

## **Research Proposal**

*This Research Proposal document consists of Section A, B and C:*

- *Section A: Application Type and Area(s) of Research*
- *Section B: Main Proposal*
- *Section C: Annex (For Resubmission/Renewal only)*

*Please upload the research proposal (named as “Research Proposal”) under the Research Proposal sub-section in IGMS.*

*Please use Arial font size 10 for all text.*

### **Section A: Application Type and Area(s) of Research**

*Please indicate the type of application.*

<b>Application Type</b>		<b>Please Tick</b>
a)	<b>New submission</b>  I declare that I have not submitted any similar proposals to NMRC prior to this submission.	✓
b)	<b>Resubmission</b>  No. of resubmission attempts: All Past Application ID(s): <i>Please note resubmission attempts is capped at 2 times.</i>  <u>Additional Requirement – Summary of Changes to Proposal</u> Under Section A, in no more than 2 pages, please summarise how the resubmission has addressed past reviewers'/panel's comments and highlight new features/merits of the resubmission.  <i>If you have submitted to this programme before, your application is considered a “resubmission” if the last submission was not awarded.</i>	
c)	<b>Renewal</b>  Past Project ID:  <i>If you have been awarded within the same category you are applying for under this programme, your application is considered a “renewal”.</i>	

*Please tick the relevant box below if the **main area** of research is in one of the following fields. You may tick more than one box if there are more than one main area of research.*

<b>Area(s) of Research (Please Tick)</b>	
<input type="checkbox"/> Medical Technology (MedTech)	<input type="checkbox"/> Artificial Intelligence (AI)
<input type="checkbox"/> Data Science and Data Analytics	<input type="checkbox"/> Digital Health
<input type="checkbox"/> Epidemiology	<input type="checkbox"/> Family Medicine and Primary Care
<input checked="" type="checkbox"/> Healthy and Meaningful Longevity	<input type="checkbox"/> Implementation Science
<input type="checkbox"/> Precision Medicine	<input checked="" type="checkbox"/> Population Health

## **Summary of Changes to Proposal** (only applicable for resubmissions)

*In no more than 2 pages, please summarise how the resubmission has addressed past reviewers'/panel's comments and highlight new features/merits of the resubmission.*

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## **Section B: Main Proposal**

*In no more than 12 pages (page limit excludes the translation pathway, key performance indicators and reference section), the proposal should include following sections.*

*Please note that hyperlinks are not allowed within the Proposal document except for Section X – References.*

- I. Specific aims & Hypothesis
- II. Background & Clinical Significance
- III. Description and Impact
- IV. Preliminary Studies/Progress
- V. Methods/Approach
- VI. Roles of Team Members
- VII. How the research furthers the vision/mission of NMRC
- VIII. Translation Pathway
- IX. Key Performance Indicators (KPI)
- X. References

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**Proposal Title: Dose-response Effect of Community Dance Programme on the Physical, Cognitive, Psychosocial Health of Pre-frail Older Adults: An Interventional Study with Co-design Approach and Process Evaluation**

**I Specific Aims & Hypothesis**

Frailty is a complex phenomenon with multiple dimensions in physical, psychological and social domains. It is common among older adults, and is characterised by depletion of reserves in multiple organ systems leading to physiologic vulnerability such as increased risk of falls, functional decline, as well as reduced capacity to withstand and recover from acute injury or stress [1]. **Hence, it is important to prevent frailty and enable older adults to live healthily in the community.**

Across different musical genres and dance styles, dancing has been shown to improve muscular strength, endurance, and balance [2]. Furthermore, dance with music is effective for increasing motivation and adherence to prescribed physical exercises [3]. **Apart from its benefits among healthy older adults, dance can alleviate symptoms experienced by older adults with medical conditions by increasing flexibility, balance confidence, and motor performance [4].**

The results of our meta-analysis showed that dance interventions had a significant effect on global cognition, memory, visuospatial function, and language in older adults with mild cognitive impairment [5]. We also found that dance interventions produced a significant effect on physical function and quality of life. The subgroup analysis demonstrated that interventions longer than 3 months and higher frequency (3 times per week) had a larger pooled effect size than short-term and less frequent dance interventions. **In summary, dance interventions have been shown to be beneficial for older adults, such as improving their physical health, cognitive function, as well as their psychosocial and emotional well-being by ameliorating depression, anxiety and social isolation [5].**

We have recently completed a pilot study of an 8-week dance programme, with 27 older adults [Age-mean (SD): 71.04 (6.3)] in the intervention (dancing) group and 27 in the control group [Age-mean (SD): 73.81 (5.8)] at Active Ageing Centres. This pilot study showed that those in the dancing group reported significantly higher quality of life ( $p=0.044$ ). The qualitative findings provided insights that older adults enjoyed participating in the creatively crafted dance programme, while learning nature and world travel-based dance movements [6].

**However, there are unresolved concerns and issues about a feasible and acceptable dance programme that can be tailored in dose and duration.** Firstly, some felt it was a steep learning curve, as they did not have any foundation in dance. Secondly, the pilot study was underpowered to show significant differences in physical function, cognition, mood, and social connection. Additionally, the intervention programme was only conducted over 8 weeks (1 time per week, 1 hour per session), which was less than the desired duration and frequency of the dance intervention as recommended by the meta-analysis [long-term interventions (>3 months) and higher frequency (3 times per week)]. Thirdly, 15% of participants dropped out of the dance programme due to fatigue, muscle ache, and chronic conditions [6].

Thus, the overall aim of this study is to use data derived from the pilot study to design and conduct a definitive study to define the **dose-response effect that a systematic dance programme may have on physical, cognitive and psycho-social health in our local population**. The primary objective of the proposed project is to develop and evaluate a **Community Dance Programme**, which is aimed at promoting physical strength, balance, cognition, and psychosocial well-being of pre-frail older adults. An **interventional study with co-design approach and process evaluation** will be applied.

**The Specific Aims are to:**

**#1: Apply a co-design approach to develop a Community Dance Programme (CDP).**

With the expertise of the multi-disciplinary research team and community partners, we will first conduct a **Needs Assessment** with focus group discussions among older adults to understand the factors promoting dance and measures for overcoming common side effects of dance (e.g. fatigue, muscle aching). Next, we will engage the stakeholders (**older adults, Active Ageing Centres staff, and dance instructors**) in the co-design process of tailored dance intervention, taking into consideration of older adults' age, physical conditions, and cultural preferences on the type of dance.

**#2: Examine the dose-response effect of CDP on quantitative measures of physical, mental and psychosocial health, cognition, and quality of life among pre-frail older adults.**

We plan to conduct a **cluster randomised controlled trial** to examine the dose-response effect of the **CDP** among pre-frail older adults in the community. We **hypothesise that the older adults in the**

intervention clusters with a higher dosage of **CDP** (3 sessions/week **vs.** 1 session/week in control cluster, over 12 weeks) will have **significantly improved physical health** (**Short Physical Performance Battery-primary outcome**, Edmonton Frailty Scale, biomarkers: DNA methylation in saliva samples and muscle oxygenation via Moxy device), **cognitive function** (Montreal Cognitive Assessment, Symbol Digit Modalities Test), **psychosocial and mental health** (Geriatric Depression Scale, de Jong Gierveld Loneliness Scale, Subjective Happiness Scale, Social Support Questionnaire), and **higher quality of life** (WHOQOL).

**#3: Generate qualitative evaluation of the stakeholders' experiences on the CDP with a focused ethnographic approach**

We plan to adopt **focused ethnography** to systematically and comprehensively explore the perspectives and experiences of stakeholders, including **older adults, Active Ageing Centres staff, and dance instructors**. This approach will engage field visits and observations, in-depth focus group discussions and intensive data analysis. This design enables the judicious exploration of the distinct phenomenon experienced by stakeholders involved in **CDP** in the community settings.

The Community Dance Programme focuses on **preventive health**, takes **proactive steps to stay physically active**, and leads to **healthier lifestyles**. Findings from this study will provide scientific evidence on the **effective dose of dance programme** which balances benefit on improving physical function against side effects of muscle ache and fatigue. A distinctive feature of our project is the collaborative effort of our multi-disciplinary research team and community partners to develop this programme and bring benefits to the pre-frail older adults living in the community. This customized dance programme, if proven effective, can be optimized for our local community, which provides a platform to promote **Healthier SG** initiative to a wider population of older adults.

## II Background & Clinical Significance

**World ageing** has become one of the most significant social issues in recent years, with the older population aged 65 years and above projected to increase from less than 10% to around 17% by 2050 [7]. A “super-aged” society refers to a country where there are more than 21 percent of the individuals who are aged 65 years and older. Singapore will be a super-aged society by 2026, joining other countries such as Japan, Italy, and Germany. This phenomenon implicates the importance of healthy ageing to reduce healthcare cost and burden in the long run [8].

Frailty, common among older adults, may involve weight loss, muscle weakness, low levels of physical activity, exhaustion and slowness in walking and movement. It usually results from physical or psychological stress, such as trauma, disease, or the loss of a loved one. An individual with frailty may lose functional abilities and become care-dependent [9]. According to a systematic review and meta-analysis involving data of more than 120,000 older adults from 28 countries, the incidence of frailty and prefrailty was estimated at 43.4 and 150.6 new cases per 1000 person-years respectively. This study suggested that community-dwelling older adults are prone to developing frailty. Hence, increased awareness of factors contributing to high risks of frailty is crucial, so as to inform the design of interventions to prevent frailty and minimize its consequences [10]. Being a **complex and multi-dimensional phenomenon**, a local study reported that multimorbidity, cognitive and functional impairment were associated with frailty. **Interventions were recommended to be multi-modal to affect behavioural change and promote health in the ageing population** [11].

In order to support older adults to live healthily in the community, it is important for them to maintain good physical, cognitive and psychosocial health. Evidence shows that older adults lack exercise; as a result, they may experience decreasing muscular strength, which could lead to reduced sense of balance or even fall. Regular physical activities would help with preventing chronic diseases [12]. However, adherence to physical exercises is a significant challenge in the older population. Nonetheless, **dance with music is effective for increasing motivation and adherence to prescribed physical exercises** [3]. Dance, as a type of aerobic exercise, is able to significantly improve physical conditions of older adults by providing adequate exertion [13]. Across different movement-based activities, dancing has been shown to **improve muscular strength, endurance and balance** [2]. Apart from healthy older adults, dance can reduce symptoms experienced by older adults with medical conditions by increasing their flexibility, balance confidence and motor performance [4]. After dance intervention, older adults tend to have a better understanding of balance, which can decrease their risk of fall [14, 15].

Dancing also promotes the psychosocial well-being of older adults [16]. These activities provide enjoyment and enhances community engagement of older adults [13]. Additionally, dance could also

be used to **support cognition by engaging older adults with movements and music** [4, 17]. Not only can dance to music be effective for improving cognitive performance among the elderly, it has also been shown to help **decrease anxiety and depression**, as well as **improving their quality of life** [18-20]. **Low cost** is another advantage of dance programmes, as they are more **sustainable to be carried out within the community** [13]. Hence, dancing is one of the most effective programmes for promoting healthier ageing among community-dwelling older adults.

The older adults **enjoyed dancing**, which could **evoke positive memories from the past** as a form of reminiscence [21]. While integrating dance with reminiscence therapy, tangible prompts such as historical items, old photographs, videos, and songs are often used to evoke memories and stimulate conversations. A meta-analysis demonstrated that reminiscence-based interventions significantly reduced depressive symptoms, **improved life satisfaction, enhanced self-esteem, and happiness** among cognitively intact older adults [22]. Dance with elements of reminiscence intervention can enhance one's quality of life. Additionally, the **group-based dance intervention reduces loneliness**, thereby **minimising the risk of social isolation**, and provides a platform to **develop friendships and social support** among the older adults [23, 24].

Generally, it is well recognized that dance and physical exercises impact brain plasticity, cognitive and physical functions positively. However, emerging evidence demonstrates that different exercise regimes (i.e., variations in frequency, dosage, duration) induce heterogeneous outcomes across individuals. However, **limited research investigated the dose-response effect of dance intervention**. Hence, we refer to the research of the dose-response relationship in physical exercise. A systematic review examining the dose-response relationship between exercise and cognitive function in older adults has demonstrated that exercise programmes with a short session duration and high frequency predict higher effect sizes ( $d=0.43-0.50$ ) in older adults with cognitive impairments [25]. With a customised exercise prescription, dosage can be made comparable across individuals, which is necessary for validated evidence of the dose-response relationship in physical exercise and dance research. This insightful evidence of **dose-response relationships could contribute to designing more efficient physical training approaches (e.g., dance intervention)** against frailty and cognitive decline [26].

Dance is a **non-pharmacological and cost-effective approach** of physical exercise which could be recommended for older adults at a **larger-scale community level**. Nevertheless, the **effect of the dance intervention duration and dose-response frequency could be investigated further to gain insight into possible maintenance effects**, such as one's cognition, physical, and psychosocial function. Additionally, **some practical issues need further examination**, such as the **factors promoting dance, overcoming common side effects of dance, and integration of dance as a regular programme in the community**, to promote sustainability of dance intervention among prefrail older adults. Finally, a **dance intervention with larger sample size, and varying doses of intensity, duration can enable us to more closely investigate the physiological mechanisms underlying the effects of dance on desirable ageing outcomes**.

### **Short-term Aims**

Our study aims to determine the **effectiveness of a dance programme on the physical function and psychosocial health** in approximately 200 pre-frail older adults using a CRT design. We aim to **ascertain the optimal therapeutic dose level and dosing frequency of the dance intervention** (i.e., number of dance sessions per week). Since a larger number of participants will be involved in the dance programme of the proposed study, there is a greater chance to observe for data on side effects. Findings from this study will provide scientific evidence on the **effective dose of dance programme**, which balances the benefits on improving physical function against its side effects. Therefore, if proven effective, this intervention can be optimized for our local community, while **promoting population health** and the **Healthier SG** initiative to a wider population of older adults.

### **Long-term Aims**

In the long term, we plan to conduct the **evidence-based dance programme** with a **wider population** of pre-frail older adults at multiple AACs across the country. Applying **Implementation Science**, we will undertake a scientific study of strategies to facilitate the uptake of evidence-based research (dance programme) into regular use by community practitioners (AAC staff). We aim to reach out to thousands of pre-frail older adults; massive testing of the dance intervention provides **continuing generation of data on the safety and efficacy of the intervention**. The field of implementation science seeks to systematically close the gap between what we know and what we do (**know-do gap**) by identifying and addressing the barriers that slow or halt the uptake of evidence-based dance intervention [27]. The CDP focuses on **preventive health** and taking **proactive steps to stay physically active**, which leads

to **healthier lifestyles**, as well as reduced hospitalisation rates and institutionalization at long-term care facilities.

### III Description and Impact

Exploring **minimally invasive interventions to improve physical function, cognitive and psychosocial health among the ageing population** is our key motivation. Dance intervention has been shown to bring numerous benefits for older adults, such as improving their cognition, physical and psychosocial well-being by ameliorating depression, anxiety, and social isolation [5]. With the evidence generated from the meta-analysis and pilot study, we are confident that **Community Dance Programme (CDP)** will make a positive impact on the older adults' physical, psychosocial, and cognitive health. Additionally, findings from this proposed study will provide further scientific evidence on the **effective dose of the dance programme** which balances its benefits on improving physical function against its side effects.

The positive impacts of **CDP** will encourage older adults to **live an active life and maximise their social capital within the community**. Therefore, **CDP** promotes the health and well-being of pre-frail older adults, while reducing their geriatric-related conditions. The outcomes of the study will have tremendous potential to be implemented at a larger scale within the community. Upon completion of the project, we will work closely with other **AACs** and the **Agency of Integrated Care (AIC)** to integrate **CDP** into their existing programmes. **CDP** could then benefit a larger population, given the evidence gathered from our research.

In the Singapore's healthcare landscape, AACs are the community partners who work closely with AIC. AIC was formed as an independent corporate entity under MOH Holdings to work with stakeholders and partners in developing the Community Care Sector. AIC reaches out to caregivers and seniors with information on staying active and ageing well, while connecting people to services they need. Hence, **our partnership with AIC will facilitate the uptake of the evidence-based dance programme across the AACs located island-wide**, so as to **support healthy and active ageing**. Additionally, AIC supports partners in strengthening their capability to deliver quality care, bringing them together to meet the needs of our ageing population. With the support from AIC and the **Age Well National Initiative**, **we will work with our community partners and dance instructors to train and equip the community care staff with health assessment and monitoring skill sets**, so as to ensure the safety of our older adults during the dance intervention.

### IV Preliminary Studies/Progress

The results of our meta-analysis showed that **dance interventions had a significant moderate effect on global cognition** ( $SMD = 0.54$ ,  $Z = 3.55$ ,  $p < 0.001$ ), **significantly improved memory** ( $SMD = 0.33$ ,  $Z = 3.97$ ,  $p < 0.001$ ), **visuospatial function** ( $SMD = 0.42$ ,  $Z = 2.41$ ,  $p = 0.02$ ), and language ( $SMD = 0.39$ ,  $Z = 2.69$ ,  $p = 0.007$ ) in older adults with mild cognitive impairment (Wu et al., 2021). We found that dance interventions produced a **significant moderate effect on physical function** ( $SMD = 0.55$ ,  $Z = 3.43$ ,  $p < 0.001$ ), and a **significant effect on quality of life** ( $SMD = 0.93$ ,  $Z = 5.04$ ,  $p < 0.001$ ). The subgroup analysis demonstrated that **long-term interventions (>3 months) and higher frequency (3 times per week) had a larger pooled effect size** than the short-term and less frequent dance interventions. The review recommended that selection on the **type of dance should consider the social-cultural factors**; for instance, Latin dance is popular in South American region, whereas line-dancing has higher popularity in East Asian region.

The **PI and two investigators (A/P Tam, Dr Goh)** have completed a pilot study of an 8-week dance programme, with a total of 54 older adults participated, 27 older adults [Age/mean (SD): 71.04 (6.3)] in the intervention (dancing) group and 27 in the control group [Age/mean (SD): 73.81 (5.8)] at the AACs in 2021-2022. The results showed that **dance is an effective solution to achieve significantly higher quality of life ( $p=0.044$ )**. The qualitative findings provided insights that older adults enjoyed participating in the creatively crafted dance programme, and they learnt nature and world travel-based dance movements from the student instructors. Nevertheless, they felt it was a steep learning curve, as some did not have any foundation in dance [4]. However, the **pilot study did not show any significant improvement in physical function, cognition, mood, and social connection, which was inconsistent with the results of meta-analysis**. The inconclusive results of the pilot study could be due to small sample size, limited number of centres, and its quasi-experimental design. The dance practice was conducted over 8 weeks (1 hour session weekly), which was below the desired duration and frequency of the dance intervention as recommended by the meta-analysis. Additionally, 15% participants dropped out of the dance programme due to fatigue, muscle aching, chronic

conditions, etc. Hence, there are still unresolved issues and unanswered questions about a feasible and acceptable programme that can be tailored in dose and duration, in which a dose-response analysis of the tangible benefit of a dance programme on multi-dimensional frailty in our local population will be needed in the proposed study.

**Table 1: Physical, cognitive, and self-reported psychosocial performance Pre- and Post-Intervention**

Physical variables	Control group		Intervention group		General Linear Model (GLM)	
	Unadjusted Mean Difference (95% CI)	p (paired t-test)	Unadjusted Mean Difference (95% CI)	p (paired t-test)	Adjusted Mean Difference (95% CI)	p-value
SPPB	-0.26 (-0.47, 0.99)	0.473	0.41 (-0.91, 0.10)	0.110	0.46 (-0.38, 1.30)	0.278
Hand grip	0.59 (-4.25, 3.06)	0.742	1.06 (-3.42, 1.30)	0.365	0.01 (-4.36, 4.38)	0.998
<b>Cognitive variables</b>				Adjusted Mean Difference (95% CI)	p-value	
MoCA	-0.22 (-0.83, 1.28)	0.668	0.78 (-1.81, 0.25)	0.133	0.64 (-0.76, 2.04)	0.363
SDMT	5.70 (-11.12, -0.28)	0.040*	-1.00 (-1.05, 3.05)	0.325	-6.70 (-12.13, -1.26)	0.017*
<b>Psychosocial variables</b>				Adjusted Mean Difference (95% CI)	p-value	
Subjective happiness	-0.13 (-0.19, 0.45)	0.415	0.17 (-0.56, 0.23)	0.391	0.12 (-0.30, 0.54)	0.560
Quality of life	3.76 (-11.28, 3.77)	0.314	10.25 (-20.23, -2.82)	0.044*	6.79 (-4.95, 18.53)	0.251
Social support (satisfaction with support)	0.23 (-0.48, 0.01)	0.062	-0.04 (-0.32, 0.39)	0.830	-0.28 (-0.68, 0.12)	0.169

Note: General Linear Model (GLM): added pre-measurement and group type as covariates. \*p < .05.

Abbreviations: SPPB, Short Physical Performance Battery; MoCA, Montreal Cognitive Assessment; SDMT, Symbol Digit Modalities Test.

## V Methods/Approach

### Overall Research Design

An **interventional study with co-design approach and process evaluation** will be applied.

**The Research Question** is: What is a dance programme (genre, intensity, duration, and frequency) that strikes a balance between enhancing physical function and minimizing its potential side effects among pre-frail older adults, and will also be acceptable in our local population?

### Participants and Eligibility Criteria

Recruitment posters will be posted at **Active Aging Centres (AACs)** at Lions Befrienders (LB). LB has 14 AACs island wide which deliver a full range of integrated services for community-dwelling older adults, providing convenient access to services, while creating opportunities for seniors to interact and build friendships with members of the community. The Research Assistant (RA) will check eligibility of the subjects. Older adults will be recruited from AACs.

The **inclusion criteria** are: 1) aged 60 to 85; 2) able to understand and communicate in either English or Mandarin; 3) able to give consent to participate; 4) lives within the community setting; 5) obtain at least a score of 7 in Edmonton Frail Scale [28]; 6) able to ambulate with minimal assistance; 7) able to achieve at least 75% attendance rate of the dance programme; 8) consent to video and audio recording of the dance sessions and FGDs.

The **exclusion criteria** are older adults with: 1) medical conditions which result in limitation of dancing, e.g. walking aids, wheelchair bound; 2) severe cognitive or psychiatric disorders; 3) severe hearing or vision impairments; 4) registered in any other dance group during interventional period.

## **Aim #1: Co-design of the Intervention**

### **Study Design**

The contents of the programme are developed based on our systematic review [5], pilot study, needs assessment and content validation, as illustrated in the following process:

**(1) Needs assessment** will be conducted for stakeholders, such as the **older adults, AAC staff, and dance instructors**, to understand their needs (e.g., factors promoting dance, measures to overcome common side effects of dance, social-cultural considerations) and seek their opinions to further develop the programme. A **qualitative approach with in-depth, face-to-face, focused group discussions** (FGDs) will be used. A purposive sample of 20 to 30 participants (older adults, AACs staff, and dance instructors) will be recruited. An interview guide will be developed based on the literature review and guide the FGDs. Each FGD consists of 5-6 participants and lasts for 45 to 60 minutes. Five to six FGDs will be conducted. The decision on the sample size for qualitative study depends on data saturation. The **qualitative data will provide valuable information in the development of CDP**.

**(2)** Furthermore, WHO's Integrated Care for Older People: guidelines on community-level interventions (**WHO ICOPE**) will be applied as the framework to guide the development of **CDP** to promote the **intrinsic capacity** of older adults. ICOPE is developed based on five intrinsic capacity domains. It comprises **physical outcomes** such as balance, gait, mobility, hand grip strength and vision, as well as **psychosocial** domains including depression symptoms, quality of life and cognition [9, 29].

**(3) Content validation** will be evaluated by a **panel of multi-disciplinary experts** including Dance Artist (Ms Ebelle Chong), Geriatric Nurse Scientist (Dr Vivien Wu), Exercise Physiologist (Dr Goh Jorming), Consultant Geriatrician (Dr Matthew Chen), Performing Arts Researcher (A/P Liang Peilin), AAC Director (Ms Justina Teo), Agency of Integrated Care Director (Ms Charmaine Tan). The panel will review the contents of **CDP**, provide suggestions and make further refinements. This process consists of multiple iterations, which aim at designing a customized **CDP** to meet the needs of our local older population with social-cultural consideration.

### **Novelty – Co-design of Community Dance Programme**

**CDP** will be developed to promote older adults' physical, cognitive, and psychosocial health through dancing. The outline of **CDP** is illustrated in Table 2 and 3. **Contemporary dance** will be used, as it promotes a balance between didactic and creative aspects [30]. We plan to **integrate nature and travel themes**, to provide older adults with **spaces for creativity and imagination**. The **CDP** includes both seated and standing body movement such as leg extensions and lunges to **build on their strength and balance**. Each dance session will last for one hour and will be conducted in a semi-structured manner. Apart from the didactic choreography taught by the instructors, the older adult participants will be encouraged to improvise and incorporate new dance movements relevant to the theme of that week into the existing choreography, whilst actively engaging in the dance sessions. The dance sessions for older adults aim to provide progressive learning. The participants will immerse themselves in dance that develops their body awareness, focuses on strength building, encourages artistry and expression.

### **Mode of Delivery**

The chief dance instructor is the artistic director and resident choreographer of *Dance Synergy*, a university contemporary dance society, while being experienced in conducting dance programmes for seniors. The chief dance instructor will contribute to the choreography of the dance programme, and conduct training for the student instructors. The student instructors will meet older adults at AACs in groups of 12 to 16. During each dance session, there will be time reserved for small group practice where older adults will be further divided into 4 small groups. The student instructors will help the older adults in each small group to recall the dance steps and practice. Both demonstration and small group practices will be engaged as the teaching methodology for the workshop.

The **CDP** will be delivered over a period of 12 weeks. Subsequently, the older adults will join the **CDP** to practice under the guidance of the student instructors. Older adults will learn and practice the basic steps together for the first few weeks. Then, the student instructors will start teaching on the final dance formation. The final dance performance showcase will be during the last week. During each session, participants will need to warm up first to prevent injuries. The small group practices also allow the older adults to interact with each other and with the student instructors. All the participants will do relaxation exercise before ending the session to cool down their bodies and release muscle tension.

**Table 2: Structure of the Community Dance Programme**

Week	Brief Lesson Plan
1	Introduction of the Dance programme. Warm up with basic dance steps

2-3	Contemporary Dance (Nature Theme - didactic and creative aspects): Step by step learning and practice group dance
4-5	Practice - dance formation, <b>Retrospective Reminiscence Theme (Back to 1980's)</b>
6-7	Step by step learning and practice group dance, <b>Travel Theme</b>
8-9	Practice - dance formation, <b>Integrated with self-creation of movements</b>
10-11	Practice and rehearsal – dance formation with Costumes
12	Final dance performance showcase

**Table 3: Outline of each dance session**

Duration	Progress
10 mins	Warm up
15 mins	Steps learning
15 mins	Small groups practice
10 mins	Revision
10 mins	Relaxation/Cool down

## **#2: Cluster Randomised Trial (CRT) on the Dose–response Effect of CDP**

### **Study Design**

A CRT with parallel, single-blind (i.e., participants will be blinded), pre and post-test measures will be conducted to examine the dose-response effect of the **CDP** among pre-frail older adults in the community. In order to examine the dose-response effect of the **CDP**, the dose frequency of intervention cluster is designed as:

**Intervention Clusters:** 3 sessions per week and 1 hour per session;

**Active Control Clusters:** 1 session per week and 1 hour per session.

**Hypothesis:** Older adults in the intervention clusters with **higher dosage of CDP** will have **significantly improved physical health, cognition, psychosocial health, and higher quality of life.**

### **Randomisation**

Since the **CDP** is a group-based intervention, a CRT method will be used to avoid contamination, as the older adults in the same centre will usually interact and share their experiences with one another. CRT is recommended when the target of the intervention is a collective or system rather than an individual [31]. We will recruit participants from 10 AACs. The 10 AACs will be randomised into intervention and active control clusters; participants from the active control clusters will be recruited from 5 AACs, while participants from the intervention clusters will be recruited from the other 5 AACs.

### **Sample Size**

For the CRT, the sample size is estimated by the method suggested by Hemming et al. [32]. First, the conventional sample size estimation was computed using the formula from Matthews [33]. For the effect size, as there was no previous study comparing different intensity, we borrowed the effect size reported in one systematic review (0.55) and one randomised controlled trial (0.4) which had similar intervention as ours [5, 34]. As their studies are comparing the intervention group with control group without the intervention, the mid-point of their effect sizes was taken for the sample size estimation. Given an effect size of 0.48, 5% level of significance and 80% power, 69 subjects per group are needed to detect the difference. The modification formula is then used. Given that the common Intra-class Correlation Coefficient (ICC) is 0 to 0.1 from the literature, an ICC of 0.05 is assumed in this study. As we estimate about 20 to 30 eligible subjects per centre based on our prior study experiences, the number of subjects per arm needed in the CRT becomes 128. Assuming a 10% attrition rate, a total of 284 participants with 142 per group will be recruited.

### **Outcomes Measurement**

Objective assessments and self-reported questionnaires will be used. Outcome measures will include **physical health** (Short Physical Performance Battery, Edmonton Frailty Scale, biomarkers), **cognitive function** (Montreal Cognitive Assessment, Symbol Digit Modalities Test), **psychosocial health** (Geriatric Depression Scale, de Jong Gierveld Loneliness Scale, Subjective Happiness Scale, Social Support Questionnaire), and **quality of life** (WHOQOL).

### **Primary Outcome:**

**A) Physical Health - Short Physical Performance Battery (SPPB):** evaluates the physical function.

This instrument comprises physical tests of standing balance, gait speed, and chair stand. Each component (i.e., balance, gait speed, chair stand) will be scored from 0 to 4, with a score of 0 indicating

inability to carry out the test and a score of 4 indicating perfect execution of the test. The total score ranges from 0 to 12, with higher scores indicating higher physical performance [35].

**Secondary Outcomes:**

**B) Frailty - Edmonton Frail Scale (EFS):** This is an 11-item questionnaire that examines nine domains of frailty (i.e., cognition, general health status, functional independence, social support, medication use, nutrition, mood, continence, and functioning performance). The scores range from 0 to 17, with higher scores indicating higher levels of frailty. The scores can be categorized into five levels of frailty, namely: fit (0–3), vulnerable (4–5), mild frailty (6–7), Moderate frailty (8–9) and severe frailty ( $\geq 10$ ). This instrument has been utilised and validated in a local tertiary hospital, with high acceptability and low inter-rater variability [36].

**C) Biomarker Analysis: DNAm testing:** DNA methylation will be measured to determine biological age. Saliva samples will be collected from participants in the fasted state and kept at  $-80^{\circ}\text{C}$  until analysis. Genomic DNA will be extracted using a DNeasy kit (Qiagen), followed by purification using the QIAamp DNA micro kit (Qiagen, Germany) and an additional ethanol precipitation step. DNA will be treated with sodium bisulphite using the EZ DNA methylation kit (Zymo Research, CA,). Cytosine methylation covering  $\sim 850,000$  CpG islands will be quantified using the Human MethylationEPIC (EPIC) BeadChip (Illumina, CA, USA) and run on an Illumina iScan System (Illumina, CA) using the manufacturer's standard protocol [37].

**MOXY Oxygen Monitor:** MOXY (Moxy, Fortiori Design LLC, Minnesota, USA) is a non-invasive small wearable portable device that measures muscle oxygen saturation ( $\text{SmO}_2$ ), using near-infrared spectroscopy (NIRS) [38]. MOXY measures oxygen levels in the muscles of participants during exercise. Saliva sampling and MOXY oxygen monitoring are **non-invasive** procedures. The RAs will instruct the participants on the collection of saliva and MOXY oxygen monitoring at AACs, and the procedures involve minimal risk for the participants.

**D) Cognitive Health:** Brief cognitive tests comprising **Montreal Cognitive Assessment (MoCA)** and **Symbol Digit Modalities Test (SDMT)**. MoCA is a screening instrument developed to detect mild cognitive impairment [39]. Study has proved that MoCA may be relatively more sensitive to detect characteristic cognitive deficits due to cardiovascular diseases prevalent in Asian elderly, and it takes approximately 12 minutes to complete [40]. We supplement the MoCA with a sensitive processing speed test, SDMT for optimal cognitive screening in the proposed study. SDMT is widely used and takes approximately 5 minutes [41].

**E) Psychosocial Health:**

**Geriatric Depression Scale (GDS-15):** This scale contains 15 close-ended questions [42]. One point is allocated per question with the total scores below four indicating the absence of clinically depressive symptoms while scores between four and nine are indicative of mild to moderate depression. Scores of 10 or more are suggestive of a major depressive episode [43]. GDS-15 has good internal consistency, test-retest reliability as well as construct validity [42].

**de Jong Gierveld Loneliness Scale (dJGLS-6):** Loneliness concerns the subjective evaluation of one's situation, characterised by either a smaller than desirable number of relationships with friends (social loneliness), or situations whereby the intimacy in confidant relationships one wishes for has not been realised (emotional loneliness) [44]. **dJGLS-6** (six-item) will be used to measure social and emotional loneliness. The dJGLS-6 scale has shown good psychometric characteristics and reliability, with Cronbach's alphas ranging from 0.81 to 0.85 among older adults [44]. The Chinese version of this scale is available, showing good internal consistency among the Chinese elderly population [45].

**Subjective Happiness Scale:** Using a “subjectivist” approach to the assessment of happiness, a 4-item measure of global subjective happiness was developed and validated in 14 studies with a total of 2732 participants. Results indicated that the Subjective Happiness Scale has high internal consistency, which was found to be stable across samples. Test-retest and self/peer correlations suggested good to excellent reliability, and construct validation studies of convergent and discriminant validity confirmed the use of this scale to measure the construct of subjective happiness [46].

**Social Support Questionnaire 6 items (SSQ6):** This scale is developed by Sarason et al. [47]. It is used to measure the number of people providing support to an individual and the satisfaction level of the individual who received the support. The scale consists of 6 items. Rating of the items is from 1 (very dissatisfied) to 6 (very satisfied). With excellent Cronbach alphas of 0.90 and 0.93 for 2 respective domains, the scale has been proved to be valid and reliable.

**F) Quality of Life: World Health Organization Quality of Life (WHOQOL)** developed WHOQOL-OLD for older adults to measure the quality of life for elderly. WHOQOL-OLD containing six facets (including sensory abilities; autonomy; past, present, and future activities; social participation; death and dying; and intimacy), with four items in each facet [48]. Each of the facets has four items and therefore can obtain a possible score ranging from 4 to 20. The sum of the facet scores results in an overall QOL

score. Different language versions of WHOQOL-OLD have been evaluated and have shown good reliability and validity [49].

**Social-demographic and Clinical Data:** Sociodemographic data includes age, gender, ethnicity, religion, marital status, employment status, education, social-economic status, source of financial support, household type/ownership, living arrangement and number of children. Clinical data includes chronic conditions, blood pressure, body mass index, dietary habits, smoking and drinking status, daily activity status (i.e., basic and instrumental activities of daily living), visual and hearing status.

### Data Collection

Objective assessments and self-reported questionnaires will be administered to the older adults. Confidentiality and anonymity will be maintained as no identifiers will be recorded in the questionnaires. Participants who are assigned to the active control and intervention clusters will be asked to complete the questionnaire at two time points: baseline (before **CDP**) and post-test (end of **CDP**). (Table 4)

**Table 4: Schedule of the Community Dance Programme (CDP)**

Visit Time	Intervention Cluster <b>CDP</b> (3 sessions per week)		Active Control Cluster <b>CDP</b> (1 session per week)	
	Visit	Procedure	Visit	Procedure
Week 0	1	Consent-taking Baseline Questionnaires and Objective Assessment	1	Consent-taking Baseline Questionnaires and Objective Assessment
Week 1-12	2-13	<b>CDP Session 1-36</b> (180 mins each session, 3 sessions per week, 36 sessions in total)	2-13	<b>CDP Session 1-12</b> (60 mins each session, 1 session per week, 12 sessions in total)
Week 13	14	Post-test Questionnaires and Objective Assessment	14	Post-test Questionnaires and Objective Assessment

### Statistical Analysis

Descriptive statistics, including mean, standard deviation, frequency, and percentages, will be used to summarize the demographic information and outcome at baseline and post intervention. Paired sample t-tests will be used to examine the differences in outcome measures between the baseline and post intervention among the participants. Analysis of Covariance (ANCOVA) will be used to examine for any differences of outcomes at post-intervention. All the analyses will be conducted using IBM SPSS (Version 28) and the significance level will be set at 5%.

Independent sample t-tests will be conducted to investigate the effectiveness of **CDP** in improving physical health and its associated variables. The independent variables will be the group type (i.e., active control vs. intervention clusters) and the time-point (i.e., pre-intervention, post-intervention), while the outcome variables will be physical performance, frailty score, cognitive score, psychosocial scores, and QOL. Analysis of covariance (ANCOVA) will be conducted to investigate the effectiveness of **CDP** in enhancing levels of the outcome variables for physical and psychosocial health. Post-intervention will be the outcome variable, while pre-intervention, and the group type (i.e., active control vs. intervention clusters) will be selected as covariates in the model.

We proposed to use t-test as a preliminary analysis and we will also use linear mixed model to explore the effect of group, time, and their potential interactions. Independent sample t-tests will be conducted to preliminarily investigate the effectiveness of **CDP** in improving physical health (e.g. physical performance, frailty, cognition and IADL scores). Linear Mixed Model will then be used to explore the effectiveness of the **CDP** after taking the repeated measure data into consideration.

### **#3: Qualitative Focused Ethnographic Approach on the Stakeholders' Experiences of CDP**

#### Study Design

A **focused ethnography** will be applied to explore the perspectives and experiences of stakeholders, including older adults, AACs staff, and dance instructors systematically and comprehensively. The purpose of ethnographic approach is to assess the **acceptability, strengths, and limitations** of the **CDP** based on the stakeholders' perspectives. This approach will engage field visits and observations, in-depth focus group discussions and intensive data analysis. The triangulation of data from multiple sources within a short timeframe compensates for the relatively time-intensive traditional ethnography [49]. This design enables a judicious exploration of the **CDP** in community settings.

#### Sampling Methods

A qualitative approach with in-depth, focused group discussions (FGDs) will be used. The face-to-face FGDs will be conducted for older adults, AACs staff, and dance instructors within 2 months after completing the intervention. A purposive sample of 20 to 30 older adults in the intervention group, 15-

20 student instructors, and 10-15 AAC staff will be recruited. Semi-structured FGDs will be conducted with **older adults to understand their perceptions and experiences regarding the activities, delivery, and acceptability of the CDP**. FGDs will be conducted with **AAC staff and student dance instructors to explore their experiences and suggestions on how to improve the CDP**. Additionally, we will explore with the student dance instructors on their perceptions of working with older adults. We will also monitor the attendance, which may reflect the **acceptability of CDP**.

Field visits will be conducted, and the researchers will **observe the behaviours and interaction of the older adults, student instructors, and AACs staff**. Field notes will be taken to document the detailed observations. An emic and semi-covert approach would be used to truly understand the experiences of participants. An emic approach is selected as it enables the researcher to truly understand the landscape from the participants' perspectives, providing a detailed micro view of their experiences [50]. A covert approach is selected for its ability to yield more fruitful data due to minimizing the Hawthorne effect, thus minimising the contamination of participants' behaviours and reactions [51]. However, for the purpose of producing more rigorous results, covert observational data will be triangulated with FGDs findings, which would be adopting a more overt approach. This will ensure congruity of data obtained from covert observations. In conclusion, the ethnographic design would enable the researcher to gain a deeper understanding of the experiences of the participants.

### **Data Collection**

The RA will invite the participants in the intervention clusters, student dance instructors and AAC staff for FGDs. Each FGD consists of five to six participants and lasts for 45 to 60 minutes. Five to six FGDs will be conducted. The decision on the sample size for qualitative study depends on data saturation. The interview guides will be developed based on the literature review, and guide the FGDs. All FGDs will be audio-recorded. The qualitative data will provide valuable information for programme evaluation.

### **Data Analysis**

The audio-recorded interviews will be transcribed into verbatim respectively. The transcripts will be analysed in its original language to capture the perspectives of the participants closely. The field notes and observation notes will be included in the analysis. Thematic analysis using Braun and Clarke's six steps of analysis will be applied to provide in-depth and rich analysis [52]. All themes and sub-themes will be translated to English during report writing by the bilingual research team members to ensure the meaning of the translated themes and sub-themes are congruent to the participants' views.

### **Ethical Issues**

NUS Institutional Review Board will be sought before data collection. The principal investigator and co-investigators will explain the purpose of the research to potential participants. Informed consent will be obtained from the participants prior to data collection. The participants will be reassured that participation in the study is voluntary, and withdrawal from the study will not result in any negative consequences. Permission to use the instruments will be obtained from the developers of the instruments prior to data collection.

### **Potential limitations and alternative approaches**

The project will be conducted at 10 AACs based on our prior project experience with LB. The project may expand to the remaining AACs within LB depending on the rate of recruitment. We will encourage participants to attend all 12 weeks of the dance programme. However, we do provide some flexibility by setting a minimum attendance rate of 75% for the dance programme, to give allowance in case the participant needs to attend to medical appointment or urgent family matters. In the event of any adverse occurrences during the intervention, the researchers and AAC staff who are first aid certified will provide the basic care and escalate the emergency services if necessary. Mitigation measures will be in place if participants experience adverse effects during or after the CDP. In addition, CDP is also prepared to conduct the sessions via a virtual platform (e.g., Zoom) in case of any unpredictable circumstances such as the COVID-19 pandemic.

## **VI Roles of Team Members<sup>1</sup>**

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<sup>1</sup> Applicants are encouraged to collaborate with AI, Data Science and/or Technology talent where possible, and the necessary budget to engage these talents can be incorporated into the grant applications where needed/applicable.

The research team comprises of **multi-disciplinary experts** with extensive experience in ageing, neurocognition, chronic disease management, immunology, exercise physiology, and biostatistics research as evidenced by their notable contributions to those high impact, peer-reviewed journals.

**Dr Wu Xi Vivien (PI)** is experienced with **geriatric community care, chronic disease management and interventions**. Dr Wu has managed national competitive grants (NMRC/PHRG, MOE/TRF). As the PI, Dr Wu has conceptualised the study with the input from the team, and will oversee the entire project, e.g., ethical application, development of **CDP**, recruitment, intervention, data collection, analysis and report writing. Dr Wu has published extensively in high impact Geriatrics, Health Technology, and Nursing journals. **Dr Wu, A/P Tam, Dr Goh** have worked on the pilot study of dance programme and co-authored papers on the ageing research (Please refer to the CVs).

**Prof Koh Woon Puay (Mentor)** is an **NMRC Clinician Scientist (Senior Investigator)** and Assistant Dean for Faculty Development in the PI's institution (NUSMed). Prof Koh is the PI of the Singapore Chinese Health Study, a 63,257-strong cohort of middle-aged and elderly Chinese Singaporeans established for the long-term study of dietary and environmental determinants of chronic diseases common among Singaporeans. As a **renowned epidemiologist**, she will provide methodological guidance on the overall conception and conduct of the study.

**A/Prof Tam Wai San Wilson (Co-I)** is an **epidemiologist and statistician** by training. He is involved in the design and analysis of large scale randomized controlled trials on respiratory health [53-55]. Besides interventional studies, Dr Tam also conducted cross-sectional surveys for emerging issues, e.g., two surveys about the mental well-being among Chinese population during the initial COVID-19 period have been published in top neurology journals in 2020 and has got more than 300 citations [56, 57]. He will work on the methodology of CRT to evaluate the dose-response effect of **CDP**, sampling methods and quantitative data analysis.

**Dr Goh Jor Ming (Co-I)**, Research Asst/Prof, is a **translational exercise physiologist** [58-60]. His study focuses on how physical exercise, including short bouts and marathon-like exercises, can cause muscular trauma and the release of high mobility group protein B1 (HMGB1), a prototypical cellular DAMP (released as a result of necrotic cell death [61]). This line of investigation helps manage training programmes to avoid sudden fatal sepsis-like conditions as well as a syndrome known as overtraining [61]. Dr Goh's leading expertise in how exercise impacts the immune system is valuable for the design and management of suitable training programmes for older adults, in collaboration with physiotherapists and exercise trainers to avoid overtraining, while providing sufficient stimulus and adaptation to the muscular system. He will work on the physical aspect of dance intervention (e.g. intensity), physical outcomes and analysis of the biomarkers with ELISA assays in his lab.

**A/Prof Liang Peilin (Co-I)** is a researcher in **theatre and performance** at NUS. Her research interests lie in health and wellness in performance, using theatre and performance as a form of sociocultural and psychophysical care. She has also led several community projects involving theatre and performances in both local and international contexts. Her expertise in **qualitative research and performing arts** will contribute in the co-designing of our dance intervention, **ethnographic research and qualitative analysis**, to engage the participants while optimising the acceptability, delivery, and feasibility of the programme.

**Dr Matthew Chen (Co-I)** is a **Consultant Geriatrician** at NUHS, and the current Geriatric Medicine lead for NCIS Geriatric Oncology (GOLDEN) service. His clinical and research interests are in **frailty and geriatric oncology**. He is also involved in a large-scale epidemiologic population-based study known as the "Healthy Older People Everyday (HOPE)" study – which examines frailty and its factors among community-dwelling older adults in Singapore. Dr Chen's expertise on **Geriatric Medicine** will contribute in the co-designing of the **CDP** and outcome measures targeting at older adults.

**Ms Justina Teo (Collaborator)** is the **Director and Head of Department for the Befriending Services** in Lions Befrienders (LB). She also manages the portfolio of Special Projects and Development which includes Research collaborations with various universities and hospitals. She currently leads a team of 23 staff in the Befriending Department, providing befriending services to 4,000 seniors island wide. We have previously worked with LB for our previous research projects such as the pilot Community Dance Programme (CDP) and e-Health programme, in which our pilot CDP has been documented and published in LB's Research website [62]. Ms Teo will support the recruitment of the participants in LB, co-development of the intervention, as well as facilitating the logistics for the CDP.

**Ms Charmaine Tan (Collaborator)** is the **Senior Assistant Director for the Healthy Ageing Department in Agency of Integrated Care (AIC)**. She is also the programme lead for AIC Wellness Programme, which involves a range of arts, movement, and music-based activities for the Community Care sector, especially frail seniors. Our team has previously engaged Ms Tan to explore collaboration in healthy ageing programmes. Ms Tan's expertise and experiences will be valuable in the co-designing

of our CDP, as well as to ensure the potential of the CDP to extend beyond a larger scale among older adults in Singapore.

**Ms Jobina Tan (Collaborator)** is the **Senior Associate Director at the Centre for the Arts in NUS**. She was also the Director for the NUS Arts Festival 2023. She is experienced in coordinating arts and performance-related events for the community in NUS and beyond, while ensuring their relevancy and engagement. We have previously worked with NUS Centre for the Arts for our previous pilot CDP study, where we recruit their chief dance choreographer and student dance instructors to co-design the dance intervention and facilitate the dance sessions respectively. Ms Tan will support the management of the student dance instructors in NUS for the dance intervention, as well as to support its continuity for the community over the long run.

**Ms Ebelle Chong (Collaborator)** is the Manager under Office of Student Affairs, at the Centre for the Arts in NUS. Ms Chong has an extensive portfolio in Contemporary Dance as a former dancer and dance educator. She was the Company Manager of RAW Moves Ltd, a local contemporary dance company. During her time with RAW Moves, Ebelle has worked with various local and international artists, production crew, as well as statutory boards such as the National Arts Council, Ministry of Education, and National Youth Council. As a performer, she has danced for Joavien Ng, Daniel K, Susan Yeung and Melissa Quek. Her work *w a l l s* was commissioned for Forward Moves, a platform showcasing local contemporary artistes in the Singapore Arts Festival 2008. She was also an Artist-Mentor for Open Homes Singapore International Festival of Arts 2015, where she worked with non-performers to showcase their stories in their living rooms. Ms Chong will assist in coordinating the student dance instructors in NUS for the dance intervention, as well as to support the continuity of the dance programme over the long run.

## VII How the research furthers the vision/missions of NMRC

Our study consists of a **multi-disciplinary field of scientific investigation** that examines the dose-response effect of the **CDP** among pre-frail older adults in the community. **CDP** is a locally developed dance programme that is customised to the healthcare needs of older adults. Our new **preventive health model** engages the older adults in a proactive manner, which can reduce the burden of Singapore's healthcare system and its limited resources. **CDP** focuses on **building physical capabilities, social connection, and enhancing quality of life** among pre-frail older adults, while providing early intervention to slow down deterioration in age-induced frailty.

In the long run, this **new model of preventive health** has the potential to transform care, contain healthcare cost inflation, and increase the efficiency of its lean manpower. We aim to **build capacities of community staff** through their engagement in research programs. Hence, they will be confident to continue the program to support the community-dwelling older adults after the completion of the research. **CDP** will raise the awareness of health behaviour, thus attracting more older adults to **engage in preventive health** – which better **prepare them for healthy ageing**. Additionally, it will **translate scientific knowledge into practice** and result in impactful outcomes, such as **older adults making proactive efforts to stay physically active and socially connected** to promote healthy longevity.

In November 2023, the Ministry of Health (MOH), Ministry of National Development (MND) and Ministry of Transport (MOT) has announced that around SGD\$800 million will be earmarked for improving **AACs** as part of new national **Age Well SG initiative** to support seniors ageing within their communities. Age Well SG is a national programme that focuses on **preventive care by keeping seniors active and involved in the community**, as Singapore heads towards "super-aged" society, when the population aged 65 and above hits the 21% in 2026. **AIC** works closely with **AACs** to build and ensure that care and services remain available and relevant for the seniors in their community. Our pilot study has built a solid foundation and has established positive collaboration with AACs and NUS Dance Synergy. We have been working with **LB AACs** on the pilot dance program from 2021 to 2022. This has built a strong collaboration between academic and community partners, which established an excellent platform to translate research outcomes into practice.

## VIII Translation Pathway

### a) Potential Areas of Implementation or Adoption

With the evidence on the benefits of **CDP** for the older adults, **CDP** will be made accessible to general older adult population. We will work closely with staff of **AACs** and **AIC** to conduct training of senior volunteers, as well as supporting the elderly in the dance programme. The **CDP** empowers older adults to effectively manage their physical and psychosocial health, while aging gracefully in the community with the support from professionals in healthcare and social sectors. We have been working with **LB AACs** on the pilot dance programme from 2021 to 2022. This has built a strong foundation between academic and community partners, which established an excellent platform to translate research outcomes into practice.

We will continue building up with our current community partners to: 1) provide essential support for the dance programme in the community spaces; 2) train **AAC staff** to support the elderly's health and social needs; 3) work with AIC's new initiative to support the elderly: Silver Generation Ambassadors, Befriending and neighbouring teams. '**Healthier SG**' is a major reform of the healthcare system and encompassed under Population Health, **AACs** and **AIC** will partner agencies such as, Health Promotion Board, People's Association, Sport Singapore, as well as social and community partners to support older adults' health goals. Our study will pave the way for large-scale community-based service delivery island wide in support by **AACs**. **Keeping the elderly ageing-in-place with good physical and psychosocial health** will be a mainstream community service to promote better health and well-being for the older adults. Aligning with **Age Well SG National initiative**, older adults will have positive experiences in **Healthy Ageing** with optimal community healthcare support in place.

### b) Patient-related Outcomes

We hypothesise that older adults in the intervention cluster with **higher dosage of CDP** will have **significantly improved physical health, cognition, psychosocial health, and higher quality of life**. Based on this study, we hope to evaluate the **dose-response effect of the dance programme**. Hence, this study will generate scientific evidence to **recommend the prescribed effective dosage of the dance regime** for older adults. This will be a **ground-breaking contribution** in the scientific field of dance intervention globally.

Furthermore, the proposed study will establish a new **preventive health model** in the community and promote **physical, psychosocial health, cognition, and quality of life** among pre-frail older adults. This **novel preventive health intervention** will encourage older adults to **keep physically active and socially engaged**. Moreover, it will **decelerate the progress of frailty**, as well as promote healthy ageing through **precise and effective dance regime** – which can enhance **healthy longevity**.

### c) Next steps

In the long run, the **CDP** can encourage older adults to **take proactive approach to manage their health effectively** with the support from professionals in healthcare and social sectors, thus enabling them to **age healthily in the community**. Our current study will **pave the way for future large-scale and community-based initiatives island wide** in support by **AACs** and **AIC**. AIC works closely with the community service providers to ensure that older adults are well taken care of by building holistic wrap-around care in the community. A *Community of Care* (CoC) is an overarching framework to build local networks of collaboration among providers, and to deliver holistic health and social care for residents in their neighbourhood. It places the resident in the centre of the community care ecosystem so that better support is provided to help them age in place (AIC, 2022).

Within the CoC, the dedicated network of partners come together to provide holistic services for the residents. A successful CoC will allow for residents to age in place within their neighbourhoods, feel supported, and maintain a high level of participation in the management of their own health. Hence, a **precise and effective dance programme** will provide an option for the community service to promote better well-being for the older adults. Older adults will have **healthy ageing** with optimal community healthcare support in place, as supported by **Age Well SG National initiative**. We will allocate budget on **public dissemination and engagement**. We will also conduct public talks and workshops to the community partners, charities, public sector to promote the support for healthy ageing by stakeholders.

**IX Key Performance Indicators (KPIs)**

Please fill in the proposed targets for the KPIs listed below. The proposed targets should be **achievable within the project timeframe**.

**1. Number of High Impact Publications and Top Conference Proceedings**

KPI Criteria	Target
Number of Journal Publications (Top 10%)	2
Number of Journal Publications (Not Top 10%)	2

**2. Number of Collaboration Projects**

KPI Criteria	Target
Number of Collaboration Projects with Industry, Academic, Public Agency, Research Institutes or Centres	1

**3. Cash Funding**

KPI Criteria	Target (S\$)
Cash Funding from Industry or Public Agency	0

**4. In-Kind Contributions**

KPI Criteria	Target (S\$)
In-Kind Contributions from Industry or Public Agency	0

**5. Number of Technologies Deployed**

KPI Criteria	Target
Number of Technologies Deployed by Industry or Public Agency	0

**6. Number of Patents**

KPI criteria	Target
Number of Patents	0

**7. Licenses**

KPI criteria	Target
Number of Licenses, Industry or Public Agency	0
Licensing Revenue, Industry or Public Agency	0

**8. Number of Successful Start-Ups**

KPI criteria	Target
Total Number of Start-Ups	0

**9. Manpower Development (Number of PhD and Masters Students Trained or Being Trained)**

KPI criteria	Target
Number of 'New' PhDs Trained or Being Trained	1
Number of 'New' Masters Students Trained or Being Trained	1

**10. Health-Specific Outcomes**

KPI criteria	Target
Number of registered clinical trials started	1
Number of findings that result in new or change in local or international Clinical Practice Guidelines and healthcare/health policies, including implementation of new or improved medical interventions or diagnostics (can be drugs and procedures) or services (e.g. new clinical service and shorter patient waiting time)	1
Number of interventions which result in a more cost-effective outcome	1
Number of coordinated media coverage of research findings which can help the Government to advance public interest	1

**11. Others**

KPI criteria	Target
Number of human subjects recruited	350

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### **Section C: Annex (For Resubmission/Renewal only)**

Please note that this Annex is only allowed for Resubmission/Renewal. Any supplemental

information/data to the main research proposal is not allowed.

For Resubmission (where applicable), append the following documents to the end of the research proposal as Annex B:

- Response to past reviewers (no more than 3 pages)
- Past review reports (inserted as images)

For Renewal (where applicable), append the following document to the end of the research proposal as Annex C:

- Summary of progress and research outputs of the previous/existing project (no more than 2 pages)