

# Evaluation of a sitting light volleyball intervention: a social-ecological approach

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## Research article

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# Abstract

**Background** This study was part of a 15-week sitting light volleyball (SLVB) intervention programme which examined the effectiveness of the intervention on physical and psychological attributes of people with physical disabilities (PWPD) in Hong Kong. Gaining an in-depth understanding of the perceptions and experiences of PWPD in the SLVB intervention is critical to further develop SLVB as a PA intervention and sport. This qualitative study explored and examined the association between the SLVB intervention elements and outcomes.

**Methods** Using a social–ecological model (SEM), the participants' experiences regarding the intervention were assessed and the suitability and feasibility of the SLVB intervention elements were examined. Twenty participants (mean age = 53.52 years standard deviation (SD = 9.02), 60% female participants; 25% had at least a college degree) attended our semi-structured interviews.

**Results** Using thematic analysis, their experiences at the individual or intrapersonal level (improved health and well-being, enjoyment, novelty, competence autonomy, and self-regulation when playing SLVB); relationship or interpersonal levels (teamwork, social support, socialization, and communication); perceived environment level (comfort, privacy, spaciousness, and accessibility concerns); community or organizational level (safety, dissemination of information, and community facilities); and policy level (resources allocation by the government) were obtained. The participants also commented on the suitability of the SLVB intervention for PWPD, contents and coaching, modified rules, duration of session and scheduling, and number of participants and coaches.

**Conclusion** This qualitative study identified several primary drivers and barriers for engaging PWPD in SLVB, and demonstrated that adopting a multilevel approach to our SLVB intervention has positive outcomes. Our results can facilitate the development of the experiential aspects of SLVB and indicate the suitability and feasibility of organizing SLVB-related activities in a community setting in the future.

## Background

People with physical disabilities (PWPD) are less physically active than healthy people [1, 2]. In 2015, the Government of Hong Kong Special Administration Region (HKSAR) commissioned a consultancy study to examine methods to promote participation in sports by PWPD. Schools for PWPD expressed concern regarding the decrease in types of sports and number of courses offered to them. Furthermore, only students with relatively high levels of motor ability and cognitive function were selected for participation in existing sports programs [3]. The HKSAR Government advocates sport for all, including PWPD; accordingly, in recent years, the HKSAR Government has increased the allocation of resources to support the development of sports for PWPD. The expenditure on development of sports for PWPD for the year 2018–19 was estimated to be \$70 million, which is an increase of more than 50% over the previous year, and it includes hosting local large-scale sports events for PWPD [4].

In addition to promoting existing sports programs, practitioners and researchers [3] are recommended to develop new physical activities (PAs) for PWPDP. Light volleyball (LVB) is a relatively common PA for older adults in China [5]. Compared with the traditional ball, the LVB is bigger (with a diameter of 80–83 cm vs traditional volleyball of 65–67 cm), lighter (100–150 g vs 250 g), and travels at a lower velocity; furthermore, the LVB remains airborne for longer than the traditional ball, which increases the rally time between players during the games. Additionally, LVB can be played in a standard badminton court. Team composition is 10 members as a team with five players on court. The height of the net for men and women is 2 m and 1.8 m, respectively. Studies in China have indicated that older adults gain physical and psychological health benefits by practicing LBV regularly [6, 7]. Leung and colleagues [8] conducted a 15-week LVB intervention to evaluate its effectiveness in improving physical and psychological attributes among adults aged  $\geq 60$  years in Hong Kong. The control group (CG) showed significant improvements in agility, cardiovascular endurance, upper and lower extremity muscle strength, and PA enjoyment when compared with the participants in the rouliqiu (RLQ) group and those in the LVB group [8]. The participants in the LVB group also demonstrated higher cardiovascular endurance, upper extremity muscle strength, and PA enjoyment than participants in the RLQ group. This pilot study suggested that future studies should investigate the effect of LVB on the health of other populations with relatively low fitness levels (e.g., PWPDP).

Sitting volleyball (SVB) is an official paralympic sports event. Similar to traditional volleyball, an SVB game comprises two teams of six players each on a smaller playing court with a size of 10 m  $\times$  6 m. The height of the net is approximately 1.15 m for men's teams and 1 m for women's teams. Unlike traditional volleyball, the SVB player's position is determined by the contact of the buttocks on the floor or the playing court, which is also a parameter for assessing any fouls. The British Paralympic Association [9] stated that SVB is faster than the Olympic indoor game because of the modified rules of the game (such as a low net height). Thus, SVB is a fast, high-level competitive team sport, demanding power and agility, which is only suitable for PWPDP with a very high sports competence.

Considering the high speed and high sports competence requirements of SVB and extending the aforementioned work, the objectives of the SLVB intervention were to develop a new sport and provide additional PA opportunities to PWPDP in Hong Kong and to improve the physical and psychosocial health of PWPDP. SLVB is a newly modified sport from LVB and SVB for PWPDP. The bigger and lighter ball used in SLVB makes it more accessible to PWPDP with a low fitness level (slow speed and long reaction time). Furthermore, the light weight of the ball results in considerably less soreness in the shoulders, arms, palms, fingers, and forearms than that caused by the traditional ball. SLVB is a safer non-contact team sport that can be played in a standard court with a size of 10  $\times$  6 m or in space-friendly badminton court, which is smaller than a standard volleyball court. The smaller court enables the promotion of SLVB for PWPDP in sports facilities in Hong Kong that normally have limited space. Team composition is 12 members as a team with six players on the court. It is optional to have one non-disabled player. SLVB is played in a sitting position and has modified rules, such as allowing the ball to bounce at most once in each pass, and the height of the net for men and women is 1.15 m and 1.05 m, respectively. Being playable, easier to learn and control, SLVB is relatively accessible for those with muscular degradation

and motor disabilities. Leung and colleagues [10] conducted a 15-week SLVB intervention in 2018 and examined its effectiveness in improving selected physical and psychological attributes in PWPD in Hong Kong. The study results revealed that the SLVB intervention group, compared with the controls, had significantly higher cardiovascular endurance, body composition, and PA enjoyment. Furthermore, the SLVB intervention effectively enhanced the participant's quality of life in the areas of role limitations due to physical health or emotional problems, body ache, social functioning as well as mental health [10].

## Objectives

This study was part of the SLVB intervention. Gaining an in-depth understanding of the perceptions and experiences of PWPD in the SLVB intervention is critical to further develop SLVB as a PA intervention and sport. Using a social–ecological approach, in this qualitative study, the associations between the SLVB intervention elements and outcomes were assessed. Specifically, the participants' experiences in the 15-week SLVB intervention were examined and the suitability and feasibility of the SLVB intervention content to PWPD were evaluated. These results were necessary for organizing SLVB-related activities in a community setting in the future.

## Methods

### Social–ecological approach

A social–ecological model (SEM) was applied in this qualitative study. This model has been used to create more physically active communities [11], in a framework of studies in sustainability of PWPD empowerment projects in Nairobi, Kenya [12], to evaluate multiple effects on participating in PA in old age [13], and to define social inclusion of people with intellectual and developmental disabilities [14]. SEM helps in understanding the multifaceted and interactive effects of personal and environmental factors that determine behaviors and identifies behavioral and organizational leverage points and intermediaries for health promotion within organizations. SEM has five nested hierarchical levels, namely individual, interpersonal, community, organizational, and policy or enabling environment. *Individual factors* refer to the personal factors, such as fitness levels, which affect the likelihood of participating in a PA. *Interpersonal factors* refer to the relationships, culture, and society with whom the individual interacts (e.g., social support). *Organizational factors* are institutional rules and methods to implement and promote PA, including organizational capacity (such as professionals in PA and therapy) of non-government organizations (NGOs) to organize structured and PA programs that are suitable to PWPD. *Community factors* represent PA promotion through collaboration between parties (e.g., NGOs and academic institutions). *Policy factors* include policies regarding the allocation of resources for health and access to health care services and restrictive policies (e.g., high fees for health services) or lack thereof.

### Semi-structured interviews

In this qualitative study, data were collected using semi-structured interviews (conducted in Cantonese) after the 15-week SLVB intervention. The semi-structured format is a frequently used interview technique in qualitative research [15] and in the health care context [16]. Semi-structured interviews were used to collect information on participants' experiences of participating in the intervention, identify the participant's experiential aspects of SLVB, and account for the suitability and feasibility of rolling out the SLVB-related activities in a community setting in future. A set of interview questions was pilot-tested on five PWPD and investigators involved in the study. The interviewers adapted a flexible approach and, when necessary, altered the question sequence and/or asked some probing questions to facilitate in-depth conversations about the SLVB intervention. Because they combine a predetermined set of open questions (See Appendix 1 for sample questions) with opportunities for the interviewers to further explore particular themes or responses, semi-structured interviews were used to understand the working of the SLVB intervention, its effects, and areas of improvement. This qualitative method of inquiry does not limit interviewees to a set of predetermined answers (unlike a structured questionnaire) and allows them to discuss and raise issues that the interviewer may not have considered. This method assisted the interviewees in describing complex phenomena and the interviewers in collecting information on SLVB, immediately clarifying the information collected, and ensuring optimal use of the limited interview time [17].

## Procedures

The study was conducted between September and November 2018. All research activities were reviewed and approved by the University Institutional Review Board. Additional details of the SLVB intervention can be found elsewhere [10]. The primary results of this SLVB intervention have been reported elsewhere. A cover letter stating the details of the study (e.g., aims and procedures) was given to the partner NGO serving PWPD in Hong Kong. After receiving the agreement of the person-in-charge of the NGO, recruitment was conducted by the NGO through social media (e.g., WhatsApp) and by advertisements in their bimonthly magazine. With the enrolment of the potential participants, details of the interviews (the time and venue) were confirmed. The interviewees were informed about the confidentiality and details of the study, namely the objectives of the study, their involvement, and potential risks of participation in the study) and their right to leave the project at any time. Upon signing, participants agreed to participate in the study. All interviews were conducted by the principal investigator and a trained research assistant, who knew about sports and exercise (especially in LVB) and was trained in qualitative research methods and interviewing skills. All interviews were audio-taped for further data analysis. A HK\$100 supermarket cash voucher was given to the participants to acknowledge their contributions to the study. The interviews averaged 40 min (range = 20–77 min).

## Participants

Twenty-three participants who participated in our SLVB intervention were invited to attend our qualitative interviews: Three participants refused due to personal reasons, so 20 interviews were conducted, and

saturation was reached. The interview participants ( $n = 20$ ; 12 women, 25% with a college degree or higher) had a mean age of 53.52 years (standard deviation [SD] = 9.02). Participant characteristics are summarized in Table 1

**[Insert Table 1 about here]**

## Data analysis

All interviews were transcribed ad verbatim and checked against the co-investigators' notes. The transcripts were qualitatively analyzed using thematic analysis (TA). TA is one of a cluster of analytic approaches for identifying patterns of meaning across a qualitative dataset. Both theory-driven and inductive TA were used in this study to analyze data and consolidate them into meaningful themes, following the process suggested by Biddle et al. [18]. A coding team comprising two individuals (KML and CYM) read all transcripts and developed a codebook, which was iteratively refined throughout the coding process and with reference to the SEM. Each transcript was coded independently by two coders who used the latest codebook. At regular intervals throughout the coding process, a reliability check of the coding was conducted in the team. Any differences were resolved through a consensus. The final codes were determined by KML, who ensured that transcripts coded earlier reconciled with the most current codebook.

The raw data extracted for TA included participant quotations and our interpretations of these data. Exemplar quotes are presented in Table 2. The participants' experiences and perceptions of SLVB interventions were coded inductively with reference to the SEM framework.

**[Insert Table 2 about here]**

## Results

### Participants' experiences regarding the intervention

#### At the individual or intrapersonal level

*Health and well-being.* Reduction in lumbar spine pain and improvements in upper limb muscles, reactivity, and body coordination were the positive outcomes perceived by the participants.

One of the male participants (M4) expressed that SLVB helped reduce lumbar spine pain: *"In the past three months, I often sat on the floor while playing SLVB. Eventually, I found that my lumbar spine and hip bones had become more flexible than before. I used to have lumbar spine pain. After playing SLVB, I found it less painful than before."*

He (M4) added that SLVB had strengthened his upper limbs although it was a bit tiresome: *“It enhanced my body strength as well. When the receiving team wins every rally, it gains the right to serve and rotates before actually serving. The player who moves from the front-right position to the back-right position will serve. This rotation movement is even more tiresome than serving and smashing a ball. It strained my arms more than using the wheelchair did. Such lateral movements, through the use of different muscles, strengthened my arms over time. As such, I would say, SLVB is a pretty good exercise.”*

Two female participants, (F3) and (F2), mentioned that SLVB enabled PA and improved reactivity. (F3) said, *“It gave me a chance to do more exercise, which is good for my hands, legs, and joints. Unlike stretching exercises, SLVB entails the movement of my whole upper body. I found that my sensitivity is better. [Do you mean reactivity?] Yes, reactivity has become better.”*

This was echoed by (F2): *“We are limited by our disabilities to do many things, such as running. SLVB gives us an opportunity to do aerobic exercise. It is also good for training our reactivity.”*

Two male participants, (M6) and (M2), expressed that SLVB was good for bodily coordination: *“We have to rotate and manage hand–eye coordination ... Hand–eye coordination is important to receive”* and *“It demands reactivity and synchronization of the players.... As such, I think it is good for building our brain and body.”*

In addition to physical health, potential improvements in mental health (positive mood and fewer worries) and quality of sleep were mentioned by a few participants.

A female participant (F5) said, *“We often look at near objects and hence strain our eyes. When you play SLVB, you look at distant objects, which could be good for our eyesight. I think playing SLVB could help ease our mood, and it is good for our lumbar spine.”* *“Playing SLVB causes me to have a good mood. I become worry-free while focusing on the ball,”* she added (F5).

*“I feel more energetic. Besides, I slept well after playing SLVB. Yes. I think it has improved the quality of my sleep,”* said another female participant (F3).

*Enjoyment.* Analysis of the semi-structured interviews demonstrated perceived enjoyment and happiness of the participants when playing SLVB.

*“I would tell them that SLVB is something I never came across before. Playing SLVB is very joyful and a sort of exercise. I seldom exercised before I retired,”* expressed a female participant (F2).

Another female participant (F4) said, *“In general, I found SLVB fun-full to play with.”*

One male participant (M3) expressed, *“It is surely good. I saw that they were very happy to play SLVB. It was impactful, at least psychologically. The sports ground was full of happiness and laughter. They cheered when they served a good ball. They laughed when someone hit a ball beyond the lines. The atmosphere was joyous. (How about you?) I felt happy too.”*

Another male participant (M6) exclaimed, *"Once I started, oh, I love it!"*

Some participants even went earlier to the sports ground for additional SLVB practice. One female participant (F11) reflected, *"I think I really enjoy. Because I would arrive earlier, if the class started at 4, I could get some practice if I arrived at 3:30. I would practice serving as I knew I was not good at serving.... Yes, I was looking forward to it sometimes. Sometimes we would tell others to come earlier. The class started at four. We arrived 30 min earlier to practice so that we can play better."*

*Novelty.* Because SLVB was new to the participants, they were curious and eager to find out what it is, how it is played, and whether they could play this form of PA, which is for a healthy and strong body.

One female participant (F1) expressed, *"Curiosity drove me to join the project. SLVB was new to me. The moment I heard of SLVB, I wondered if it can be played by wheelchair users like me. I was so curious to find out how it is played. Moving around the volleyball court, smashing a ball on my wheelchair, etc. are totally new to me. All these attract me to join the project."*

Another female participant (F2) reflected, *"It was new to me. I never did it before."* She added, *"I have done other exercises for at least three years. I never did SLVB. That is why I want to try."*

One of the male participants (M1) said, *"I want to know more about SLVB as a sport.... I have known how to play a new kind of sport. If it is further developed into a regular sports item in the future, I would certainly play with my friend."*

Another male participant (M3) echoed, *"I wanted to know what SLVB is about. I wanted to do more exercise for a healthy and strong body."*

*Competence.* Moreover, participants indicated that playing SLVB brought about a sense of competence derived not only from successful service, scoring points, and mastering techniques progressively but also from positive feedback from coaches.

One female participant (F1) said, *"As a matter of fact, I am a fan of VB. Have you ever heard of Lang Ping? I like to watch her playing VB. I know the rules of the games. However, I have never played VB because of my disabilities and body weight. Thanks to the project, I am able to play SLVB."* She (F1) added, *"What I enjoyed most was the joyous moment when we served a good ball and scored a point."*

She (F1) remarked further, *"Within the team, we have a player who had a stroke. Playing SLVB is good for her even though she could just move one of her hands."*

Another female participant (F4) said, *"I felt very happy when I served or received a ball well."* When asked if there was any psychological change after playing SLVB, she (F4) exclaimed, *"I feel happier because I can make it. I can play!"*

A sense of achievement was expressed by a male participant (M4) who received positive feedback from his coach: *"What I enjoyed most was to listen to and apply what the coaches had taught me. For*

*example, if I smashed a good ball, Y. W. Sir would praise me and said, 'Well done; you have applied the skills I taught you.' I got much sense of satisfaction from this positive feedback.... I am able to apply well the skills taught by the coaches. I can control well my position and direction while serving and receiving the ball."*

*Autonomy.* The participants positively expressed they attained body autonomy gain and sense of freedom from playing SLVB.

A female participant (F2) said, *"Suitable. For instance, some players can do SLVB with just one hand. Despite our walking impairments, we are able to play SLVB in a sitting position. I do not know how to operate and control a wheelchair. I fear falling while playing SLVB in a wheelchair. Playing in a sitting position fits me very much."*

Sense of freedom was felt by a male participant (M6). He reflected, *"After the caliper is removed, I can play it, rotate, and pick up the ball freely..... Now watching back the videos, I found myself so free in it.... I need neither wheelchair nor caliper, which is so delightful. I also feel like a dream as if I am an astronaut, no limitation and without caliper."*

In addition to body autonomy, self-regulation skills were evident by the participants routinely scheduling time for exercise. One female participant (F2) said, *"Once I decide to do something, I am dedicated to doing it well. Just like playing SLVB, I didn't miss any session unless necessary. That's why I don't often meet with my friends and family members, once every one to two months."*

Another male participant (M6) reflected, *"My wife and I have attended more than 80% of the classes. It was quite fun. I was absent for four times. My wife reminded me that I had one quota left; otherwise I will fall into 80%. I traveled to Okinawa. Then I attended the classes every week and rejected all the dates with friends."*

*At the relationships or interpersonal level*

*Socialization and communication.* Other than physical and psychological well-being, the interviewees also described the social interaction effects of joining the SLVB intervention, namely mixing socially with others, discussion and exchange of information within teams, extension of social circles from one that mainly included wheelchair-bound friend to one that included volunteers, coaches, and the organizing team

*"It ...enlarges my social circle. It gives me a chance to interact with other people and volunteers and keep contact with my wheelchair friends. When I don't do exercise, I usually stay at home."* Said a male participant (M2).

Another male participant (M1) mentioned, *"The good things are.... and interacting with my friends. With my teammates, we discussed how to win a game strategically and adjust ourselves to play better."*

The socialization effect was echoed by a female participant (F2), *"I felt quite happy to play and practice passing the ball in a small group..... I am happy to know a few new friends too."*

*"Yes. It enlarges my circle of social interaction. It enables me to know more new friends."* Said another female participant (F3).

Through SLVB, another male participant (M6) extended his social circle beyond wheelchair-bound friends. *"I met many coaches, like PY and R. It's good to meet them. A new network formed which we can play together, like Yuk and Yin. Second, I can meet many people outside my zone, like people at the network of light volleyball, people who pick up the balls. The security guards are nice and help us open the door."*

*Teamwork.* Mutual inclusion, cooperation, team spirit, and combined action as a group resulted from the SLVB intervention.

A female participant (F2) said, *"... Individual exercise differs from group exercise.... Group exercise demands mutual inclusion, cooperation, and interaction among the participants. For SLVB, you need at least ten people to make it playful."*

Another female participant (F1) remarked, *"Absolutely, we played hard to win as a team. We cheered to each other whenever scoring a point. We were very happy as a team. It is awesome."*

A male participant (M3) expressed, *"To me, SLVB is playful. It cultivates team spirit and demands the cooperation of each member..."*

One male participant (M3) expressed that SLVB developed communication skills among the team members, *"SLVB provides us with a chance to move around, stretch our muscles, enable communication within the team, learn how to interact with each other, and to follow instructions from the coaches. There are many advantages...."*

## **Social support.**

Support from peers, friends, family members, coaches and volunteers as well as peer pressure were evident during the SLVB intervention.

Support from peers and friends was described by one of the female participants (F2): *"Some of my classmates are very friendly. They are proactive to say "hello" to me and even invite me to play with them in a small group. They told me some tricks of playing SLVB, which had helped me do better."* She added, *"I didn't tell others except for my old friends. They said that wow, you were awesome!"*

Nevertheless, some participants found intangible pressure from her peers when servicing. *".....I feared losing a point because it would affect the whole team. When it was my turn to serve a ball, everybody stared at me and told me to 'add oil.' This frightened me despite knowing the two-step approach Coach PY had taught me. I said to myself, 'Don't be afraid, don't be afraid.' However, it did not work out. The*

*intangible pressure on me was so large that my hands were out of control."* One female participant (F1) reflected.

She (F1) elaborated, *"Yes. I knew of their good intention to encourage me to serve the ball well. However, the more they yelled at me, the more nervous I become and the higher the chance of my serving the ball badly....."*

Family support, which was crucial to engaging the participants in PA, was mentioned by many participants. One male participant (M2) said, *"Most of them encouraged me to do so. My wife supported me too, even though she was more introverted than me."*

*"Yes, they (family members) were very supportive. They said that it was good for me to go out and play more. They told me not to stay at home alone."* Echoed by a female participant (F2). *"I felt that I have become more proactive than before (in knowing friends and social interactions)."* She (F2) added

*"I didn't hear any objection. Both my family and daughter were supportive."* Said a female participant (F3). *"They said, 'It is good for you to do more exercise!' (Verbal support?) Yes."*

Support and positive feedback from the coaches were evident by a male participant (M4): *"What I enjoyed most was to listen to and applied what the coaches had taught me. For example, if I smashed a good ball, YW Sir would praise me and say, 'Well done, you have applied the skills I taught you.' I got much sense of satisfaction from this positive feedback. I really enjoyed the processes of learning, practicing, and applying the skills."*

Volunteer support was appreciated by a female participant (F4): *"I am very thankful to those ball-boys and girls. (They were very co-operative, right?) Yes, absolutely. We played, and the balls were everywhere. They helped picking the balls for us quickly. They did a great job."*

## **At the perceived environment level**

*Comfort, privacy, and spaciousness.* Comfort, privacy, spaciousness, and convenience of the venue affected the participants' engagement in the intervention.

One male participant (M4) exclaimed, *"Superb, superb! Unlike other playgrounds, there were no other players except us. I liked very much the privacy and comfort this playground gave me."*

Sufficient space was necessary to accommodate numerous wheelchairs and participants' belongings. One wheelchair user (F1) commented, *"The playground is big, and the indoor environment is ok."* One male participant M(6) commented on the sports ground: *"It is convenient and comfortable inside the center. It is big enough to place our wheelchair and the air-conditioner is great. There is a restroom and drinking water on 1/F."*

Room temperature and accessibility to toilet are two of the environmental factors to engage in PA. One female participant (F4) said, *"I am fine with that (the room temperature). It would be better if there were a toilet on the same floor. However, we could do little because this building is established. We have no alternatives. As for the temperature, we felt a bit cool upon arrival. It was about right after we played for a while and warmed up."* Another female participant (F6) commented on the room temperature: *"It (the sports ground) is quite good, but sometimes the air-con is too strong."*

*Accessibility concerns.* As many participants were wheelchair users and have walking impairments, accessibility concerns were at the heart of the discussions.

*Steep road leading to the sports ground.* Accessibility to the sports ground is important to encourage participation in PA. One of the male participants (M3) said, *"It is quite convenient to come here by train (Kowloon MTR station)...However, the steep roads leading to the sports ground are not convenient for wheelchair users."*

Another female participant who came by train (F10) echoed: *No, the place is fine, but the way traveling there isn't convenient at all. I take the train here and walking from the station to the venue is difficult. (Which station?) Kowloon Tong. It's slope all the way. It's easy on the way back home but not the way to the sports center. I will never come without an electric one."*

*Parking space.* Availability and proximity to disabled parking spaces are essential to engage in PA. One female (F4) participant said, *"We drove to the venue. We got to wait for a parking slot downstairs."* She (F4) added, *"They are (small). Sometimes we parked at the public car park downstairs which was always full. It was difficult to get space."*

However, for some participants with higher mobility, they can park at a normal though smaller parking space. One male participant (M2) said, *"Given my mobility, I can manage to off-load or up-load my wheelchair even though the parking lot is a bit narrow. No big deal."* Another male participant (M3) commented, *"There's only one disabled people parking slot out there. Once occupied, others had to use HKBU's car park, which some commented that it was too far away. I have always parked at HKBU's car park. To me, it was quite close to the sports ground."*

Nevertheless, some participants were not discouraged by the accessibility issues. *"I met many of the players on other occasions. Some are old friends, and we chat with each other sometimes. The changes are that many of them had become proactive to play SLVB although the venue was quite inconvenient to them, given the steep road, insufficient parking spaces, etc."* Commented by one male participant (M3).

*Toilet.* Availability of toilet facilities for wheelchair users is important. One female participant (F1) commented on the toilet facility: *"Oh, it is quite troublesome going to the toilet downstairs....the toilet is not that accessible. Firstly, it is hard for us to pass through the twist and turn. Secondly, the door panel is too small and is not specially designed for wheelchair users. It is not spacious enough for me to move"*

around. It was very difficult for me to close/open the door from inside...." She (F1) elaborated, "...I needed to call other team members to help close the door... going to the toilet is a big headache to me...!"

#### *At the community/organizational level*

*Safety.* Safety is a concern when playing sports, particularly for PWPD and people with relatively low fitness levels. When asked about the potential risks of playing SLVB, a male participant (M3) expressed, "Every sporting event has its own risk. SLVB players may strain their muscles; they may fall on the floor and get hurt if they don't play it properly. At their ages, the chance of hurting themselves is higher. It would be troublesome if they hurt their hands."

The disability conditions of the participants posed a potential risk of playing SLVB. "As I have walking impairment on one leg only, one side of my buttock is bigger than the other. As a result, I need to balance myself with one hand while sitting on the floor. This explained why I seldom use two hands and mostly one hand to receive the ball. Otherwise, I would lose my balance and fall backward. Besides, I could not bend my legs while sitting on the floor. That's why my legs would cramp sometimes." Said a female participant (F2). She (F2) added, "As our disabilities vary, some can sit with good balance while some can't and need to support themselves with one hand on the floor. This makes it difficult for them to receive a ball with two hands. When they use both hands to receive a ball, they are vulnerable to fall."

Nevertheless, the potential risk can be reduced by using proper techniques and protective gears, as mentioned by another male participant (M3): "The lumbar region of some is weak. They will fall straight down on the floor when they lose balance. As you said before, they should have been taught how to fall properly so as not to hurt themselves. For instance, how to use the elbow-supporters as buffers while falling."

One female participant (F1) said, "SLVB is not that risky. The risk of falling could be higher if we played while standing up. While sitting on the floor, the risk of falling and hurting our hands is lower. The risk could be lowered by wearing elbow-supporters. The only potential risk is that our legs are powerless. Some team members suffered from abrasion while dragging or moving their legs on the floor."

"The potential risk is that you could be hit by a ball. Sometimes, I fear being hit by a ball. Sometimes, I fear hurting my hands, which is no good for moving my wheelchair around. However, after playing for a few sessions, I know how to avoid the risk of being hurt. As the ball is light, it is no big deal even being hit by it." Said a female participant (F4).

*Dissemination of information.* One female participant (F2) commented on the dissemination of information: "The enrolment process was smooth. However, I sometimes found that the dissemination of information was quite confusing.... For instance, there were occasions that we were not clearly informed of changes in the training schedules and venue. We didn't know how to go to the new venue... It would be better if we could be informed as a group by a single party who has all our phone numbers."

She (F2) added, *"Some players may disagree with setting up a WhatsApp group because they don't like to receive irrelevant personal messages. However, I think that the group should only be used by the responsible party to disseminate relevant information such as change in venue, training schedule, etc. One message will then be sent to all."*

*Community facilities.* The lack of wheelchair-accessible facilities in the community discouraged participation in PA (i.e., SLVB). One female participant (F1) expressed, *"I rarely go out ... for extra exercises ... there are staircases and therefore not suitable to a wheelchair."* She (F1) added, *"It takes time for the government to make good sportsground facilities...sportsgrounds are booked for playing basketball and badminton, leaving no room for us to play SLVB... Alternatively, I think the government should let us book community halls to play SLVB. Community halls are big. Even half of it is spacious enough for us to play."*

When asked if there was an alternative venue to play SLVB at HKFHY (the partner NGO), a male participant (M3) commented, *"It is hard to do so. The ceiling of this room is too low; the activity room outside is full of stuff. HKFHY is not spacious enough."*

## **At the policy level**

*Resources allocation.* Concerns about the sustainability of activity sessions were raised by participants, who wanted to see local government departments provide both financial and practical resources to support activity sessions [13].

One sporty male participant (M3) said, *"Unlike wheelchair rugby and basketball, SLVB is played without a tailor-made wheelchair and in a sitting position. As such, I think it is ok and worthy of promoting SLVB as long as a sports ground is available."*

A female participant (F1) commented, *"It takes time for the government to make good sportsground facilities, particularly for those located in old districts...Some sportsgrounds are so small that they could hardly be modified. Many sportsgrounds are booked for playing basketball and badminton, leaving no room for us to play SLVB. Alternatively, I think the government should let us book community halls to play SLVB. Community halls are big. Even half of it is spacious enough for us to play."*

## **Suitability and feasibility of our SLVB intervention elements**

*Suitability.* SLVB is played in the sitting position and is relatively less vigorous and intensive; hence, it is perceived to be suitable for PWPDP.

A female participant (F3) expressed, *"As you know, most HKFHY members are disabled in their legs. Exercises requiring a lot of leg movements don't suit us. Being played in a sitting position, SLVB is suitable for us."*

*"I will tell them that SLVB is very suitable for disabled people to play. It is less vigorous than wheelchair basketball; you will not hurt your hands easily. SLVB could also enhance the flexibility of our arms and the tendons of our hip bones."* Reflected by another female participant (F4)

Another male participant (M6) said, *"We.... should try using every part of our body. Light volleyball is the best one. I don't play wheelchair basketball because the player will crash easily .... Crashing does not happen much in light volleyball, and we will not get hurt that often, so it is quite suitable for....wheelchair-bound people."*

However, due considerations have to be given to the disability conditions of the participants when mapping out an intervention program for PWPD.

*"I am not good at coordinating my upper limbs. As such, I found it quite hard for me to play SLVB with my hands because of my disability. However, I am ok in general."* Said one of the male participants (M1).

Another male participant (M2) commented, *"There're different categories and levels of disabilities. At the very beginning, those with higher levels of disabilities could play it for fun and leisure. Gradually, they could progress to competition level as long as their body conditions can support."* *"It fits for some with a normal upper body. It doesn't fit for those with insensible lower limbs because they may hurt their legs easily while moving on the floor."*

(M2) commented further, *"The participants have to judge themselves whether SLVB suits their physical condition or not. If it is an SLVB competition, there must be some pre-conditions to fulfill. If the aim is fun, it should be quite ok for people with lower ability. The soft and light volleyball reduces the probability of hurting themselves."*

*Project contents and coaching.* In general, the project contents were perceived to be adequate and progressive, and the caring approach adopted by the coaches was appropriate and made instructions easy to understand.

One male participant (M2) said, *"It (the content) was adequate. It takes time for you to progress from not knowing to knowing how to play... The duration and progress of the project were good."* He (M2) added, *"They (the coaches) were ok. They sat on the floor when coaching us. This was good because they could feel how we played in a sitting position."*

The comments of M2 were shared by two other male participants. (M3) echoed, *"I think that the two coaches started with the basics and then gradually taught us more techniques of playing SLVB. (Step by step approach). It should be OK."* (M6) reflected, *"There is theory, and it is taught in a structured way. It is easily understood."*

*Duration of each session and scheduling.* In general, participants preferred longer and flexible training sessions. A male participant (M2) said, *"At least two to three hours per session. If the session is too short, you don't have much time to play after warming up."* A female participant (F6) who wanted flexibility

commented, *"I think it is too short. It could be longer on Saturday night.... The class on Saturday should be 3 hours like the class now. We can play in groups. But not on Thursday, because I need to work."*

*Number of participants and coaches.* An appropriate coach to participant ratio is required. A female participant (F10) commented, *"It's a large number.... It should not cross 30; after 30, it is hard to satisfy everyone."* She (F10) added, *"At the beginning, two coaches were enough...."*

*Modified rules.* Unlike traditional volleyball, an SLVB player's position is determined by the degree of contact of the buttocks with the floor or the playing court, which is also a parameter for assessing any fouls. However, a male participant (M3) suggested, *"In our case, the six members of each team may have different levels/types of disabilities. Some may be able to raise their buttocks above the ground a bit, and some may not. You may consider skipping this rule. As such, it is needless for the referee to enforce this rule."* He (M3) added, *"You should be flexible about that.... Option one: one or two designated members of each team are allowed to do that. Option two: only the most able-bodied member is allowed/disallowed to do that."*

Unlike SVB, where each player can serve multiple times until the team loses, each SLVB player can serve only once. When the receiving team wins every rally, it gains the right to serve and rotates (clockwise) before actually serving. The player who moves from the front-right position to the back-right position will serve. The participants' views about this modified rule were mixed. Some said that it had better allow each player to serve multiple times until the team loses because this would give each player more chance to practice servicing. However, a female participant (F4) preferred the original rule, *"I don't think so. I prefer the original rule because the more we rotate, the more we move, and that is good for our body strength."*

The Social Ecological Model developed using the aforementioned findings is presented in Fig. 1.

**[Insert Figure 1 about here]**

## **Discussion**

This qualitative study examined the association between the elements of SLVB intervention and outcomes. Specifically, it aimed to explore participants' experiences regarding the intervention by using SEM and examining the suitability and feasibility of our SLVB intervention contents.

## **Participants' experiences of participating in the intervention**

Using SEM, this qualitative study yielded five levels of themes that influenced PWP to engage in the SLVB intervention. They were health and well-being, enjoyment, novelty, competence, and autonomy (at the individual or intrapersonal level); socialization and communication, teamwork, and social support (at the relationship or interpersonal level); comfort, privacy, spaciousness, and accessibility concerns (at the

perceived environment level); safety, dissemination of information, and community facilities (at the community or organizational level); and resource allocation (at the policy level).

## **At the individual or intrapersonal level**

*Health and well-being.* Exercise and PA are an effective way to improve people's physical and mental health. However, mental health research is no longer focused only on diagnosis and disorders but also on an individual's subjective well-being. The most frequently cited outcomes of this study were perceived health and well-being when playing SLVB. Partaking in the intervention resulted in many health benefits, including reduction in lumbar spine pain, strengthening of upper limbs, and improved reactivity, eyesight, and hand–eye coordination. Potential improvement in mental health (positive mood and fewer worries) and quality of sleep were also mentioned by a few participants. These aligned with the results of the meta-synthesis, where health and well-being were substantial concepts. The potential for improvement in health and well-being motivated engagement in the intervention, and these improvements facilitated an ongoing physically active lifestyle [19].

*Enjoyment.* According to the utilitarianism theory, people should aim at producing and doing work that produce the maximum happiness and well-being in order to uphold their standard and quality of life. People participating in sports activities and organizations exhibit a significant positive correlation with happiness and have a higher level of happiness than do people engaged in other leisure activities, such as listening to music, going to church, and watching television series [20–22]. Feedback from the participants of the present study indicated that promotion of SLVB in the form of group participation in PA (one of the intervention elements) could uphold the subjective happiness (outcome) of PWPD. Participants expressed an overall perception that they felt happy and joyous (individually and as a group) when playing SLVB, which was consistent with the findings of a previous study that enjoyment was mentioned most often in PA activities and was evident in group activities as well as independent activities [13].

*Novelty.* The uniqueness of SLVB (using a bigger, lighter, and softer ball and with modified rules such as allowing the ball to bounce at most once in each pass) is noteworthy and brings novelty (outcome) to the participants. SLVB being new to them, the participants were curious and eager to find out what it is, how it is played, and whether they could play this form of PA, which is for a healthy and strong body. This was consistent with the finding of Krops et al. [2] that diverse or new activities were one of the themes regarding PWPD's perspectives about an effective community-based PA intervention.

*Competence and autonomy.* Competence and autonomy were two of the basic psychological needs in the self-determination theory [23]. These needs must be satisfied to foster well-being and health. Competence is to seek control of the outcome and experience mastery [24]. Deci [25] found that giving people unexpected positive feedback on a task increases their intrinsic motivation to do it because the positive feedback fulfills people's need for competence. Many of the participants expressed that they derived a sense of competence from serving a good ball, scoring a point for his/her team, mastering the skills of

playing SLVB gradually, receiving positive feedback from the coaches, and even helping peers progress. The sense of “can do” was expressed evidently by a female participant (F4) who exclaimed that she felt happier because she made it and she could play SLVB. In his fifties, one male participant (M4) reflected proudly that he was one of the top players within the team, being appraised by the coaches for applying well the taught techniques. This intervention even brought positive changes to participants’ thoughts about the role of exercise in their lives.

Autonomy is the want to have self-control of one’s own life and to be someone; however, Deci and Vansteenkiste [26] noted that this does not mean becoming independent of others. In the process of rehabilitation, PWPD faces such barriers as acting independently, their mobility being regulated by external aspects which causes the feeling of being unable to control their own body, self, and life [27]. The participants in the present study positively reflected that they attained body autonomy and a sense of freedom by playing SLVB. They had higher mobility when sitting on the floor and were able to hit the ball at different positions and were not limited in their space and action by the wheelchair. Some players could play SLVB with just one hand despite their impairments. *Sense of freedom* was perceived as a crucial motivator for getting involved in SLVB.

In addition to body autonomy, *self-regulation* skills were evident by participants’ routinely scheduling time for exercise, planning ahead, and setting meaningful goals [19]. In this context, self-regulation means the capability of an individual to modulate their thoughts and emotions to regulate their PA behavior [28]. The participants were dedicated to playing SLVB well and did not miss any session unless necessary. All these findings indicated that interventions that were implemented long enough could facilitate PA to become habitual.

## **At the relationship or interpersonal level**

Hills and Argyle [20] showed that sports provide sociability and well-being. Gatab and Pirhayti [29] indicated that people participating in sports associate with each other by teamwork, social communication skills and strengthened social development. The results of the present study indicated that social interaction effects (socialization and communication, teamwork, and social support) made the SLVB intervention effective.

*Socialization and communication and teamwork.* This theme coincided with the relatedness of the self-determination theory. Relatedness is the wish to interact, interconnect with and to feel affection for others [30]. Cooperation and interaction during the mock games (a crucial element of the SLVB intervention) engendered socialization and communication skills. Our findings revealed that the intervention had multiple socialization effects on the participants, namely learning how to interact with each other, following instructions from the coaches, and mix socially with others; extending from playing SLVB to other types of PA; and enlarging one’s social circle to include not merely wheelchair-bound friends but also coaches, the organizing team, and volunteers who helped picking and feeding balls to participants. Similarly, teamwork also enhanced the relatedness of our participants. SLVB is group-based PA requiring

teamwork to win a game. Mutual inclusion, cooperation, team spirit, combined action as a group, and winning as a team were perceived from the SLVB intervention program.

*Social support.* Consistent with previous studies that have shown different types of social support for PA were a significant component of the interventions [28], support from peers, friends, family members, coaches, and volunteers was evidenced from the SLVB intervention. Peer support facilitates a sense of feeling that members matter to one another and to the group as people shared their experiences with others [19]. This was consistent with the research results that participants were associated with buddies who rendered support by motivating them and making them feel welcome at the activity [2]. However, peer pressure was perceived by a few female participants during mock competitions despite good peer intention to encourage them to serve well. They felt stressed during service because if they could not serve successfully, points would be deducted. Peer pressure can be counter-productive if not managed appropriately and in a timely manner.

## **At the perceived environment level**

The diverse environment in which PA took place also influenced participants' engagement in the intervention. For example, the culture of the environment and facilities enable continued exercise. By contrast, inaccessible facilities and transport inhibit continued exercise [19]. Participant's experiences of the environmental factors influence how they feel and act. Dynamic, multidirectional relationships exist among various SEM levels [31]. Our findings revealed that comfort, privacy, and spaciousness of and accessibility to the venue were necessary for engaging PWPD in PA.

*Comfort, privacy, spaciousness.* To encourage participation in PA, venues need to be warm, clean and proximal to home [13]. Our results indicated that comfort (e.g., room temperature, drinking water facility, and attitude of the security guards), privacy, and spaciousness of the venue (spacious enough to accommodate participants' wheelchairs and their belongings) were crucial for engaging PWPD in PA.

*Accessibility concerns.* Despite that a supportive environment that is culturally accepting of differences is crucial for PWPD to maintain a physically active life, PWPD face multiple environmental and social obstacles that inhibit them taking part in sports and PA [32]. Many participants are wheelchair users who drew considerable attention to accessibility issues. Our findings revealed that if concerns regarding steep roads leading to the venue, availability and proximity of parking spaces, ease of use of the toilet facility, and ease of transportation are not satisfactorily addressed, the PWPD will not be encouraged to engage in PA.

## **At the community or organizational level**

*Safety.* The disability PWPD poses a potential obstacle in PA. Safety is certainly a concern when playing sports, particularly for PWPD and people with a relatively low fitness level. Considering the different categories and levels of disabilities of the participants, our findings revealed that they were vulnerable to

loss of balance, falling, and injury. They might strain their muscles and even experience abrasion while dragging or moving their legs on the floor because their legs were powerless. At their age (i.e., average 53.32 years), the chances of injury were higher. Nevertheless, the use of proper techniques (e.g., teaching them how to prevent falling as well as teaching them to fall properly) and protective gears (e.g., elbow-ankle and knees supporters to protect their ankles from abrasion) can reduce potential risk.

*Dissemination of information.* In terms of the importance of communication, participants should be allowed to communicate with each other by means of multiple ways to meet individual preference and capabilities (phone or email) [19]. The participant opined that a specific WhatsApp group should have been used by the responsible party to disseminate relevant information such as change of venue and training schedule. A range of resources should be drawn upon to disseminate PA information through more engaging means.

*Community facilities.* Inaccessible facilities are obstacles to continue exercise [19], and our findings too revealed that lack of wheelchair-friendly and wheelchair-accessible facilities in the community (public sports complex or NGOs) discouraged participation in SLVB in the future.

## **At the policy level**

Resource allocation was identified as one of the difficulties among NGOs at promoting sports in the community. Among the many elements influencing participation in PA at an old age, the importance of affordable activities has a strong evidence base [33, 34]. However, this intervention project was funded, and participants could attend all the sessions free of charge. Thus, the element of affordability was not included in this qualitative study.

## **Suitability and feasibility of our SLVB intervention contents**

Because SLVB is played in a sitting position, it is less impactful and less intensive than wheelchair basketball. Furthermore, it uses a bigger, lighter, and softer ball (compared with SVB) and lower net and is expected to be easier to learn and control and more suitable (expected outcomes) than traditional volleyball for those with motor disabilities and muscular degradation. The interview results revealed the expected outcomes that SLVB was considered by many participants (both female and male) to be suitable for PWPDP mainly because it is played in a sitting position and was less vigorous and intensive than wheelchair basketball; therefore, a player's hands would not be hurt easily. Nevertheless, due consideration must be given to the different categories and levels of disabilities of the participants while mapping out an intervention program for PWPDP. Their comments about the rules of SVLB also reflected that our modification to SVB and LVB seemed reasonable to them.

Regarding the intervention, participants were satisfied with its content, coaching, time, and class size. Adaptable activities like SLVB are important so that people can proceed at their own pace within an activity [13]. The results of this qualitative study indicated that flexible scheduling was an important

element of the intervention program. As far as possible, it should take into consideration participants' family days, other training sessions (like wheelchair basketball), and work schedule. In addition, participants preferred longer and flexible training sessions.

## Reflections and recommendations

To the best of our knowledge, this qualitative study was the first of its kind to examine the association between the SLVB intervention elements and outcomes and to explore PWPDs' experiences of participating in a 15-week SLVB intervention. Both participants who completed or did not complete the intervention program were invited for interviews, which enhanced the vigor of this study. However, the study has a few limitations. First, exit instead of interim interviews were conducted, which inhibited interim improvements of the intervention program. Second, all participants came from the same partner NGO, which might lead to group-think.

Furthermore, our findings provided insights into a few issues important for mapping out future SLVB intervention programs, namely designing the project contents with due considerations disability conditions (for instance, teaching them how to fall properly in view of their disability conditions), using protective gears (e.g., supporters for elbows, knees, and ankles) to reduce the risk of hurting their hands and legs, being sensitive to and timely handling of peer pressure, and having a specific communication channel (e.g. WhatsApp group) for dissemination of information among the participants. In addition, this qualitative study also identified a few areas for future studies to explore whether better engagement effects on PA could be attained by recruiting samples from multiple NGOs with more participants and an equal sex ratio, dividing the class into two groups of players according to their levels of mastering the techniques, flexible scheduling that takes into account participants' family day or other schedules, working out an optimum ratio between the number of coaches and players, and testing the importance of the element of affordability.

## Conclusion

This qualitative study identified several primary drivers and barriers for engaging PWP in SLVB. It demonstrated that adopting a multilevel approach to intervention in PA has positive outcomes for the participants. Taken together with the limitations and recommendations, the findings contribute to an in-depth understanding of the perceptions and experiences among PWP in the SLVB intervention, which is very critical to the further development of SLVB in terms of a PA intervention and sport. Furthermore, our results could be used for establishing the experiential aspects of SLVB and accounting for the suitability and feasibility of organizing SLVB-related activities in a community setting in the future.

## Abbreviations

sitting light volleyball (SLVB), social-ecological model (SEM), people with physical disabilities (PWP), physical activities (PAs), the Government of Hong Kong Special Administration Region (HKSAR), light

volleyball (LVB), rouliqiu (RLQ), sitting volleyball (SVB), non-government organization (NGO), thematic analysis (TA).

## **Declarations**

### **Ethics approval and consent to participate**

All research activities were reviewed and approved by the University Institutional Review Board. Written informed consent was obtained from participants prior to study commencement.

### **Consent for publication**

Not applicable.

### **Availability of data and material**

Parts of the anonymized transcripts are available from the corresponding author on reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

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### **Authors' contributions**

The first author contributed on research concept and study design, literature review, data collection, data analysis and interpretation, statistical analyses, and writing of the manuscript. The second author contributed on research concept and study design, reviewed and edited a draft of the manuscript. The third author interpreted data drafted the manuscript. All authors read and approved the final manuscript.

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## Tables

Tables 1 and 2 not provided with this version

## Figures

**Figure 1 not provided  
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Figure 1