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Physical literacy-based intervention for chronic disease management: a quasi-experimental study protocol

Alexandre Mouton[1*], Jean-Pierre Weerts[1] and Johannes Carl[2]

Abstract

Background As chronic diseases proliferate globally, innovative interventions that promote sustainable physical activity are crucial. Physical literacy offers a holistic strategy for the promotion of lifelong health. This protocol describes a study investigating the effects of the integration of physical literacy principles in community-based physical activity group sessions in adults with chronic diseases. The primary outcome of this study is the physical literacy level (global physical literacy score and sub-scores) of participants.

Methods This quasi-experimental study will compare three groups: a control group, a group taking part in traditional physical activity (TPA) group sessions tailored for adults with chronic disease focusing on physical fitness general improvement, and a group taking part in TPA sessions that incorporates physical literacy goals and intervention content in line with 6 core dimensions of physical literacy (TPA + PL). Intervention groups will take part in 12 one-and-a-half-hour sessions organised weekly over a 3-month cycle. The study will assess the impact of these interventions using a mixed qualitative and quantitative physical literacy assessment tool at baseline (physical tests for the physical competence dimension; questionnaire for the 5 other core dimensions), three months (post-intervention), and six months (follow-up).

Discussion This studypresents an innovative intervention for chronic disease population through physical literacy, hypothesising that integrating physical literacy dimensions in tailored physical activity group sessions can significantly improve physical literacy to improve physical activity sustainability and health outcomes. Results from this study will provide insights into the efficacy of physical literacy interventions compared to traditional approaches, potentially guiding future public health initiatives and chronic disease management strategies.

Trial registration NCT06325306 (21/03/2024).

Keywords Physical literacy, Chronic disease management, Tailored physical activity, Study protocol, Health promotion, Multidimensional intervention

*Correspondence:
Alexandre Mouton
alexandre.mouton@uliege.be
[1]Department of Physical Activity and Rehabilitation Sciences, RUCHE–Research Unit for a life-Course perspective on Health & Education, University of Liege Allée des Sports, Liège 4: 4000, Belgium
[2]Institute for Physical Activity and Nutrition (IPAN), School of Health and Social Development, Deakin University, 221 Burwood Highway, Burwood, VIC 3125, Australia

Background

The generalisation of sedentary and inactive behaviours, observable across all age groups, has emerged as a significant health concern from the individual to the societal levels [1, 2]. Despite the well-known health benefits of physical activity (PA), a concerning majority of the global population does not adhere to international PA recommendations [3]. Physical inactivity puts adults at greater risk of cardiovascular diseases such as heart attacks and strokes, type 2 diabetes, dementia and cancers such as breast and colon [4]. Known as non-communicable diseases (NCDs), those chronic diseases are characterized by non-contagious nature, multiple risk factors, a long latency period, a prolonged temporal course, functional impairment or disability, and incurability (i.e., a complete cure is rarely achieved). Chronic diseases account for over 41 million deaths annually, representing 74% of all global deaths. The four most common types of NCDs are cardiovascular diseases (including heart disease and stroke), which cause 17.9 million deaths each year, cancer (9.3 million deaths annually), chronic respiratory diseases (such as chronic obstructive pulmonary disease and asthma) at 4.1 million deaths per year, and diabetes mellitus, responsible for 2.0 million deaths annually [5]. PA, when maintained consistently over the long term, is heralded as a primary agent for health prevention, taking a pivotal role in effectively preventing and treating chronic disease [6].

Strategies aiming to promote PA have not yet exhausted their full potential effectively, with an observed population decline in daily PA influenced by multifaceted factors ranging from individual determinants to broader societal and institutional frameworks [7–9]. Among individuals diagnosed with chronic diseases, a significant number abstain from exercise regimens, with others discontinuing or failing to maintain regular, self-directed PA during subsequent phases [10]. Holistic and patient-centred approaches that take into account the unique characteristics of each participant, are essential to achieve lasting behaviour change [11, 12]. Others have emphasized the need to go "beyond the plateau" [13] advocating for strategies to bridge the gap between formal rehabilitation and the integration of exercise into daily life within community settings. This approach suggests a shift towards creating a seamless continuum of care that supports individuals not just in the recovery phase but also in the longer-term adoption of an active lifestyle [14]. Taking into consideration a broader range of determinants of PA participation, such as psychological, social and environmental factors, is therefore largely recommended [6, 15].

In response, the evolving paradigm of 'physical literacy' (PL) has gained momentum. Defined as "the motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in physical activities for life" [16], PL encompasses physical, psycho-social and cognitive dimensions, reinforcing a lifelong commitment to an active, health-conscious lifestyle [17]. Interpretations and operationalisations of this concept differ [18], but the overarching philosophy envisages PL as a lifelong journey, dynamically evolving based on individual trajectories. PL share several conceptual overlaps with other behaviour change theories applied to PA promotion in general and chronic disease populations. For example, the COM-B model (Capability, Opportunity, Motivation– Behaviour) posits that behaviour (such as engaging in PA) is driven by an individual's capability (physical and psychological), opportunity (physical and social), and motivation (automatic and reflective). The physical competence dimension of PL aligns closely with the 'capability' component of COM-B, while motivation within PL mirrors the COM-B model's focus on both reflective and automatic motivational drivers [19]. However, our decision to use PL as the guiding framework for this study rather than COM-B is due to PL's comprehensive focus on long-term engagement and the intrinsic value of movement. PL uniquely emphasizes the integration of PA into a person's identity and lifelong practice, which is crucial for sustainable behaviour change, especially in chronic disease management. While the COM-B model is excellent for identifying the components necessary for immediate behaviour change, PL encompasses not only the behavioural aspect but also the cognitive, emotional, and social dimensions of PA, making it a more holistic framework suited to our long-term intervention goals. Recognizing the health potential of PL [20, 21], we focus in this study on its contributions to the foundation of sustainable active lifestyle.

Historically, the discourse around PL has been predominantly anchored in developed, English-speaking countries such as Australia, the UK, and the USA [24, 25]. Within Europe, efforts have been made to promulgate the concept, as evidenced by a collaborative publication underscoring the necessity for age-specific PL measurement tools [22]. Despite the heterogeneous situation across Europe, a recent state of implementation in research, practice and policy analysis has uncovered similar challenges among the countries [23]. Unfortunately, existing validated metrics have been disproportionately skewed towards school-aged populations, predominantly young children [24]. Preliminary findings among younger populations suggest that individuals with higher PL scores are more likely to meet PA guidelines and exhibit lower levels of sedentary behaviour [25]. At present, only a few studies extend research on PL to adults and almost none cover older adults or those with chronic diseases [26, 27]. Furthermore, there is a greater emphasis on the physical domain of PL, whereas the affective, cognitive, and behavioural domains in the actual studies are

underrepresented [21]. First, PL interventions exposed significant effects on all main outcomes of PL, with the strongest effects were found for the physical domain, followed by (in descending order) cognitive, behavioural, and affective domains [28]. This imbalance in research and outcomes points to a need for more holistic investigations into all facets of PL [29].

While young populations have been the primary beneficiaries of physical literacy-centric interventions, adults also require tailored tools and interventions [30, 31]. To date, existing scientific literature concerning PL in a health context remains scant [21]. PL in health care setting is then identified as one of the "blank spots" for exploration in the field [32]. There is a significant lack of evidence in populations such as individuals with chronic diseases. Additionally, the concept of PL has not yet been fully embraced in practical applications by healthcare practitioners, indicating an opportunity for growth in incorporating this construct into healthcare education and clinical practice.

As the interest over PL in the field of public health grows, Cairney et al. [20] highlighted the need for the generation of new research questions and the possibility of broadening impact beyond the context of physical education by positioning PL as a determinant of health. The present study has been designed taking into consideration the results of a pilot study undertaken in medical centres in patients with chronic diseases [33]. Participants, referred by healthcare professionals, underwent two face-to-face counselling sessions with a PA professional, setting PL-development goals based on motivational interviewing techniques. Initial results revealed significant improvements in overall PL and the cognitive and physical domains, but not in the psychological and social domains. The relatively small sample size, combined with the short duration of the intervention, could explain the lack of significant improvements. To offer a more long-term solution than one-off consultations and overcome those limitations, the goal of the present study is to explore the effects of the integration of PL principles in community-based PA group sessions in adults with chronic diseases. Primary outcomes are the PL level (global PL score and sub-scores) of the participants. As a sub-aim of this study, we also seek to contribute to the development of a suitable assessment for measuring PL among adults with chronic diseases who participate in group PA sessions.

Methods

Study design

A quasi-experimental approach will be adopted for this investigation, focusing on chronic disease patients enrolled in PA group sessions. We will follow the guidance for protocols of clinical trials to elaborate our study (SPIRIT 2013 checklist; [34]). The Physical Literacy Interventions Reporting Template (PLIRT) will be used to organise the conceptualization and reporting of this intervention [35]. The 16-items PLIRT for mixed-methods studies was designed by experts in the field to facilitate improved transparency in and interpretability of reports on PL interventions. Our Checklist (see additional file 1) provides a systematic statement of the consideration of each item of the PLIRT.

This study will use a quasi-experimental design with three distinct arms: one control condition (no intervention) and two experimental conditions, each aimed at examining different types of intervention for chronic disease management: a condition where participant take part in traditional physical activity (TPA) group sessions tailored for adults with chronic disease focusing on physical fitness general improvement, and a condition where participants take part in TPA sessions that incorporates PL goals and intervention content in line with 6 core dimensions of PL (TPA + PL). This quasi-experimental design was chosen for this study due to the practical and logistical constraints of working with existing community groups in real-world settings.

Participant and recruitment

For the current study, all participants will be recruited from the 'Citoyen, en mouvement pour ma santé' (translation: "citizen, moving for my health") program, a joint initiative by the University Hospital of Liège and the University of Liège. This program targets adult individuals with chronic diseases, offering PA sessions in community settings within the Wallonia-Brussels Federation.

Eligibility criteria for participation in the study include being at least 18 years old, having a least one chronic disease diagnosis, possessing a medical clearance to participate in physical activities, and 'being enrolled in the 'Citoyen, en mouvement pour ma santé' program. There is no strict restriction on the type of chronic disease for participation in the program. However, based on our experience from the previous study [33], the majority of participants will be affected by one or more chronic health conditions, such as cardiovascular diseases, type 2 diabetes, chronic obstructive pulmonary disease (COPD), low back pain, and obesity. Additionally, participants are expected to autonomously attend and engage in physical activities as part of the intervention. Informed consent will be obtained from all participants prior to the start of the study.

This recruitment approach is pragmatic, considering the availability of participants and the logistical aspects of organising group-based interventions in community settings [36, 37]. It also allows for an examination of the interventions within a real-life context, which is critical

for understanding the applicability of the findings in public health practice [38].

Local intervention groups will be randomly assigned to one of the intervention conditions using a randomization protocol. It means that there is no randomization at the individual level; participants are allocated to the groups based on practical and logistical considerations (participants attend the intervention proposed in their local community). By assigning local intervention groups to different study conditions (block randomisation), the quasi-experimental design allows us to evaluate the effectiveness of the intervention in a manner that reflects natural group settings, thus providing valuable insights into how the intervention may function in typical, non-controlled environments. To achieve the required sample size, we expect to recruit participants across 4 to 5 local sites for each intervention condition. Additional file 2 provide with a structured description of the study arms using the TIDieR checklist.

Control group (CONTROL)

Participants in this group will not receive any specific intervention during the study. This "waiting-list" control group comprises individuals registered to join the program after the study period, providing a baseline for comparison with the intervention groups. This approach ensures ethical best practice by eventually offering all participants access to the program. Participants assigned to the control group will not be permitted to enter either of the intervention groups at any point during the study.

Intervention groups: traditional physical activity (TPA) and physical literacy oriented traditional physical activity (TPA + PL) programs

The recruitment for intervention groups will consist of voluntary individuals from local communities that are already actively running the program. In order to ensure optimum comparison between the intervention conditions and minimize therapist effect, the same and unique physical educator will supervise all sessions. The physical educator holds a master's degree in both physical education and physiotherapy, with specialized training in exercise therapy and motivational interviewing. During the intervention, 12 one-and-a-half-hour sessions will be organised weekly over a 3-month cycle. The first session is primarily focused on the PL assessment, followed by a comprehensive introduction to physical conditioning exercises. In each of the subsequent sessions ($n = 10$), Participants will receive an intervention focused on the development of their physical fitness. Only the incorporation of explicit PL-oriented content (see Table 1) will differ between those two conditions. The physical educator will use common base of standardised program in those two groups, considered as "care as usual". Each session will commence with a fifteen-minute warm-up comprising of a blend of cardiovascular and joint mobilisation exercises. The warm-up routines will vary from one session to another to expose participants to a range of activation techniques, diversifying their practices. The core part of each session, lasting around one hour, will be dedicated to session-specific exercises targeting key physical competencies such as endurance, strength, flexibility, and balance, along with other motor and

Table 1 Detailed overview of the PL-oriented tailored physical activity program (TPA + PL) content

Session *n*°	Goal	PL-oriented content focus
1	Pre-intervention PL assessment	30 min of LP evaluation; group divided into two: 15 min of questionnaires for group 1 and 15 min of physical tests for group 2 and vice versa.
2–7	(1)+(2)	1. Raise awareness of current personal physical activity (PA) habits in playful form. 2. Encouragement to practice through the provision of monitoring tools (watches, pedometers, home exercises, calendars) inviting participants to initiate the practice of PA outside the session.
3–8	(1)+(3)	1. Information and awareness about PA in and its dimensions (types, recommendations, benefits). 2. Exchange on the physical environmental offer (park, trails, sport facilities, etc.) and social (sports group, association, etc.) of AP available at local level.
4–9	(1)+(4)	1. Experimentation of collective/cooperative exercising situations (pairs or groups). 2. Invitation to extend practice outside the sessions by involving the entourage; awareness of the participant's potential role as an PA initiator. 3. Invitation to practice between participants beyond the session cycle.
5–10	(1)+(5)	1. Collective identification of key barriers to participant PA; valuing the progress of each. 2. Role-playing, taking responsibility of the participants in the session to increase the perception of skills.
6–11	(1)+(6)	1. Sensitisation of the participant towards PA who have meaning in his daily life. 2. Diversification of exercise modalities (music, groups, new formats) to solicit pleasure. 3. Autonomous choice of exercises and modalities by participants
12	Post-intervention PL assessment	30 min of evaluation LP: Group divided into two: 15 min of questionnaires for group 1 and 15 min of physical tests for group 2, and vice versa.

Legend: [1] Physical competence [2] Physical activity behaviour/engagement in physical activity [3] Knowledge/understanding [5] Motivation and confidence for physical activity [6] Environment interactions [6] Meaningful/purposeful activities

physical skills. A variety of training accessories including elastics, medicine balls, Swiss balls, and mats, as well as diverse conditions like music, room arrangements, and both individual- and group-centred exercises, will be employed by the PA professional. The size of the group will never exceed the number of 15 participants. At the conclusion of each session, participants will be guided through a return-to-calm sequence that included stretching and relaxation exercises. This time also provide an ideal opportunity for participants to express their feelings about the activities and their overall relationship with PA. During those recovery periods and exercises, the instructor will not only provide guidance on correct exercise execution but will also highlight the "everyday relevance" of each exercise and the opportunities for applying them in daily life. The health benefits of exercise and regular PA will also be discussed [39]. The final session is reserved for the end-of-cycle assessment and concludes with a socially oriented activity, notably a "social tea."

Physical literacy oriented traditional physical activity (TPA + PL) program specificities

In this group, participants will take part in a traditional PA program that incorporates PL elements (see Table 1). This arm will explore whether the addition of PL components can offer any additional benefits to the TPA approach. All sessions will be designed in accordance with the principles outlined in the PLIRT [35]. A particular and explicit emphasis on PL dimensions will be added during the sessions. While the dimension of physical competence is consistently incorporated into the sessions, the remaining five dimensions are addressed twice over the course of the semester with the setting of specific goals and intervention content.

Other PL domains are only explicitly addressed by the educator as a reminder of previous objectives and content. This could involve quizzes or games integrated into circuits or exercise workshops, role-play exercises simulating real-life situations, or social interactions between participants with a particular focus on PL-related topics. In addition to the sessions, a follow-up telephone call will be scheduled between the educator and each participant in the TPA + PL group during the two weeks following the initial PL assessment. These conversations will aim to share individual PL assessment results and assist participants in setting person-centred goals using a motivational interviewing technique [40]. Goals could relate to any of the PL dimensions, depending on the motivation of each participant.

Materials and instruments

Along with our aim to identify suitable assessment tools for PL among adults, particularly chronic disease patients, a comprehensive literature search has been conducted. It became evident that there are limited validated tools specifically for this demographic in the current literature. Most existing instruments are self-reported and primarily focus on the physical domain of PL [32]. These tools are not designed to provide follow-up data on PL that is readily usable by health professionals in the sector [41].

The preliminary tool used in our previous PL intervention delivered in a medical centre setting [33] will also be used as a reference. This tool includes a 40-item questionnaire and 4 physical tests, divided into 4 domains of PL (psychological, social, cognitive, physical), and allows the calculation of a global PL score. However, considering the broader scope of components to be framed in PL among adults highlighted by the recent literature, we decided to extend our initial assessment.

For this study, our assessment tool will integrate six core dimensions of PL, highlighted as the most frequent components of PL in studies among aging adults [27]:

- Physical activity behaviour and engagement.
- Physical competence.
- Motivation and confidence.
- Knowledge and understanding.
- Social interaction.
- Meaningful and purposeful activities.

Our tool (see additional file 3) incorporates closed-ended questions for each of the six dimensions, offering a concise score to track participants' progress in each dimension and in a global score of PL. As far as possible, items were extracted from existing validated tools. Open-ended questions are also included to stimulate discourse on PL, providing a platform for more personalised advice from the PA educator. Carl et al.'s recent work [32] highlighted the significance of qualitative assessment components as a prevailing gap in PL research.

Physical activity behaviour and engagement

PA behaviour and engagement represent a critical dimension of PL that refers to the frequency, intensity, and regularity with which individuals participate in physical activities. It involves making conscious choices to integrate PA into daily routines, reflecting an individual's dedication to health and well-being. In our study, this dimension is assessed using questions from the International Physical Activity Questionnaire - Short Form (IPAQ-S; [42]). It is a validated tool designed to assess PA levels in adults. It captures data across various intensities, including walking, moderate, and vigorous activities, over the preceding 7 days. The questionnaire comprises seven items, encompassing domains such as work-related, transportation, domestic, and leisure-time activities. For the purpose of this study, we decided to only integrate

in our questionnaire the six items allowing the calculation of total weekly PA by computing metabolic equivalent (MET) minutes per week. An extra item was added to provide with the number of days performing muscle-strengthening activities, making it possible to compare the results obtained with the WHO international recommendations for PA in adults [3]. The open-ended question related to this dimension will ask participants what (quality) physical activities they currently practice during their leisure time, transportation, at work, or at home (see additional file 3).

Physical competence

The concept of PL encompasses more than just the knowledge or motivation to move; it dives into the tangible abilities individuals possess, making the assessment of physical competence crucial for adults [30]. We included aerobic endurance, strength, flexibility, and balance brief assessments within this PL tool for adults (see additional file 3). These domains have been substantiated by various scientific studies and hold significance in understanding one's physical competence [43, 44]. The recommendation to assess these domains aligns perfectly with international recommendations for PA in adults, older adults, and chronic disease patients [3]. Emphasizing these domains complements the holistic intent of a PL tool, ensuring individuals are not just moving but moving effectively, safely, and in a manner that promotes long-term health.

Endurance

By assessing endurance, professionals can gauge an individual's capacity for sustained PA and their potential risk for these conditions [43]. We will use the 2-minute walking test (2MWT), a submaximal exercise test used to evaluate functional exercise capacity in adults, especially in those with chronic conditions. It entails recording the distance a person can walk on a level surface within 2 min. The 2MWT serves as a more concise alternative to the frequently employed 6-minute walking test (6MWT). Excellent correlations with the 6MWT have been observed in older adults or long-time care population ($r = 0.93$; [44]). It offers similar predictive and discriminative properties in specific populations [45]. One of its main advantages is its shorter duration, which makes it particularly suitable for patients with significant limitations or who tend to tire quickly. The 2MWT has been shown to be responsive to interventions, enabling clinicians to gauge the efficacy of treatment and rehabilitation programs [46].

Strength

Strength training or resistance-based activities have been recognised for their benefits in preserving lean muscle mass and prevent sarcopenia, functional impairments and increased risk of falls; this is especially crucial as one ages or is affected by a chronic disease [47, 48]. In this study, we will use a test from the Senior Fitness Test (SFT), a battery of tests specifically designed to assess the functional fitness of older adults [43]: the 30-second Chair Stand Test (Sit to Stand Test). It is a validated tool in chronic condition populations assessing the lower body strength [49, 50]. Lower body strength is essential for tasks such as climbing stairs, walking, and getting out of a chair or bed. This test is indicative of leg strength and endurance. The participant starts by sitting in the middle of a chair, arms crossed at the wrists and held against the chest. On the command "go", the participant rises to a full stand and then sits back down, repeating as many times as possible for 30 s.

Flexibility

Flexibility, while often overshadowed by endurance and strength [51], holds its unique importance. Improved flexibility contributes to a broader range of motion (e.g., daily life physical tasks), reduced muscle stiffness, and a decreased risk of musculoskeletal injuries [52]. In this study,, we will use the Sit and Reach test, a widely recognised and validated measure assessing flexibility [53], specifically of the hamstrings and lower back. Participants sit with straight legs and lean forward, trying to reach as far as they can. This test's significance is highlighted in its ability to predict potential lower back pain, as restricted flexibility in these areas has been linked to lumbar issues [54]. Moreover, adequate flexibility is pivotal for daily activities, with its relevance magnified in older adults and those with chronic conditions for whom functional mobility is crucial. For chronic diseases like Parkinson's, consistent flexibility assessment can help improve disease management and quality of life [55].

Balance

As adults age, balance proficiency becomes crucial in averting falls, which are a leading cause of morbidity and mortality among older adults [56]. Furthermore, enhanced balance abilities have been linked to better performance in daily activities, overall mobility and quality of life [57]. In this study we will use the one-leg balance test to gauge static balance in individuals [58], a reliable and validated tool in chronic disease population [59]. To execute this test, participants are required to stand on one leg without support, with the duration of balance maintained serving as the primary measure. For chronic disease patients with balance deficits, regular assessments can offer crucial data about disease progression and the efficacy of therapeutic interventions [60].

Motivation and confidence

Motivation and confidence to participate in physical activities are identified as key factors to attaining PL for individuals of all ages [61]. Within the PL model, motivation refers to a person's enthusiasm and pleasure in embracing PA as an integral part of life [16]. It is an important predictor of initiation and maintenance of long-term PA adherence across lifespan [62]. Two closed-ended questions (Likert scale) related to motivation and confidence for the integration of regular PA in daily life are included, based on the preliminary tool ([33]– see additional file 3). Participants will also be asked to freely report (open-ended questions) their perceived facilitators and barriers to integrating PA into their daily lives. Those answers could help the PA professional to identify and counsel, individually or collectively, about ways to amplify facilitators or to overcome perceived barriers.

Knowledge and Understanding

Understanding the knowledge and understanding dimension of PL is crucial as it helps individuals make informed decisions about their physical activities, thereby promoting lifelong engagement and well-being [17]. It refers to a person's knowledge about how to perform a variety of physical activities as well as a person's knowledge of the everyday relevance of exercises and the health benefits of PA in general [63]. Relying on the core categories defined by Edwards et al. [61] within the cognitive domain of PL, we decided to integrate three items assessing this domain (see additional file 3). Two closed-ended questions will ask the participant about their [1] perceived value of taking part in regular PA and [2] their perceived knowledge/understanding of main exercising guidelines (e.g., warm-up, progressiveness, and recovery) for health-related purposes. Finally, an open-ended question will ask participants to write down what they know about WHO recommendations [3] for aerobic PA.

Environment interaction

Perceived environmental opportunities, both social and physical, could be informed by PA professionals and play a crucial role in influencing PA among adults, particularly those with chronic diseases. Being aware of supportive surroundings opportunities, like accessible walking paths, parks, or sport facilities can promote routine exercises [64]. For adults, especially those with chronic diseases, social interactions can have a profound influence on their engagement in PA and overall health outcomes [65]. In this study, two closed-ended questions (Likert scale– see additional file 3) will be asked over the perceived support from peers (family, friends, etc.) for PA and over the perceived environmental (social and physical) opportunities for PA. Additionally, an open-ended question will ask participants about the people and places that they would consider as helpful to help them to take part into a regular PA practice.

Meaningful and purposeful activities

Whitehead [17] posits that meaningful engagement in PA is more than mere participation—it's about understanding and valuing the relevance of the activity to one's life. Engaging in activities that resonate with an individual's values and interests leads to enhanced commitment, sustainability, and psychological well-being [61]. In this study, two closed-ended questions (see additional file 3) will ask participants about their perceived pleasure in taking part in PA, and about their perceptions of the meaningfulness/purposefulness of integrating PA in their daily life. Finally, participants will be asked to describe in an open-ended question the characteristics of physical activities that they would personally consider as meaningful/purposeful.

Outcome measures

In this study, the primary outcomes will focus on the quantitative assessment of changes in a global score of PL and its six dimensions: Physical Activity Behaviour/Engagement, Motivation and Confidence, Knowledge/Understanding, Physical Competence, Environment Interaction, and Meaningful and Purposeful Engagement. Each dimension will be provided with an aggregated score out of 8 points, with a maximum score of 48 points representing the global score of PL. Score for PA behaviour/engagement relies on the IPAQ-S scoring protocol (low, moderate or high level of PA; /6 pts) and on the achievement of WHO recommendations for regular strength training activities (/2pts). The score for physical competence will be based on the scoring scales used in our preliminary study [33], with 2pts attributed to each physical test. Scores for the other dimensions will be calculated according to the level of answer given on each 4-point Likert scale (4pts per scale). Measurements will be taken at baseline, three months (post-intervention), and at the primary endpoint, which is six months post-intervention, to evaluate changes in PL and monitor longer term effects.

Secondary outcomes will include qualitative insights gathered from open-ended questions. From the raw responses, a process of preliminary data coding using a combination of deductive codes drawn from the research questions and inductive codes generated by the data will be undertaken. As the coding progresses, recurrent codes will be grouped in overarching categories [66]. Following this, frequency-based reporting will be used to highlight the most commonly reported themes. A triangulation process, involving the producing of a "convergence matrix" to display findings emerging from quantitative and qualitative components, will allow to

gain a more complete picture of the intervention effects [67].

Assessment procedure

The tool is designed to be administered autonomously by the professional educator during the tailored PA sessions. However, for the purpose of this research, the educator is supported by a second person (researcher) for the days of assessment. Blinding of the assessors will not be implemented, as they are regular staff who are not employed solely for the purposes of this study and therefore are aware of the group assignments. However, participants will be unaware of the existence of other intervention types in different communities, which helps reduce potential bias from their side. These professionals have both acquired a master degree in physical education and/or physiotherapy with an additional training in exercise therapy.

Assessment of participants will be undertaken every 3 months, for a total duration of 6 months. This procedure coincides with the beginning (T0) and the ending (T + 3 months) of a semester of tailored PA sessions, end after a follow-up period of 3 additional months (T + 6 months). During the follow-up period, participants will be asked about their continuation of any structured PA or other encouragement for PA continuation by health or exercise professionals to control for other significant influential factors. A flow chart illustrating the anticipated participant flow from enrolment through intervention and follow-up phases is provided in Fig. 1.

All assessments will take place in the regular sport facility used for the physical activities program, ensuring familiarity and comfort for participants. During the assessment, participants will be divided into two subgroups: [1] a group performing the physical tests supervised by the physical educator, and [2] a group performing the written assessment of the other 5 dimensions of the tool supervised by a researcher. Each sub-assessment is expected to last about 15 to 20 min, before groups are changing tasks. The assessment are performed at the beginning of the session, after a standardised warm-up (15 min; light aerobic activity and mobilisation), to avoid bias related to an acute fatigue due to the exercising activities. Physical competence tests will be conducted in designated areas within the assessment facility to ensure safety and consistency. Each test follows established protocols to ensure consistency, and the physical educator has received additional training on the standardized procedures and scoring criteria for each test to ensure robust and reliable data collection. For the written assessment, participants will be provided with pens, chairs, and tables to complete questionnaires comfortably and efficiently. During this time, they will also be asked to provide demographic information, including their gender, age, and type of chronic disease.

Data analysis

Utilising G*Power software for power analysis, we target a statistical power of 80% and a significance level (α) of 0.05. In line with a recent meta-analysis of the effectiveness of PL interventions, we aim to detect a moderate effect size of ~ 0.4 for the global PL score [28]. Based on these parameters, the analysis indicates a need for 52 participants per group. To account for a potential 25% dropout rate, we plan to recruit 65 participants per group to maintain the study's validity. An intention-to-treat (ITT) approach will be used to analyse participants based on their assigned groups regardless of protocol adherence. This method ensures unbiased treatment effect estimates and reflects real-world application. Due to the geographical separation of each intervention group across distinct communities and regions, the risk of cross-over between groups is minimized. Each group will operate independently within its own community setting, ensuring that participants remain within their assigned intervention throughout the study. For missing values, we will utilise multiple imputation techniques to maintain the integrity and robustness of our results, minimising bias from data loss. Adherence to the intervention will be assessed by calculating the ratio between attended intervention days and theoretically possible intervention days, expressed as a percentage. To monitor fidelity of the intervention, the physical educator will complete a session checklist after each session, confirming that all key elements of the physical fitness and PL components were delivered as intended in both intervention groups. Additional analyses will include subgroup analyses based on age, gender, and type of chronic disease. Adjusted analyses will be performed to control for potential confounders through multivariate regression at baseline.

Results will be presented as mean and standard deviation (M ± SD) for continuous variables or as frequency (%) for categorical variables, unless otherwise specified. The normality of distribution for each continuous variable will be assessed, with skewness and Kurtosis values below ranging between − 2 and + 2 indicating acceptable normality [68]. Baseline comparisons between the three groups– control, traditional Physical Activity (TPA), and TPA with Physical Literacy (TPA + PL)– will be conducted using one-way ANOVA for normally distributed data, or Kruskal-Wallis tests for non-normally distributed data. Chi-squared tests will be used for categorical variables. The primary analysis will involve mixed ANOVA models to analyse both changes within subjects over time and differences between groups on the PL aggregated score and domain scores. Individual variability will be modelled as a random factor. In cases where

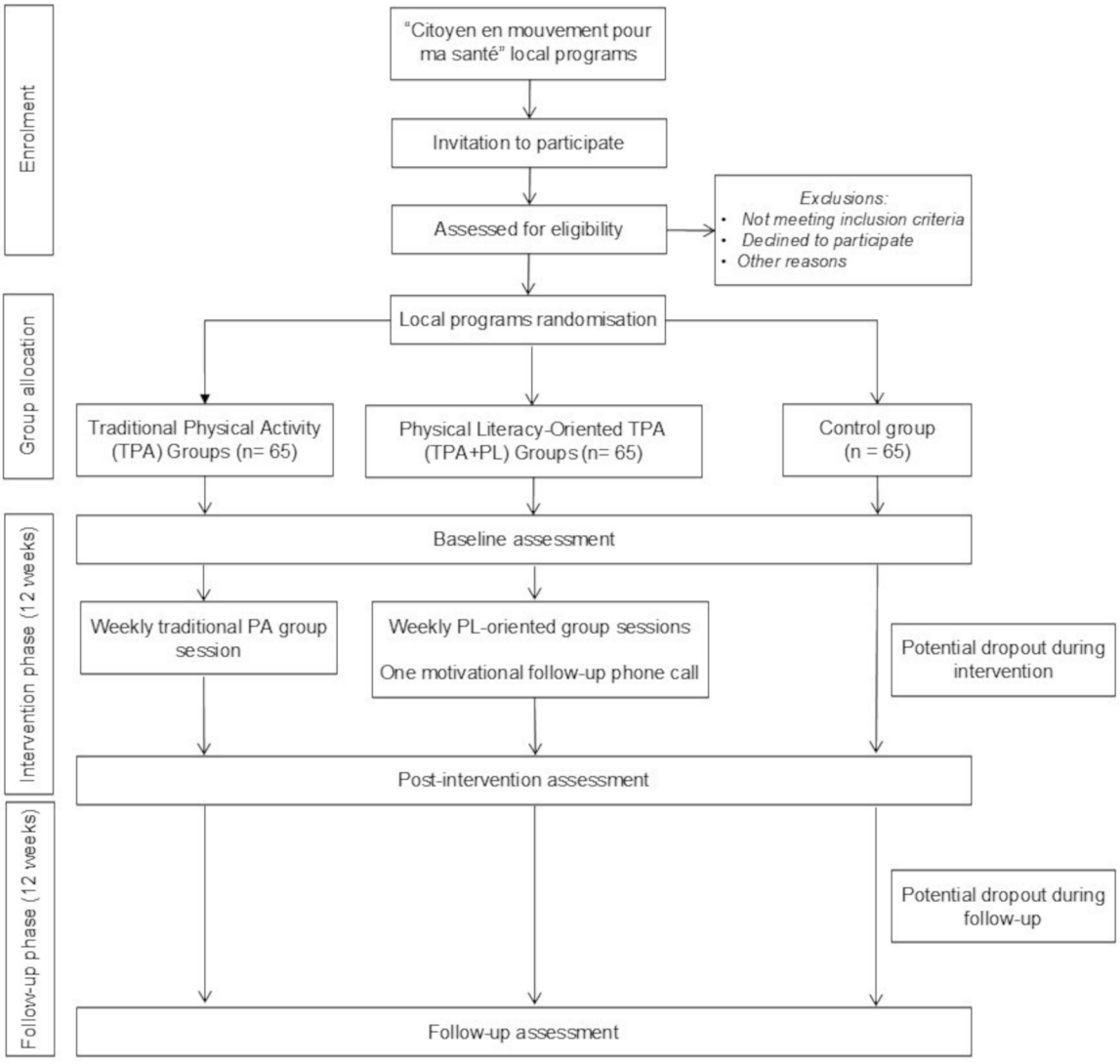

Fig. 1 Participant flow diagram

the mixed ANOVA indicates a significant difference, Bonferroni-adjusted post hoc analyses will be conducted to assess specific within- and between-group changes over time. Effect sizes for the ANOVA results will be calculated using partial eta-squared (η_p^2), with $\eta_p^2 \geq 0.01$ considered small, $\eta_p^2 \geq 0.06$ moderate, and $\eta_p^2 \geq 0.14$ large. Additionally, for pairwise comparisons, Cohen's d will be used, with $d \geq 0.2$ denoting a small effect, $d \geq 0.5$ as moderate, and $d \geq 0.8$ as large [69]. The Expectation-Maximization (EM) algorithm will be employed to impute missing data arising from dropouts or incomplete records, ensuring comprehensive and unbiased analysis in our intention-to-treat approach. All statistical analyses will be conducted using the software R. Statistical significance will be set at a two-tailed p-value < 0.05.

Discussion

This study aims to explore the integration of PL intervention in PA group sessions tailored for chronic disease management. We anticipate that our findings will contribute significantly to the current understanding of PL's role in this context. Specifically, we expect to observe improvements in some specific domains of PL, particularly in physical competence, as previous studies

have demonstrated that interventional practices tend to enhance physical competence more successfully than knowledge and understanding, or motivation and confidence [28]. Our intervention will also focus on this dimension during each session, while other dimensions, will be specifically addressed twice during the program. Factors such as the intervention's duration, the assessment tools used, or the specific nature of the chronic diseases involved could influence these outcomes. As the programme 'Citoyen, en mouvement pour ma santé' is open to all types of chronic disease, and in an exploratory setting, we chose to prioritise a broad inclusion of participants rather than a specific targeting. If significant PL improvements are observed, together with increased PA behaviour and engagement, this could provide valuable insights for integrating PL interventions into health promotion and management settings.

Moreover, we acknowledge that our study will have limitations, such as that it applied a non-randomized design and potential sample size constraints. These limitations will be important to consider when interpreting our results. We will suggest future research directions, including the need for long-term studies and follow-up, tailored interventions for specific chronic disease populations, or employing further qualitative assessment tools [70]. While we have implemented standardized procedures to ensure consistency, additional validation studies will be necessary to confirm the robustness, reliability and validity of the instrument in chronic disease populations.

In addition to the immediate goals of this study, our research will also contribute to reducing significant gaps in PL research, as outlined by Carl et al. [32]. Specifically, the need for more qualitative assessments, empirical studies on determinants and outcomes, and a deeper understanding of PL levels and trends over time. Our study will also examine the moderators and decisive program parameters of interventions, offering insights into the most effective strategies for promoting PL in chronic disease populations. By tackling these research gaps, we aim to provide valuable contributions to the broader field of PL and its role in health promotion.

Abbreviations

AP	Physical Activity
PL	Physical Literacy
TPA	Traditional Physical Activity
TPA + PL	Physical Literacy Oriented traditional Physical Activity
IPLA	International Physical Literacy Association
M ± SD	Mean ± Standard Deviation
ANOVA	Analysis of Variance
PLIRT	Physical Literacy Interventions Reporting Template
ηp2	Partial Eta Squared

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13102-025-01175-6.

Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

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Author contributions

All three authors contributed significantly to this work. AM and JPW were involved in the conception, design, data collection, intervention development, analysis, and manuscript writing of this protocol. AM wrote the first draft of the protocol, then JC and JPW contributed to the review and editing of the manuscript. AM, JC, and JPW, have read and approved the final manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study involving human participants was reviewed and approved by University Hospital of Liège Ethics Committee (reference number 2023/392 dated 02/02/2024). Informed consent to participate in the study will be obtained from all participants prior the enrolment in the study (see additional file 4).

Consent for publication

Not applicable. This protocol does not contain any individual person's data in any form.

Trial status

Recruitment for the study began in August 2024, with an anticipated completion in December 2024. Baseline assessments and interventions are scheduled to start in January 2025.

Competing interests

The authors declare no competing interests.

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