectiveness-implementation hybrid study (see Curran et al., 2012). We developed

two co-primary aims. First, we sought to assess elements of feasibility regarding the implementation of a novel on-campus exercise program to support students experiencing mental distress or illness. Second, we sought to analyse pre-to-post program change with respect to relevant mental health, physical health, and various other program outcomes. Regarding feasibility assessment, we aimed to measure participant perceptions regarding key program elements (e.g., initial assessment, exercise sessions and information, mentor) as well as participant referral, drop-out, and retention indicators in line with recommendations on reporting feasibility trials (Eldridge, Chan, et al., 2016). We assessed participants' pre-to-post-program changes in depressive symptomatology, physical activity levels, physical health, confidence perceptions, quality of life, social identity, and lifestyle behaviours (i.e., sleep, dietary intake) to provide program outcome insight that is aligned with the types of outcomes reported on in similar research (for example, deJonge et al., 2021).

2. Methods

We designed and conducted a non-randomised feasibility trial using considerations for a type 2 effectiveness-implementation hybrid study (Curran et al., 2012). A type 2 hybrid study provides insight into the effectiveness of a clinical intervention (i.e., the Stride program) and the feasibility of an implementation strategy (i.e., elements of program feasibility as reported above and below). For design and reporting purposes, we also adhered to the CONSORT guidelines extension for non-randomised pilot and feasibility trials (Eldridge, Lancaster, et al., 2016). Feasibility trials are versions of a proposed main study, or large-scale program implementation, that allow for analysis of program and program component effectiveness. Feasibility trials such as the present study are recommended as a first step in understanding whether and how a program and its components promise to be effective (e.g., which appropriate procedures and tools) and can be implemented on a larger scale (i.e., using effect sizes found during feasibility testing) (Eccles et al., 2009). It should be noted that a priori power calculations are therefore often not completed for feasibility trials. However, informed by previous literature—an effect size of 0.58 for the effect of exercise on symptoms of anxiety (Stubbs et al., 2017), and an effect size of 1.24 for the effect of exercise on depressive symptomatology (Kvam et al., 2016)—and a cautious approach, a priori analysis was completed to *guide* the sample size. As such, a priori analysis for differences between two dependent measures (effect size = 0.45; alpha = 0.05; power = 0.95) resulted in a sample size of 55.

2.1. Recruitment

Our feasibility trial was conducted using a single on-campus exercise program for students experiencing mental distress or illness—the Stride program at The University of Western Australia. Participants in the research study did not include all program participants due to the nature of the recruitment method (i.e., the voluntary nature of the research procedures). Recruitment into the research study occurred after initial screening by the program coordinator—this process allowed for the coordinator to assess participants' capacity to understand research requirements and to gauge whether participation in the research study would present any harm to a student's mental health. The program was promoted across campus through flyers, emails, and word-of-mouth among other on-campus support services (e.g., medical, counselling, psychological, psychiatric, and student support services) and the student cohort (e.g., posters). Promotion took place primarily through on-campus support services due to the referral-based nature of the program. Referrals could be provided by any student medical or support services available on the university campus, or a student's external healthcare provider. However, involvement in the research procedures (i.e., where students consented to the study separate from involvement in the program itself) was not publicly advertised in any of these materials. Inclusion criteria for the research procedures were that participants were aged 18 or older and had passed an initial mental health screening assessment—outlined below—by the program coordinator. No specific exclusion criteria were set regarding demographics, type of mental distress or illness, or current types of treatment (e.g., pharmacotherapy or psychotherapy); however, the program coordinator did, at their discretion following an initial assessment, exclude participants on the basis of whether participation in the research component would adversely affect a participants mental health (e.g., the participant was experiencing severe mental illness and did not have the capacity to make an informed decision to participate in research).

2.2. Program description

A detailed account of the program description, program coordinator, mentors training and roles, and exercise session structure are available in the Supplementary Materials S1. In this section we provide a brief descriptions of the Stride program. Stride is a 12-week referral-based exercise program for students experiencing mental distress or illness. Program development was informed by existing exercise programs in other tertiary education settings (e.g., Ashdown-Franks et al., 2022; Keeler et al., 2019; Muir et al., 2020) and literature within the fields of behaviour change, health psychology, motivation, exercise prescription, and implementation science (Jeftic et al., 2023). Briefly, the program consists of an intake assessment by the program coordinator; a 12-week tailored exercise program delivered on-campus with a minimum of 12 exercise sessions (informed by recommendations for exercise prescription; Rethorst & Trivedi, 2013; Trivedi et al., 2011). Managed by either a postgraduate student in the field of sport science and exercise and health science or the Stride program coordinator (i.e., their mentor); and a final assessment by the program coordinator.

2.3. Procedure

Ethical approval was provided by The Human Research Ethics Committee at the first author's institution (RA/4/20/6055). Procedures for data collection were as follows. First, participants were referred into the program and were provided information about the program (i.e., program only, and not research activity surrounding the program) by the referrer. Second, program participants completed an intake assessment with the Stride program coordinator. The initial assessment included baseline measurements of mental health, physical health (e.g., physiological variables), and other program related outcomes (e.g., leisure time physical activity, social identity, or sleep; for specific measurement tools, see *Assessment of Pre-to-Post Program Change* below). Physical health measures included weight, height, dual x-ray absorptiometry (body fat percentage and lean body mass). Physiological measures included oxygen uptake and power output, grip strength, resting heart rate, physical activity levels, and blood pressure. Mental health was assessed via a self-report inventory of depressive symptomatology. Other variables measured in the initial assessment included quality of life, leisure time physical-activity, self-efficacy, sleep quality and quantity, social identity, attachment to university, and dietary intake of sugary and fatty foods. Following the initial assessment, the program coordinator informed the research team as to the student's capacity to consent to and participate in the research components surrounding the program. If the coordinator deemed that the research activity posed no additional mental health risk, the participant was then provided with an invitation to participate in the research study being conducted around the Stride program.

Participants who expressed an interest in the research study met with the first author and were provided with written information about the research requirements and the opportunity to ask questions. Participants were informed that participation in the research was voluntary, that their decision would not impact their involvement in the Stride program in any way, and that they could withdraw from research without

consequence (including for their involvement in the program) at any point. Participants were made aware that by providing consent to participate in the research they were also allowing the research team to access their intake and post-program assessment data. Research participants also completed a short baseline survey—in summary, reporting their age, sex, permanent residency status (i.e., domestic or international student), current university degree level, study load, year of study, residential status, relationship status, and questionnaires related to quality of life, self-efficacy, social identity, sleep, and dietary intake. Shortly after completion of the baseline survey and initial assessment, participants were assigned a mentor for the program duration (students and mentors who had a pre-existing relationship were not matched to one another; for further information, see Supplementary Materials S1). Mentors were exercise science postgraduate students who were purposefully selected to provide support to the participant (in cases of severe mental illness, the program coordinator occupied this mentor role). Participants then completed their 12-week exercise program working in partnership with their mentor.

During their first exercise session, research participants completed a survey assessing their perceptions of their intake assessment. Additionally, throughout the 12-week exercise program, participants completed fortnightly surveys assessing exercise session perceptions. At the conclusion of the 12-week program, the program coordinator conducted a final assessment that was identical to the initial assessment, and the first author provided the end-of-program survey for research participants—this survey included assessments of the participants' program perceptions and their perception of their mentor, and identical-to-baseline questionnaires related to their quality of life, self-efficacy, social identity, sleep, and dietary intake. A table detailing time of data collection is presented in Supplementary Materials S2. Participants who missed exercise sessions for a variety of unrecorded reasons were included in all data analyses. Participants who missed sessions were offered additional 'make-up' sessions to allow them to achieve a minimum of 12 sessions over a 12-week period; however, students were able to complete more than one session per week.

2.3.1. Assessment of feasibility

Feasibility measurements are presented in itemised form in each of their respective tables (e.g., Table 1 and Supplementary Materials S3).

Program referral process assessment. To assess the program referral process, data were recorded regarding the qualification of who provided the referral (e.g., a medical practitioner, a psychologist, a mental health nurse), the location the referral was received from (e.g., the on-campus medical centre), and reason for referral (i.e., the students' mental distress or illness).

Recruitment and drop-out rates. Recruitment rates were reported as participants who were referred into the program and subsequently engaged in the program. Drop-out rates (i.e., the proportion of students

Table 1
Participants' experiences in, and perceptions of the Stride program.

Item						
Initial Assessment	N		Mean (SD)		Agree/Strongly Agree (%)	
Was well organised	62		4.60 (0.61)		93.8	
Helped me understand what to expect from the Stride program	62		4.55 (0.64)		92.3	
Answered all my questions about Stride	62		4.69 (0.56)		95.3	
Was useful in introducing the Stride program	62		4.74 (0.54)		95.5	
Program Experiences		N	Mean (SD)		Agree/Strongly Agree (%)	
There were enough 1 on 1 sessions with my mentor		62	4.35 (0.87)		88.3	
I enjoyed the 1 on 1 time with my mentor		62	4.61 (0.71)		95.2	
The 1 on 1 sessions with my mentor were well organised		62	4.58 (0.71)		95.2	
The Stride program helped my academic performance		62	3.48 (0.88)		48.4	
The Stride program helped improve my mental health		62	4.06 (0.83)		79.0	
The Stride program is a useful component of on-campus mental health treatment		62	4.37 (0.81)		85.5	
If other students were having mental health difficulties, I would recommend the Stride program to them		62	4.48 (0.81)		88.7	
The Stride sessions were good for my mood and general well-being		62	4.40 (0.82)		88.7	
Mentor Perceptions			N	Mean (SD)	Agree/Strongly Agree (%)	
"My Stride mentor …"						
arranged session times that suited me			62	4.77 (0.46)	98.4	
was easily contactable			62	4.77 (0.49)	96.8	
is someone I like			62	4.74 (0.54)	95.2	
was caring			62	4.73 (0.55)	95.2	
took into account my needs and preferences			62	4.69 (0.59)	93.5	
provided a supportive environment			62	4.76 (0.53)	95.2	
provided an enjoyable exercise experience			62	4.76 (0.56)	93.5	
explored exercise options with me to find something I would enjoy			60	4.72 (0.52)	96.7	
was knowledgeable about exercise			62	4.81 (0.40)	100	
provided me with information about things that may influence my mental health (e.g., sleep, nutrition, relationships)			62	4.19 (0.90)	82.3	
helped my motivation for exercise			62	4.65 (0.60)	93.5	
explored exercise options for my transition out of Stride			62	4.52 (0.81)	87.1	
helped support me to be active outside of the Stride sessions			62	4.50 (0.88)	91.9	
I identify with my mentor in the Stride program			62	4.55 (1.59)	56.5	
Communication	N	1-2 (%)	2-3 (%)	3-4 (%)	4-5 (%)	5-6 (%)
On an average week, how many times a week were you in contact with your mentor?	62	50.0	37.1	8.1	3.2	1.6
Exercise Session Perceptions		N	Mean (SD)		Scored 5–7/7 (%)	
I am enjoying the exercise sessions very much		375	6.20 (0.90)		96.5	
These exercise sessions are fun to do		374	6.13 (0.90)		95.2	
When I am doing these exercise sessions, I think about how much I enjoy them		376	5.44 (1.27)		50.7	

Note: Initial Assessment, Program Experiences, and Mentor *Perception* items were scored 1–5, where higher scores denote more positive perceptions. Communication items were scored 1–6, where higher scores denote more frequent communication. Exercise Session Perception items were scored from 1 to 7, where higher scores denote more positive perceptions.

who started but did not complete the program) were also recorded.

Intake assessment perceptions. During the first exercise session (i.e., following the initial assessment) participants completed a 4-item questionnaire assessing their perceptions regarding the initial assessment. Items included *"The initial assessment was well organised"* and *"The initial assessment answered all my questions about Stride"*; a full list of items is available in Table 1. All items were scored on a 5-point Likert scale ranging from 1 *(strongly disagree)* to 5 *(strongly agree)*, with higher scores indicating more positive evaluations. All items were treated as separate continuous variables, and descriptively analysed.

Exercise session information. During exercise sessions, participants reported on the location of their exercise-session (i.e., where on campus); the type of exercise completed (e.g., resistance, cardiovascular, etc.); whether the session was individual or part of a group; the total duration of an exercise session, scored in intervals of *16–30, 31–45, or 46< minutes*; and their exercise participation intensity (on a scale of 1–10, where 10 is most intense). Also, mentors scored participants on their participation level of an exercise session (full, partial, or minimal participation). Items were descriptively analysed.

Enjoyment of exercise sessions. During exercise sessions, participants completed a fortnightly 3-item questionnaire assessing their perceptions of enjoyment. An example item is *"I am enjoying the exercise sessions very much"*—a full list of items is available in Table 1. All items were scored on a 7-point Likert scale ranging from 1 *(not true at all)* to 7 *(very true),* with higher scores corresponding to more positive evaluations. The three items were treated as separate continuous variables, and descriptively analysed.

Program perceptions. Within the end-of-program survey, participants completed a 5-item questionnaire assessing their perceptions regarding the program's overall usefulness, whether they felt the program had helped their wellbeing, academic performance, mental health, and their intention to recommend the program to other students. The development of this questionnaire was informed by previous feasibility work (see, for example, Budden et al., 2022). All items were scored on a 5-point Likert scale ranging from 1 *(strongly disagree)* to 5 *(strongly agree)*, with higher scores indicating more positive evaluations. Items were treated as singular continuous variables, and descriptively analysed.

Perceptions of mentor. Within the end-of-program survey, participants completed a 13-item questionnaire regarding their experiences with their mentor. Mentors were the key program facilitators for participants, and several items were required to provide comprehensive assessment of participants' perceptions of their mentor. Example items included *"My Stride mentor took into account my needs and preferences"*, "*My Stride mentor provided an enjoyable exercise experience"*; a full of items are available in Table 1. All items were scored on a 5-point Likert scale ranging from 1 *(strongly disagree)* to 5 *(strongly agree)*, with higher scores equivalent to more positive evaluations. The 13-items were treated as continuous separate variables and analysed descriptively. Additionally, participants completed a modified version of the Single Item Social Identification measure (SISI; Postmes et al., 2013). In this study, the item was worded as, *"I identify with my mentor in the Stride program"*. Respondents indicated the extent of agreement with the statement on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The item was descriptively analysed as a singular continuous variable. Finally, participants reported the average frequency of communication with their mentor, and responses were *<1, 1–2, 2–3, 3–4, 4–5, 5–6, 6–7, >7* times per week. Communication with the mentor was descriptively analysed as a singular continuous variable.

2.3.2. Assessment of pre-to-post program change

A brief overview of the assessment of pre-to-post program change is provided in this section, with further information available in the Supplementary Materials S3. By retrieving pre- and post-program data, collected within 14 days of the first exercise cession and within 14 days of a participant completing the Stride program, we assessed changes accompanying program participation in mental health symptomatology using QIDS-SR-16 (Quick Inventory of Depressive Symptomatology – Self Report; Rush et al., 2003). Scoring, for analysis purposes, was completed according to Rush et al. (2003) guidelines. Participants also self-reported on several other measures pre- and post-program that were used for the purposes of drawing inferences about possible, although not conclusive, preliminary program effects—these variables were (a) leisure time physical activity (Godin, 2011), (b) quality of life (Gandek et al., 1998), (c) response efficacy—a student's confidence about whether exercise would result in mental health improvement (3 item scale; Witte, 1996), (d) exercise self-efficacy—a student's confidence in their capability to engage in exercise (Bandura, 2006), (e) lifestyle self-efficacy—a student's confidence in their ability to change lifestyle behaviours impacting on their mental health (2 item scale), (f) barrier self-efficacy—a student's confidence in their ability to overcome exercise barriers (Jackson & Dimmock, 2012), (g) sleep quantity and sleep quality, (h) social identity (2-SISI; (Postmes et al., 2013), (i) attachment to university (school attachment, 3 items, Moody & Bearman, 1998; originally sourced from Bollen & Hoyle, 1990), and (j) dietary intake of sugary and fatty food, assessed using the Dietary Instrument for Nutrition Education (Roe et al., 1994). Additionally, anthropometric measurements including weight, body mass index (BMI), and body fat percentage and lean body mass using Dual Energy X-ray Absorptiometry (Haarbo et al., 1991) were collection, and physiological measurements including maximum grip strength (Fukumori et al., 2015), resting heart rate, blood pressure (calculated to mean arterial pressure; (DeMers & Wachs, 2022), and power output (W/kg) and oxygen uptake (VO_2) assessed using the Aerobic Power Index (Furzer et al., 2012)—chosen due to the increased degree of fatigue that people with mental distress or illness may be experiencing (Harvey et al., 2009).

2.4. Data analysis

Data analysis was completed using SPSS Statistics 27.0. Data were initially screened for missing values. Missing variables, subscales, or isolated items within a subscale due to participant failure to respond or missed session were not replaced; that participant was, however, excluded for analysis of that variable. Data analyses were conducted based on all available data. Participant demographics and responses to feasibility data (e.g., retention, program perceptions) were descriptive in nature. Internal consistency estimates for multi-item self-report measures (i.e., self-efficacy and attachment to university) were calculated using Cronbach's alpha. The magnitude of pre-to-post-program change in outcome variables is presented primarily in the form of Cohen's *d* effect sizes and is supplemented, for interested readers, using inferential paired samples t-tests. Pearson correlation coefficients are presented in Supplementary Materials S4.

3. Results

3.1. Participant characteristics

Demographic information is reported in more detail in Supplementary Materials S4. The average age of the 114 participants who completed the baseline survey was 24.21 years (SD = 6.33)—of those, 34 participants identified as male (29.8%), 79 identified as female (69.3%), and one participant identified as non-binary (0.9%). Most participants were domestic students (62.8%), studying at an undergraduate level (60.5%), full-time (87.7%), and reported single as their relationship status (66.4%). Most participants were in their first three years of any university degree (87.9%). Participants reported a wide range of living arrangements, with the majority living with family, friends, or their partner (60.2%). The majority of participants reported taking any form of medication (57%). To determine whether there were differences for those who ultimately completed (versus did not complete) the end-of-program survey, we performed an independent-

samples t-tests on a single continuous baseline variable (i.e., age) and crosstabulations on categorical variables (i.e., sex, domestic or international student, current university degree level, study load, year of study, residential status, relationship status, and medication status)—we observed no differences between end-of-program survey completers and non-completers for all variables. The results for these analyses are reported in Supplementary Materials S4.

3.2. Feasibility

3.2.1. Program referral process assessment

A total of 259 students (i.e., combined research participants and non-participants) were referred to the Stride program between May 20, 2020 and December 8, 2022 (representing the window of data collection for this study). We provide further detail on the referral process data in Supplementary Materials S4. Briefly, the most common qualification of referral provider was a medical practitioner, and 67.6% of all referrals originated from the on-campus medical centre. The reasons for referral most frequently included anxiety disorders (53.9%), mood disorders (34.5%), attention deficit/hyperactivity disorder (17.8%), and high levels of stress (12.4%). In 59.5% of referral letters, the referrer only specified one mental distress or illness, with the remaining 40.5% of referrals specifying two or more reasons.

3.2.2. Recruitment and drop-out rates

From the 259 students referred to the program, 155 were scheduled to attend an initial assessment with the program coordinator. Data were not collected from the 104 (non-attendee) students regarding their reason for not attending an initial assessment. Of the 155 students scheduled to attend an initial assessment, 27 either did not attend, or did not complete the assessment. The remaining 128 students completed the initial assessment and entered the Stride program—of which, 80 completed ten exercise sessions with their mentor, 60 completed twelve exercise sessions, and 37 students completed more than twelve exercise sessions. Additionally, of the 128 students who entered the Stride program following initial assessment, 65 students completed the final assessment (i.e., 63 did not attend). As such, the program completion rate was 47% (i.e., 60 of the 128 students who completed 12 or more sessions following an initial assessment). A flowchart depicting the program recruitment and drop-out rates is represented in Fig. 1. The research component was optional for students and, of the 155 who attended the initial program assessment, 37 did not provide consent to participate in the research, four were excluded by the program coordinator due to mental illness acuity, and 114 provided consent for research and completed the baseline survey. Of the 114 participants who completed the baseline survey, 62 participants completed the end-of-program survey. As a result, the research completion rate was 54% (i.e., 62 of the 114 participants who initially provided consent). A flowchart representing research participation and completion rates is represented in Supplementary Materials S5.

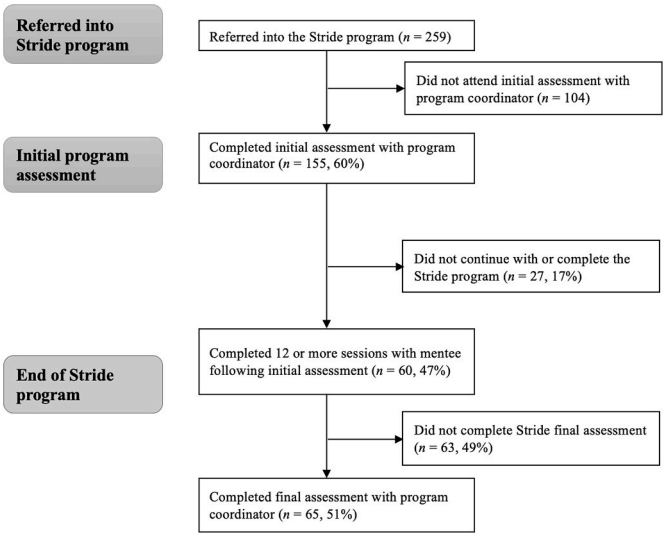

Fig. 1. Stride program flow diagram.

3.2.3. Intake assessment perceptions

Participants' perceptions of the intake assessment (following their first Stride session) are reported in Table 1. On average, across the four intake assessment items, 94.2% of participants agreed or strongly agreed with the statements. On a response scale ranging from 1 to 5, the mean score of these four items ranged from 4.55 (SD = 0.64) to 4.74 (SD = 0.54). Broadly, it appeared that the elements of intake assessment were considered satisfactory.

3.2.4. Exercise sessions

Exercise session data are reported in Supplementary Materials S5. More than one location and/or more than one type of exercise were possible for sessions, as such, percentage totals for location and type may summate to over 100%. The majority of exercise sessions were at the on-campus recreation facility (77.9%), with resistance training representing the most common type of exercise (74.3%). One-on-one exercise sessions (i.e., only student and their mentor) accounted for 88.9% of reported exercise sessions, with 89.8% of sessions completed at 'full' participation level as reported by mentor. Most commonly, exercise sessions lasted 46 min or more (60.4%), followed by sessions lasting 31–45 min (34.1%). On a scale ranging from 1 (*easiest*) to 10 (*hardest*), 71.4% of exercise sessions were rated between 6 and 8 for exercise intensity.

3.2.5. Enjoyment of exercise sessions

Exercise sessions were generally perceived as fun (M = 6.13, see Table 1), and participants reported strong exercise session enjoyment (i.e., 96.5% scored between 5 and 7 on the 7-point scale, M = 6.20). In response to the statement "*When I am doing these exercise sessions, I think about how much I enjoy them*", 50.7% of participants reported positively (an average score of 5.44).

3.2.6. Program perceptions

Descriptive data for program experiences and perceptions of program components are also reported in Table 1. Participants' perceptions of their experience in the Stride program were generally positive, with mean response scores across items ranging from 3.48 to 4.61 (range 1–5). The following program experiences are presented as a percentage of participants who responded *"agree"* or *"strongly agree"* to each item on the survey. The majority of participants felt there were enough one-on-one sessions with their mentor (88.3%), enjoyed the one-on-one time with their mentor (95.2%), and reported the one-on-one sessions with their mentors were well organised (95.2%). The majority of participants also reported that the Stride program helped improve their mental health (79.0%), was good for their mood and general wellbeing (88.7%), was a useful component of on-campus mental health treatment (85.5%), and that they would recommend the Stride program to other students experiencing mental health difficulties (88.7%). fewer than half of respondents (48.4%) felt the program helped improve academic performance (M = 3.48).

3.2.7. Perceptions of mentor

Data regarding mentor perceptions are reported in Table 1. Participants' perceptions of their mentor were largely positive, with mean scores ranging between 4.19 (SD = 0.90) and 4.81 (SD = 0.41) (on a 1-to-5 scale) for the 13 items. The majority of participants perceived their mentor to be easily contactable, and caring, and that they provided a supportive environment. All participants responded *"agree"* or *"strongly*

agree" that their mentor was knowledgeable about exercise. A smaller percentage of participants (56.5%) agreed or strongly agreed that they identified with their mentor (M = 4.55 on a 1-to-7 scale). Participants reported communication with their mentor between 1-to-3 times each week (i.e., 87.1% of responses).

3.3. Pre-to-post program change

Data for pre-to-post-program changes in mean scores, and associated standard deviations, paired samples t-tests, confidence intervals, statistical significance values, and Cohen's *d* effect sizes for each outcome variable are reported in Table 2. On average, participants reported a 3.87-point decrease from pre-to-post-program in their Quick Inventory of Depressive Symptomatology scores, which represented a large effect ($d = -0.78$) and clinical meaningful change (i.e., above the threshold of 3.75). Participants reported a 49.45% pre-to-post-program increase in their leisure-time physical activity (i.e., all physical activity inclusive of Stride sessions), equating to a medium-to-large effect ($d = 0.62$). Change on quality-of-life subscales were variable—for the physical health subscale we observed negligible change (a 0.89% increase, $d = 0.06$), and for mental health we observed a 38.76% pre-to-post-program increase, indicative of a large effect ($d = 1.04$).

Participants reported a large positive pre-to-post-program change in their *exercise self-efficacy* ($d = 1.19$), a small-to-medium-sized improvement in *lifestyle self-efficacy* ($d = 0.39$), and a medium -sized improvement in *barrier self-efficacy* ($d = 0.53$). We observed negligible change in *response efficacy* perceptions (i.e., their belief that exercise will improve mental health; $d = 0.08$). Internal consistency estimates were calculated for all multi-item self-report variables (see Supplementary S4) with acceptable internal consistency ($\alpha > 0.6$) at baseline assessment, and at minimum, high internal consistency ($\alpha > 0.8$) at follow-up. A small pre-to-post-program increase was observed for hours asleep each night ($d = 0.16$), and a medium-sized pre-to-post-program improvement was observed for the number of days participants felt they had a good sleep each week ($d = 0.45$). Of the two social identity measures, we observed a 28.14% increase in students' identification with their course, reflecting a large effect size ($d = 0.89$), and a 7.73% increase in students' perceptions of their identification with other students at the University, reflecting a small effect size ($d = 0.24$). A pre-to-post-program increase of 8.39% was observed for participants' perceptions of their attachment to university ($d = 0.45$). For dietary intake, there was a small-to-medium pre-to-post-program decrease in fatty food scores ($d = -0.33$), and a small pre-to-post-program decrease in sugary food scores ($d = -0.15$). In terms of anthropometric measurements, we

Table 2
Pre-to-post season changes on program (mental health, physical health, lifestyle, anthropometric, and physiological) outcomes.

					95% Confidence Interval of the Difference					
	M pre (SD)	*M post (SD)*	*M diff* (SD)	% change	Lower	Upper	*t*	*df*	*p*	***d***
Mental Health and Wellbeing										
Quick Inventory of Depressive Symptomatology	13.07 (4.96)	9.20 (4.99)	−3.87 (5.09)	−29.61	−5.17	−2.57	−5.99	60	<.001	**−0.78**
Physical Activity										
Leisure-time PA	26.25 (18.98)	39.23 (22.99)	12.98 (20.92)	49.45	7.58	18.39	4.81	59	<.001	**0.62**
Quality of Life										
Physical health (PCS; SF-12)	53.99 (8.42)	54.47 (7.07)	0.20 (6.51)	0.89	−1.47	1.87	0.24	60	.811	**0.06**
Mental health (MCS; SF-12)	28.35 (10.74)	39.34 (10.43)	11.00 (12.17)	38.76	7.87	14.11	7.05	60	<.001	**1.04**
Self-Efficacy										
Response-Efficacy	4.29 (0.62)	4.35 (0.86)	0.06 (0.96)	1.39	−0.19	0.31	0.45	58	.652	**0.08**
Exercise Self-Efficacy	2.89 (0.63)	3.48 (0.76)	0.59 (0.79)	20.42	0.63	1.03	8.49	60	<.001	**1.19**
Lifestyle Self-Efficacy	3.07 (0.79)	3.39 (0.84)	0.33 (0.93)	10.42	0.09	0.57	2.75	60	.008	**0.39**
Barrier Self-Efficacy	2.83 (0.75)	3.25 (0.83)	0.42 (0.80)	14.84	0.21	0.63	3.97	57	<.001	**0.53**
Social Identity										
Identify with students in course	4.62 (1.62)	5.92 (1.28)	1.30 (1.71)	28.14	0.86	1.73	5.93	60	<.001	**0.89**
Identify with students at UWA	4.48 (1.44)	4.84 (1.51)	0.36 (1.21)	8.03	0.04	0.68	2.28	57	.026	**0.24**
Attachment to university	2.86 (0.46)	3.10 (0.60)	0.24 (0.45)	8.39	0.13	0.36	4.19	58	<.001	**0.45**
Sleep										
Daily sleep quantity (in hours)	3.49 (0.74)	3.61 (0.80)	0.12 (0.69)	3.44	−0.06	0.29	1.31	60	.196	**0.16**
Weekly good sleep quality (in days)	3.23 (1.96)	4.07 (1.79)	0.84 (1.79)	26.00	0.38	1.30	3.65	60	<.001	**0.45**
Dietary Intake										
Fatty food score	19.26 (7.20)	17.06 (6.29)	−2.21 (6.31)	−11.42	−3.98	−0.43	−2.50	50	.016	**−0.33**
Sugary food score	4.21 (1.33)	4.02 (1.17)	−0.20 (1.39)	−4.51	−0.57	0.17	−1.06	50	.296	**−0.15**
Anthropometric Measurements										
Weight (kg)	72.99 (18.28)	72.24 (18.30)	−0.73 (4.41)	−1.03	−0.81	2.27	0.962	33	.343	**−0.04**
BMI	25.31 (6.25)	25.13 (5.72)	−0.19 (3.50)	−0.71	−1.41	1.03	−0.31	33	.756	**−0.03**
Body Fat %	32.67 (8.93)	32.47 (9.75)	−0.20 (3.31)	−0.61	−1.38	0.97	−0.36	32	.725	**−0.02**
Lean Body Mass (kg)	45.73 (11.60)	46.24 (11.77)	0.51 (1.50)	1.11	−0.03	1.04	1.94	32	.061	**0.04**
Physiological Measurements										
Max Grip Strength (kg)	36.21 (11.13)	35.05 (10.99)	−1.16 (7.18)	−3.20	−3.52	1.20	−1.00	37	.326	**−0.10**
Resting Heart Rate	78.42 (10.77)	78.67 (13.53)	0.24 (11.80)	0.32	−3.94	4.42	0.12	32	.907	**−0.02**
Mean Arterial Pressure (mmHg)	93.33 (7.91)	91.24 (6.73)	−2.10 (7.20)	−2.24	−4.49	0.31	−1.77	36	.086	**−0.28**
Power Output (watts/kg)	2.77 (0.55)	2.61 (0.55)	−0.16 (0.69)	−5.78	−0.57	0.26	−0.82	12	.428	**−0.29**

Note. All values (except *p* values) rounded to 2 decimal points. Positive differences for leisure-time PA, mental health (MCS; SF-12), physical health (PCS; SF-12), self-efficacy scales, social identity and engagement scales, sleep, and lean body mass items all represent positive increases. Negative differences for quick inventory of depressive symptomatology (QIDS-SR), weight, BMI, body fat %, and mean blood pressure represents positive reductions in scores. Reductions in fatty food and sugary food scores represent positive reductions. A positive difference for resting heart rate represents negative outcomes. Negative differences in max grip strength and aerobic power index represent negative outcomes. 61 participants provided responses to both baselines and end-of-program surveys including dietary information. 51 participants provided responses to both baseline and end-of-program surveys that did not include dietary information (due to mental illness concern). 33 participants were measured at their initial and final assessment for their weight and BMI, and 32 completed a DEXA scan to provide us with body fat % and lean body mass. 38 participants completed the maximum grip strength test during their initial and final assessment. 33 participants completed heart rate measurement during their initial and final assessment. 37 participants completed a blood pressure test during their initial and final assessment. 13 participants completed an aerobic power test their initial and final assessment.

witnessed negligible or small-but-inconsistent changes. We observed an average pre-to-post-program decrease in weight of 0.7 kg ($d = -0.04$), an average decrease in BMI of 0.2 units ($d = -0.03$), an average 0.2% decrease in body fat percentage ($d = -0.02$), and an average increase in lean body mass of 0.5 kg ($d = 0.04$). For physiological measurements, we observed an average pre-to-post-program decrease in maximum grip strength of 1.16 kg ($d = -0.10$), a 0.32% pre-to-post-program increase in resting heart rate ($d = -0.02$), a small-sized decrease in mean arterial pressure ($d = -0.28$), and a small-sized decrease in power output ($d = -0.29$).

4. Discussion

In broad terms, we found support for the feasibility of the Stride program, and beneficial pre-to-post program changes for participants. We assessed varied components relating to the feasibility of the Stride program—scrutiny of almost all components indicated that the program was feasible, and perceptions of the program implied acceptability. These results support previous studies in which program acceptability has been assessed (e.g., deJonge et al., 2021; Muir et al., 2020), which is noteworthy even in the face of several differences in the nature and delivery of the programs in question. For example, deJonge et al. (2021) reported positively on the acceptability of an exercise program which differed in terms of length of program and duration of sessions (6 weekly 1-h sessions), the design of sessions (i.e., 30-min physical activity and 30-min of coaching), and degree of mentor training. The comparison between these two programs highlights that there may be multiple routes to developing feasible exercise programs for this population, and that tailoring by institution involving co-design principles (Steen et al., 2011) may be an important consideration for scale-out efforts in this field (Aarons et al., 2017).

Although our data indicated that the intervention overall was considered acceptable and feasible, a closer inspection of data relating to program experiences and components (e.g., assessments, mentors, session structure) provides important additional insight. The initial assessment was viewed in a strongly positive way by students and may have had a positive effect on the engagement rates of students (e.g., Bombard et al., 2018). Additionally, students reported largely positive program experiences (e.g., that the program improved their general well-being, mood, and mental health)—which in itself may improve mental health (Mann et al., 2004). Furthermore, students' perceptions of their mentor and the exercise sessions were overwhelmingly positive. The mentors in the program were peers (i.e., university students)—the use of peer support workers has shown positive mental health outcomes for people experiencing mental distress or illness (Stubbs et al., 2016). Although the Stride mentors were not peer support 'workers', Lubman et al., (2017) reported that informal peer support may have positive effects on mental health. The use of a peer may also, at least in part, underpin the positive experiences students reported about their exercise sessions, not least due to potential reductions in barriers to engagement (Martin Ginis et al., 2013). It is important to note, for balance, that students reported relatively neutral perceptions (to the single item) regarding whether the Stride program helped their academic performance. For students and institutions, this may be noteworthy due to the potential negative effects of mental distress or illness upon academic performance (Eisenberg et al., 2009); future studies may be warranted that examine this outcome in more detail (e.g., by using more sophisticated assessments).

With respect to the assessment of pre-to-post program change, our lack of control group and randomisation means that any outcome-related conclusions regarding mental health changes must be considered as having coincided with or accompanied by (rather than being *caused by*) exercise involvement. We are also mindful that the nature of the program—typically operating contemporaneously alongside other treatment strategies—means that we are unable to isolate exercise-specific versus other (e.g., pharmacological, counselling-based, natural development, or social desirability) effects. Nonetheless, we found a large effect size for reductions in depressive symptomatology that aligned with involvement in Stride and that also align with literature documenting the effects of exercise on mental illnesses (e.g., Aylett et al., 2018; Firth et al., 2015; Hu et al., 2020). We also observed a large effect size showing increases in leisure time physical activity, improvements in the mental health component of quality-of-life, increases in exercise self-efficacy, and other positive outcomes including improvements in sleep quality and quantity and fatty and sugary food intake. Importantly, these secondary variables have also previously been shown to be related to varying degrees of improvement in mental illness (e.g., sleep: Scott et al., 2021; fatty and sugary food intake: Ventriglio et al., 2020). Taken together, therefore, we may tentatively conclude that involvement in this structured exercise program may hold potential for realising marked mental health improvements. An adequately powered randomised controlled trial is required to provide greater confidence as to the causal mechanisms and outcomes of such programs in the future—we hope this work will help to inform such trials.

In this study, we provided evidence that this exercise program was generally acceptable and may be associated with positive mental health outcomes for students experiencing mental distress or illness. We did not, however, obtain long-term follow-up data, and as such it is impossible to draw conclusions about relapse rates or any lasting changes to behaviour that accompanied involvement in the program. We encourage researchers seeking to test the effectiveness of such programs to integrate longer-term (e.g., 3-month, 6-month, 12-month) measurement points to advance our understanding further (Fitzpatrick et al., 2018). Additionally, the use of the QIDS-SR was an element of the Stride program that provided the program coordinator and mentors with substantial information on 9 domains of a students' mental health symptomatology. The 9 domains of the QIDS-SR (i.e., sleep, mood, appetite/weight change, concentration/decision making, self-outlook, suicidal ideation, involvement, energy level, and agitation/retardation) are often shared between different psychopathologies. For example, a person experiencing an anxiety disorder may have symptoms related to disturbances in sleep, mood, concentration, and energy levels, or a person experiencing psychotic disorders may present symptoms of negative self-outlook (American Psychiatric Association, 2022). However, a limitation of the QIDS-SR is that no reliability assessment is completed to identify and/or quantify severity of other psychopathologies. Nevertheless, in our study we supplemented the QIDS-SR with the mental health component of the Quality of Life Short-Form 12 questionnaire to better understand any pre-to-post program change on students' mental health in a general sense. We recommend researchers conducting future studies consider a measurement of mental illness that provides the exercise trainer with adequate information while having capacity to identify and quantify psychopathologies.

A feasibility trial is recommended prior to the scale-up, scale-out, or randomised controlled testing of an intervention in order to identify problems that may occur during further delivery (Craig et al., 2008). We recommend that more feasibility trials are implemented with an emphasis on varying key program elements (e.g., program duration, frequency of sessions) to better understand the implications of these for feasibility, engagement, and pre-to-post program changes. Following feasibility testing, randomised controlled designs progress our understanding of causal mechanisms and outcomes associated with interventions. We encourage those designing randomised controlled trials for exercise interventions with student populations to consider the nature of their chosen comparison (or control) arms (for important considerations, see Freedland et al., 2019). In doing so, researchers may also seek to examine individual components (e.g., program duration and frequency of sessions) or 'ingredients' with programs such as this (e.g., peer mentoring, exercise participation, or routine) with the goal of determining their independent and combined effects. Such work may be pursued, for example, using a self-determination theory lens (Deci &

Ryan, 2012) whereby the differential effects of certain motivationally-enriching elements (e.g., supporting autonomy or relatedness) are tested. And, although exercise has been shown to support different types of mental illnesses (Alexandratos et al., 2012), randomised controlled designs may assist in providing knowledge on the effects an exercise program on different psychopathologies for this cohort. We hope our findings not only underscore the value that exercise programs offer in the treatment of student mental illness, but also provide a platform for increased and more sophisticated research activity surrounding such programs.

CRediT authorship contribution statement

Ivan Jeftic: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Project administration. **Bonnie Furzer:** Conceptualization, Methodology, Writing – review & editing, Supervision. **James A. Dimmock:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Kemi Wright:** Conceptualization, Methodology, Writing – review & editing. **Timothy Budden:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Conor Boyd:** Conceptualization, Investigation, Writing – review & editing. **Aaron Simpson:** Writing – review & editing. **Michael Rosenberg:** Conceptualization, Writing – review & editing, Supervision. **Catherine M. Sabiston:** Conceptualization, Writing – review & editing, Supervision. **Melissa deJonge:** Conceptualization, Writing – review & editing. **Ben Jackson:** Conceptualization, Methodology, Writing – review & editing, Supervision.

Declaration of competing interest

As an author team, we declare one conflict of interest. Some of the authors of this manuscript were also involved in the design of the Stride program. However, this feasibility trial was conducted in adherence to CONSORT guidelines for feasibility trials, and we are highly confident that these stringent guidelines (e.g., reporting measures, providing access to data) will have ensured that any conflict of interest could not have interfered with the integrity of the study or its data.

Data availability

Data will be made available on request.

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Appendix ASupplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.psychsport.2023.102507.

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