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Research Article

How COVID-19 Ceases All Older Adult Services & the Way Out for Community-Dwelling Older Adults with Chronic Pain

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Abstract

The COVID-19 pandemic started at the beginning of 2020. It significantly impacted the older adults in Hong Kong, with most of the community centers and elderly centers being closed down under various restrictive measures. Thus, community-based health promotion activities were temporarily paused, which decreased older adults' health-promoting behaviors and

motivation to stay active. This research aimed to improve the quality of life and the health of older adults with chronic pain through the pain management program. This study was conducted face-to-face on the campus of Hong Kong Metropolitan University. This dyadic pain management program (DPM) was an 8-week group-based program. The DPM comprised 4 weeks of campus-based activities and 4 weeks of digital-based activities delivered via a WhatsApp group. An 80% participation rate in the campus-based activities was regarded as completing the DPM. The control group only received lesson leaflets. Pain intensity, pain self-efficacy, psychological health of pain victims, caregiver burden inventory, and a semi-structured interview were evaluated at week 1 (T0), week 8 (T1), and week 12 (T2) after randomization. The IBM-SPSS version 22 was used to perform statistical analyses. Using non-pharmacological methods and regular exercise for 12 weeks improved physical health in terms of pain intensity, pain self-efficacy, and psychological health in anxiety, depression, and stress. For caregivers, their burden decreased after the pain management program. These findings indicated that Pender's Health Promotion Model is helpful to empower the participants and their caregivers with knowledge, skills, and power to manage their chronic pain situations. Utilizing this model as a framework, Researchers can design more effective non-pharmacological interventions for older adults to increase their engagement in health-promoting activities in the community.

Keywords
COVID-19; older adults; pain management; chronic pain

1. Introduction

Chronic pain is a common health condition in older adults, and it can significantly impact their mobility, mood, social engagement, quality of life, and more. The development of pain management has become more essential in the growing aging population and the healthcare industry [1].

Pain is associated with physical and psychosocial inabilities. Older adults with pain are more depressed, anxious, less happy, experience a lack of sleep, suffer from reduced mobility, have little or no participation in exercise and physical activity, and have impaired social interactions and engagement [2, 3]. Pain in older adults tends to be constant, moderate to severe in intensity and persists for years [4, 5]. Given their physical weakness and reduced mobility resulting from chronic pain, older adults experience a decrease in exercise participation and self-care ability and are at a higher risk of falling, which can lead to further problems such as fractures and exacerbate existing pain [4, 5].

The COVID-19 pandemic started approximately on 23rd January 2020, and it significantly impacted on older adult services in Hong Kong, as measures had been implemented to prevent the spread of the virus and protect the health and safety of older adults. According a Hong Kong Special Administrative Region government webpage about COVID-19 [6], most of the community centers and elderly centers in Hong Kong, which typically offer a range of services for older adults, were temporarily closed to prevent large gatherings and limit the spread of the virus. Additionally, nursing

homes and assisted living facilities had to limit or suspend visitation, as discussed in a South China Morning Post article on the third waves of COVID-19 infections in Hong Kong [7].

Virtual or remote services for older adults were adopted in response to the COVID-19 restrictions. Some community centers also moved their activities online, and some healthcare providers offered telemedicine services to older adults [8]. Numerous services were introduced to assist older adults during the COVID-19 pandemic. For example, home delivery options were available for groceries and medications from stores and pharmacies, while healthcare providers offered telemedicine services. To alleviate social isolation, various social support initiatives were launched, including virtual events and telephone check-ins. Financial assistance programs were established to aid those who had been affected by the pandemic. Additionally, the pandemic has resulted in the development of innovative solutions, such as technology training and transportation services catered to older adults. Overall, sustained efforts were made to adapt and provide support for older adults during this challenging time.

The Health Promotion Model, developed by Nola Pender, describes the multidimensional nature of persons interacting with their interpersonal and physical environments in connection with the issue of health [4, 9]. A 2017 integrative literature review of the Health Promotion Model revealed that this framework was useful for evaluating health-promoting behaviors [10]. This model also addressed factors influencing or promoting behavioral change, such as self-efficacy, perceived benefits, surrounding cues, barriers, stress, environmental contributions, and more [11]. Several recent systematic reviews and meta-analyses showed that this model was widely accepted in the medical field and was implemented in medical practice, education, and research [12, 13], showing the high effectiveness of health promotion model-based interventions.

This present study adopted the Health Promotion Model because this model was widely established in the medical community and successfully reinforced positive behavioral changes. Using this model, our intervention involved a particular form of social support, a "dyadic" system, because we aimed to boost older adults' participation, encourage greater adherence to health-promoting activities, and produce a longer term of commitment and a higher level of enjoyment [4, 9]. Also, we aimed to further enhance behavioral change via digital add-ons. We sent reminders and delivered program material (i.e., exercise videos) to older adults and their caregivers through WhatsApp. Additionally, a website on pain management was developed during the COVID-19 pandemic to keep older adults informed and motivated to stay active (https://pain-management-program.mailchimpsites.com/). A systematic literature review by Kampmeijer et al. demonstrated the importance and effectiveness of digital tools when older adults receive adequate motivation and support [14].

2. Materials and Methods

The research team recruited 60 dyads of participants: one older adult and one informal caregiver as a dyad. Participants received the DPM intervention in the experimental group (n = 30 dyads). In the control group (n = 30 dyads), participants received leaflets about pain management as the usual care.

The Dyadic Pain Management (DPM) program had two components: education on pain management and exercise. The DPM consisted of four lessons, held from week 1 to week 4, and each lesson lasted around 40 to 50 minutes, with the first half (15 to 20 minutes) focused on learning

about pain management and the second half (25 to 30 minutes) focused on exercising. The research team used WhatsApp to send reminders to older adults to practice the 30-minute exercises with their caregivers, 3 times per week at home.

In lesson 1, participants learned the definition, symptoms, types, and impacts of pain on their physical and psychological health. They learned strategies for handling pain in older adults and effectively communicating with older adults suffering from pain. In lesson 2, participants learned about different pain situations and drug treatments for pain. They learned strategies to handle stress and non-pharmacological pain relief methods; older adults practiced communication techniques with their caregivers, music, and deep breathing exercises. In lesson 3, the research team reinforced the use of non-pharmacological pain relief methods they learned in lesson 2 (music and deep breathing exercises). The team also introduced participants to aromatherapy and hot and cold pads. In lesson 4, participants learned about multisensory stimulation for relaxation and how to enhance communication skills.

Since the DPM program was held during the COVID-19 pandemic, the research team delivered some online lessons via Zoom in case of restrictive measures. The group followed Zoom's guidelines [15] in conducting a lesson virtually. We maintained interactive teaching and ensured that participants' cameras were turned on and their audio was turned off so there was no interruption. Also, we made sure participants could understand and learn the material by ensuring that they were looking at the camera and asking them if they understood.

Before performing the exercises, the research team presented safety precautions and guidelines in every class. The group reminded participants to wear appropriate and comfortable clothing and shoes, arranged adequate space and a safe environment by removing objects (i.e., tables and chairs) in the activity area, and ensured good lighting in the room. The exercise sessions included different physical exercises, such as towel and musical movement exercises. The outline of the DPM program for older adults is attached (see Table 1).

Table 1 Experimental group: Dyadic pain management (DPM) program outline**.**

Week	**Interactive teaching (face-to-face) in the campus/center (20 minutes)**	**Exercise (in the campus/ center and at home)** **(25 minutes-30 minutes in campus/ center and 30 minutes at home 3 times a week)**	**Digital-based activities (using WhatsApp)**
1	Basic knowledge of pain: definition, symptoms, type, and the impacts of pain on the physical and psychological health of the clients How to handle pain in the elderly? How to communicate with elderly people suffering from pain? Portfolio entry: activities of the day	Exercise guided by an exercise book • Warming up and deep breathing; • Strengthening and stretching exercises (neck, shoulder, upper and lower limbs, waist, and back) with towels; • Use of towels and water bottles for resistance training • Chair exercise • ten skills for hands • Balance training • Flexibility training • Transfer skills and training	The use of a WhatsApp group (digital-based activities): All participants will join a WhatsApp group to receive teaching materials and videos of the physical exercises learned in class, for practice at home. Each dyad will be encouraged and reminded to practice the 30-minute exercises together, 3 times per week, at home, and make entries in the WhatsApp group; also, to record the use of various types of non-pharmacological methods to relieve pain and their perceived effectiveness.
2	Present the pain situations of the participants; introduce drug treatments for pain How to handle stress?		
3	Practice communication techniques together The use of various non-pharmacological methods to relieve pain: Practice the use of music, deep breathing exercises,		
4	Portfolio entry: activities of the day		

5	The use of various non-pharmacological methods to relieve pain: Reinforce the use of music, deep breathing exercises, and introduce aromatherapy, and hot and cold pads Portfolio entry: activities of the day
6	
7	
8	Multisensory stimulation for relaxation, how to enhance communication skills? Portfolio review & wrap up

We presented constructive feedback to participants to enhance compliance in the DPM program. We ensured that participants could return the exercise demonstration to us. Also, we prioritized all participants' safety and ensured they enjoyed all activities. Lastly, we sent WhatsApp messages to all participants, reminding them to do the exercises and refreshing their knowledge of pain management and non-pharmacological pain relief methods.

A comprehensive approach encompassing medical, physical, and psychological interventions was necessary to manage pain in older adults. Personalized pain management plans were developed considering the patient's medical history, current health status, and preferences. Physical interventions included exercise, physical therapy, and alternative therapies, such as acupuncture. Psychological interventions, such as cognitive-behavioral therapy, relaxation techniques, and mindfulness meditation, effectively managed pain in older adults.

Pain management in older adults was challenging, as older adults frequently had multiple chronic conditions and may have experienced medication side effects. Cultural and socioeconomic factors could have impacted access to pain management services. It was crucial to continue research and development in pain management for older adults to improve the safety and effectiveness of interventions.

2.1 Participants and Design

2.1.1 Target Group

Due to the COVID-19 pandemic, most elderly centers were temporarily closed down. Therefore, our participants were recruited by approaching older adults sitting around in public parks who had to fit the inclusion criteria before being asked to join the DPM program referred from Neighborhood Elderly Centers (NECs) and invited to come to Hong Kong Metropolitan University (HKMU) for the intervention. The target groups for the DPM program were older adults aged 60 or above who lived in the locality, cared for, and the community at large.

Participants interested in participating were randomized into the experimental group (that received the DPM in HKMU) or control group according to a computer-generated list. The unit of randomization was the older adult. The randomization took place at the beginning of the study. Each small group consisted of a maximum of 4 older adults participating in the DPM program. The experimental group received DPM, and the control group received the usual care and a pain management pamphlet. Below are the inclusion and exclusion criteria for the DPM program participants.

<u>Participants: Inclusion Criteria</u>

- Aged 60 or above
- Can understand Cantonese
- Scored >6 in the Abbreviated Mental Test; a cut-off point of 6 is valid for differentiating
- between normal and abnormal cognitive functions in geriatric clients [16]
- Have a history of non-cancer pain in the past 6 months [17]
- Have a pain score of at least 2 on the Numeric Rating Scale (0-11 numeric scale) [18]
- Able to take part in light exercise and stretching
- Owns a smartphone and can access the Internet

Participants: Exclusion Criteria

- Have severe visual and/or auditory deficits that affect seeing and hearing
- Have a severe organic disease or malignant tumor
- Have a mental disorder diagnosed by neurologists or psychiatrists
- Had a surgical treatment in the past two months
- Experienced drug addiction

2.1.2 Implementation Plan

The dyadic pain management program (DPM) was an 8-week group-based program, as shown in Table 1. The DPM comprised 4 weeks of campus-based activities and 4 weeks of digital-based activities delivered via a WhatsApp group. An 80% participation rate in the campus-based activities was regarded as completing the DPM. Timely make-up sessions were arranged for those unable to attend the scheduled session.

For the DPM lesson part, the DPM started with 20-30 minutes of physical exercise supervised by the research assistant, followed by 20- minutes of pain management education, including information on the impacts of pain, the use of drug and non-drug strategies for pain management, and demonstrations and return demonstrations of various non-drug pain management techniques. Communication skills regarding the practice of various pain management techniques by the participants and their caregivers were taught, and the participants were encouraged to practice various pain relief methods at home.

Using a WhatsApp group (digital-based activities): All participants joined a WhatsApp group to receive teaching materials and videos of the physical exercises learned in class for practicing at home. Each dyad was encouraged and reminded to practice the 30-minute exercises together three times per week at home, and make entries in the WhatsApp group to record the use of various non-pharmacological methods to relieve pain and their perceived effectiveness.

2.2 Data Collection and Outcome Measure

The period of data collection began in August 2022 to December 2022. Data were collected at three time points: at baseline (T0), week 8 (T1), and week 16 (T2), using standardized methods and questionnaires, with a follow-up assessment (T2) to determine whether the observed benefits could be sustained over an extended period.

2.2.1 Data Analysis

The IBM-SPSS version 22 was used to perform statistical analyses. Descriptive statistics (frequency %; mean (standard deviation)) were used to describe the demographic data of the participants.

An intention-to-treat analysis was conducted for any missing data. A Kolmogorov-Smirnov normality test was used to examine the normality of the variables. To examine the effects of the intervention, a multilevel regression was used to compare pain intensity, pain self-efficacy, the use of drug and non-drug pain-relief methods, quality of life, and the knowledge and skills acquired in managing pain situations at baseline (T0), week 8 (T1), and week 12 (T2) if the data were normally distributed. A Generalized Estimating Equation was used for within-group and between-group

comparisons if the data did not follow a normal distribution. A Cohen's d effect size of the intervention effect was calculated for all outcomes. A p-value of <0.05 was considered statistically significant. As for a cluster randomized controlled trial analysis, it was suggested to use both a multilevel regression and a generalized estimating equation, capable of handling clustered data. Observations from the same participant fell into a level, and participants from the same NEC fell into a level so that both within-subject correlations and intra-cluster correlations could be accounted for.

2.2.2 Outcome Measure

Primary Outcome:

1. Pain intensity: The Chinese version of the Brief Pain Inventory assessed the multidimensional nature of pain, including its intensity and interference with life activities in the previous 24 hours [19]. This was the pre-defined outcome indicator to enable scale-up to a larger project.

Secondary Outcome:

2. Pain self-efficacy: The Chinese version of the Pain Self-Efficacy Questionnaire (PSEQ) measured self-efficacy in coping with activities despite pain [20]. It consisted of 10 statements about a person's confidence in performing 10 activities or tasks despite experiencing pain. Higher scores indicated stronger self-efficacy beliefs.
3. Caregiver Burden Inventory (for the caregivers only): The Caregiver Burden Inventory comprised 24 items measuring five dimensions of burden related to the caregiving role.
4. Depression, Anxiety, and Stress: The changes in depression, anxiety, and stress levels of older adults were measured. Lower scores indicated lower depression, anxiety, and stress levels.
5. Activities of daily living: The activities of daily living (ADL) were measured by the Barthel Index, which had 10 items of ADL, including mobility and self-care ability [19]. It refers to the basic self-care tasks that individuals perform daily to maintain their overall well-being and take care of themselves; the activities include eating, grooming, bathing, and dressing.
6. Pain knowledge: To assess the participants' knowledge of pain management, an 11-item pain knowledge questionnaire was developed. Questions included: ''Is exercise effective in pain management?'', ''Can Paracetamol be used to treat fever and pain?'', ''Is it appropriate to apply a hot or cold compress when sleeping?'', ''Should deep breathing exercises be used to let the body relax before music therapy?''. The total score was calculated by counting the number of correctly answered questions, with high scores indicating better knowledge of pain.

3. Results

The demographic characteristics of older adults and their caregivers are presented in Tables 2 and 3. There were 60 older adults and 60 caregivers in the study, and they were evenly randomized into the experimental and control groups, with 30 in each group. Table 2 shows that the experimental and control groups of older adults had similar demographic backgrounds at baseline. The most frequent age range of older adults was 50 to 60, and the gender distribution was even

(male 50% and female 50%). There was not much difference in employment status between being retired (43.3%) and employed full-time (38.3%).

Table 2 Demographic characteristic of older adults

Demographic data	**Overall (N = 60)**		**Experimental Group (N = 30)**		**Control Group (N = 30)**		*p-value*
	n	%	*n*	%	*n*	%	
Age Range							*0.671*
50-60	29	48.3	14	46.7	15	50	
61-70	14	23.3	8	26.65	6	20	
71 or above	17	28.3	8	26.65	9	30	
Gender							*0.765*
Male	30	50	14	46.7	16	53.3	
Female	30	40	16	53.3	14	46.7	
Marital status							*0.549*
Single	3	5	1	3.3	2	6.7	
Married/partnered	49	81.7	25	83.3	24	80	
Divorced	3	5	2	6.7	1	3.3	
Widowed	5	8.3	2	6.7	3	10	
Highest education level							*0.897*
No formal education	3	5	3	10	1	3.3	
Primary school	17	28.3	7	23.3	11	36.7	
Middle & High school	31	51.7	17	56.7	14	46.7	
College degree or above	9	15	3	10	4	13.3	
Employment							*0.345*
Employed (Full-time)	23	38.3	12	40	11	36.7	
Employed (Part-time)	7	11.7	5	16.7	2	6.7	
Retired	26	43.3	13	43.3	13	43.3	
Unemployed	4	6.7	0	0	4	13.3	
Monthly income *(HKD$)*							*0.237*
<10,000	22	36.7	9	30	13	43.3	
10,000-15,000	9	15	5	16.7	4	13.3	
15,000-20,000	12	20	6	20	6	20	
20,000-25,000	6	10	4	13.3	2	6.7	
25,000 or above	11	18.4	6	20	5	16.6	
Suffer from Chronic disease	38	63.3	17	56.7	21	70	*0.179*
Chronic diseases							
Hypertension	32	53.3	17	56.7	15	50	*0.767*
Arthritis	15	25	10	33.3	5	16.7	*0.05*
Diabetes mellitus	11	18.3	2	6.7	9	30	*0.0342**
Cancer	1	1.7	1	3.3	0	0	*0.0568*
Gouty	9	15	4	13.3	5	16.7	*0.845*

Note. *p ≤ 0.05, **p ≤ 0.01, ᴾPaired Sample T-test.

Table 3 shows the demographic data for the caregivers. Majority of the caregivers were between the ages 20 and 30, female (55%), employed part-time (71.7%), and children of older adults (55%). The experimental and control groups of caregivers did not differ significantly in their demographic profiles.

Table 3 Demographic characteristic of Caregivers.

Demographic data	**Overall (N = 60)**		**Experimental Group (N = 30)**		**Control Group (N = 30)**		*p-value*
	n	%	*n*	%	*n*	%	
Age Range							*0.768*
20-30	30	50	16	53.3	14	46.7	
31-40	6	10	2	6.7	4	13.3	
41-50	9	15	4	13.3	5	16.7	
51-70	15	25	8	26.7	7	23.3	
Gender							*0.09*
Male	27	45	9	30	18	60	
Female	33	55	21	70	12	40	
Marital status							*0.899*
Single	34	56.7	16	53.3	18	60	
Married/partnered	26	43.3	14	46.7	12	40	
Highest education level							*0.764*
Primary school	3	5	3	10	0	0	
Middle & High school	15	25	8	26.7	7	23.3	
College degree or above	42	70	19	63.3	23	76.7	
Employment							*0.883*
Employed (Full-time)	8	13.3	7	23.3	1	3.3	
Employed (Part-time)	43	71.7	18	60	25	83.3	
Retired	7	11.7	4	13.3	3	10	
Unemployed	2	3.3	1	3.3	1	3.3	
Monthly income *(HKD$)*							*0.471*
<10,000	16	26.7	10	33.3	6	20	
10,000-15,000	13	21.7	6	20	7	23.3	
15,000-20,000	7	11.7	3	10	4	13.3	
20,000-25,000	11	18.3	6	20	5	16.7	
25,000 or above	13	21.7	5	16.7	8	26.6	
Relationship with participants							*0.274*
Spouse	12	20	7	23.3	5	16.7	
Children	33	55	14	46.7	19	63.3	
Relative	15	25	9	30	6	20	

Note. *p ≤ 0.05, **p ≤ 0.01, [D]Paired Sample T-test.

The pain situation is shown in Table 4. Before the intervention, there were no significant differences between the experimental and control groups of older adult participants for all three categories: pain intensity (p = 0.61), pain interference (p = 0.076), and pain self-efficacy (p = 0.503).

Table 4 Pain situation.

Categories (Range)		Experimental (n = 75)		Control (n = 75)		Between-group p-value
		Mean ± SD	within p	Mean ± SD	within p	
Pain Self-Efficacy (0-10)	T0	43.2 ± 1.887		41 ± 2.659		0.503
	T1	45.57 ± 1.649	0.049*	41.03 ± 2.593	0.73	0.146
	T2	48.27 ± 1.565	0.045*	41.47 ± 2.782	0.487	0.037*
Pain Intensity (0-10)	T0	4.15 ± 0.271		3.95 ± 0.280		0.61
	T1	3.25 ± 0.245	0.041*	3.82 ± 0.317	0.74	0.163
	T2	2.60 ± 0.196	0.03*	3.55 ± 0.327	0.48	0.015*
Pain Interference (0-10)	T0	5.43 ± 0.467		6.53 ± 0.604		0.076
	T1	4.25 ± 0.792	0.018*	6.20 ± 0.616	0.12	0.068
	T2	3.57 ± 0.561	0.022*	5.70 ± 0.631	0.08	0.047*

*p-value < 0.05 to be considered as significant. Remarks: T0: Before the intervention; T1: 8-week follow-up; T2: 12-week follow-up.

As seen in Table 4, the pain intensity of the experimental group decreased from 4.15 before the intervention to 2.60 after the intervention (p = 0.03), in contrast, the control group had a smaller difference after the intervention (p = 0.48). It was also found that the between-group comparisons of pain intensity after the DPM intervention were significant (p = 0.015). The pain interference of the experimental group was also significantly reduced before and after the treatment (p = 0.022), with a reduction from 5.43 to 3.57, while that of the control group showed little difference (p = 0.08). After the interventions, there were significant differences in pain interference in between-group comparisons (p = 0.047). For pain self-efficacy, the score increased after the intervention, from a baseline score of 43.2 to 48.27 (p = 0.045). The post-intervention between-group difference was also significant (p = 0.037).

According to Table 5, the experimental group had a significant decrease in the three subscales before and after the intervention, including anxiety (p = 0.05), stress (p = 0.039), and depression (p = 0.039), while there were no significant changes in the control group (p > 0.05). The between-group comparisons were substantial in the anxiety (p = 0.025), stress (p = 0.027), and depression (p = 0.014) subscales.

Table 5 Outcome of Psychological health.

Categories (Range)		Experimental (n = 75)		Control (n = 75)		Between-group p-value
		Mean ± SD	within p	Mean ± SD	within p	
Depression (0-36)	T0	11.33 ± 1.714		16.2 ± 2.472		0.071
	T1	9.2 ± 1.523	0.047*	17.1 ± 1.890	0.053	0.051
	T2	5.46 ± 1.029	0.039*	17.13 ± 1.993	0.069	0.014*
Anxiety (0-36)	T0	8.2 ± 1.425		13.13 ± 2.154		0.25
	T1	5.76 ± 1.015		13.6 ± 1.957		0.036*
	T2	4.93 ± 0.963	0.05*	14.03 ± 2.130	0.092	0.025*
Stress (0-40)	T0	11.06 ± 1.560		16.2 ± 2.227		0.079
	T1	9.46 ± 1.441	0.043*	17 ± 2.084	0.051	0.098
	T2	7.26 ± 1.252	0.039*	17.13 ± 2.229	0.06	0.027*

*p-value < 0.05 to be considered as significant. Remarks: T0: Before the intervention; T1: 8-week follow-up; T2: 12-week follow-up.

Table 6 reveals that the levels of activities of daily living improved when comparing the scores before and after the intervention, with an improvement from 19.2 to 19.9 (p = 0.04) in the experimental group, while the control group had a small improvement from 18.2 to 18.13. Regarding the between-group differences, the experimental group had a comparatively higher level of activities of daily living than the control group (p = 0.09).

Table 6 Outcome of Physical health.

Categories (Range)		Experimental (n = 75)		Control (n = 75)		Between-group p-value
		Mean ± SD	within p	Mean ± SD	within p	
Pain Knowledge (0-11)	T0	7.17 ± 1.93		7.80 ± 3.32		0.382
	T1	6.93 ± 1.59	0.818	7.40 ± 2.75	0.340	0.384
	T2	7.20 ± 1.81	0.995	7.87 ± 2.42	0.966	0.215
Activities of Daily Living (0-100)	T0	19.2 ± 0.182		18.2 ± 0.572		0.101
	T1	19.6 ± 0.113	0.02*	18.07 ± 0.673	0.0632	0.028*
	T2	19.9 ± 0.056	0.04*	18.13 ± 0.646	0.0402*	0.009*

*p-value < 0.05 to be considered as significant. Remarks: T0: Before the intervention; T1: 8-week follow-up; T2: 12-week follow-up.

Table 7 shows the caregiver burden, in which the experimental group had a significant decrease before and after the intervention from 26.4 to 13.3 (p = 0.009), while that of the control group was non-significant (p = 0.07). In regards to the between-group differences, they were significant after the intervention (p = 0.034).

Table 7 Outcome of the Caregiver Burden Inventory (CBI).

Categories (Range)		Experimental (n = 75)		Control (n = 75)		Between -group p-value
		Mean ± SD	within p	Mean ± SD	within p	
Total: The Caregiver Burden Inventory (0-16)	T0	26.4 ± 1.481		21 ± 2.547		0.072
	T1	21 ± 1.452	0.015*	21.23 ± 2.459	0.0715	0.052
	T2	13.3 ± 1.074	0.009*	21.47 ± 2.521	0.07	0.034*
Subcategories:						
Development (0-4)	T0	0.62 ± 1.22		0.81 ± 0.83		0.245
	T1	0.50 ± 0.72	0.275	0.68 ± 1.11	0.181	0.230
	T2	0.28 ± 0.52	0.007*	0.73 ± 1.19	0.642	0.003*
Physical (0-4)	T0	0.83 ± 1.58		0.91 ± 1.07		0.621
	T1	0.67 ± 0.83	0.311	0.83 ± 1.21	0.273	0.310
	T2	0.46 ± 0.62	0.032*	0.85 ± 1.28	0.664	0.015*
Emotional (0-3)	T0	0.32 ± 0.77		0.51 ± 0.76		0.082
	T1	0.32 ± 0.59	0.993	0.49 ± 0.93	0.894	0.172
	T2	0.13 ± 0.33	0.037*	0.52 ± 0.95	0.997	0.001*
Social (0-3)	T0	0.58 ± 1.03		0.70 ± 0.85		0.415
	T1	0.49 ± 0.69	0.408	0.59 ± 0.97	0.092	0.457
	T2	0.30 ± 0.51	0.009*	0.68 ± 1.12	0.957	0.007*
Time (0-4)	T0	0.93 ± 1.38		1.23 ± 0.94		0.116
	T1	0.78 ± 0.77	0.289	1.13 ± 1.03	0.149	0.023*
	T2	0.53 ± 0.49	0.006*	1.08 ± 1.24	0.230	0.000*
Intensity (0-9)	T0	3.66 ± 1.84		3.66 ± 2.04		0.992
	T1	2.87 ± 1.54	0.000*	3.33 ± 2.09	0.008*	0.138
	T2	2.17 ± 1.51	0.000*	3.22 ± 2.29	0.019*	0.003*
Interference (0-10)	T0	2.71 ± 3.13		3.19 ± 2.10		0.263
	T1	2.21 ± 1.53	0.182	2.66 ± 2.29	0.002*	0.174
	T2	1.46 ± 0.99	0.000*	2.74 ± 2.75	0.086	0.000*

*p-value < 0.05 to be considered as significant. Remarks: T0: Before the intervention; T1: 8-week follow-up; T2: 12-week follow-up.

4. Discussion

In the DPM program, there were 30 participants in the experimental group and 30 in the control group, and data were collected on several outcome measures. The results showed that the intervention met the research objectives, with improvements in pain intensity, pain self-efficacy, activities of daily living, and mental health in terms of depression, anxiety, and stress.

Due to the COVID-19 pandemic, many community service centers were closed down. We then used the digital DPM program to deliver lessons and technical support to older adults via WhatsApp. The older adults approved of this lesson format and presented an overall positive attitude towards digital learning, and this was in line with the Deng et al. study [21] that revealed that older adults perceived the adoption of mobile health services well. We also provided campus support for participants to learn more about the DPM program. During the in-person lessons, we prioritized the safety of our participants and staff by following the COVID-19 measures (e.g., hand sanitizing and wearing face coverings).

The major findings suggested that the pain severity of middle-aged or older adults was significantly less intense after completing the pain management program, with the pain level in the experimental group significantly lower than that of the control group. Moreover, most participants showed significant improvements in depression, anxiety, and stress on the Depression, Anxiety, and Stress Scale - 21 Items (DASS-21), which was used to assess mental health status. The results of this DPM intervention expressed a significant improvement in the mental health status of middle-aged or older adults in the experimental group compared to the control group. Nawai [22] suggested that improved spiritual well-being and psychological health in older adults are related to pain management intervention. In addition, the results from the participants' caregivers showed an overall significant improvement in the burden scale. Chi et al. [23] also supported that providing sufficient training in pain management can improve family caregiver outcomes. In the present study, there was a decrease in the caregivers' physical and emotional burden when the pain severity and physical health of the participants had improved, resulting in a reduced workload for the caregivers in taking care of the older adults' chronic pain and daily activities [24].

Pain self-efficacy refers to the confidence of pain sufferers to finish daily tasks when facing pain [25]. In the pain management program, non-pharmacological pain relief methods and exercises were introduced to the participants. Cheng et al. [26] suggested that self-efficacy mediates the relationship between pain intensity and depression in older adults with chronic pain. Thus, with higher pain self-efficacy, the participants of this study had larger desires to manage their pain and enhance self-efficacy. There was increased use of non-pharmacological pain relief methods for the experimental group. Therefore, the improvement in pain self-efficacy of the experimental group was more significant than that of the control group at T2.

Activities of daily living, such as self-care and mobility, were measured by the Barthel Index [20]. The higher score on the Barthel Index reflected a higher level of independence when bearing pain. After the DPM, the experimental group showed slight improvement. With low-intensity exercise in DPM, walking ability and the performance of daily activities were improved. Otones et al. [27] study found that the physical performance of older adults with chronic pain improved upon completing an exercise program. The emotional states of depression, anxiety, and stress were assessed by the DASS-21, a set of three self-report scales to assess mental health status [28]. Most participants expressed a significant improvement in depression, anxiety, and stress, which aligns with the

findings of the Otones et al. study [27], revealing significant changes in anxiety, happiness, loneliness, life satisfaction, and depression in the exercise group after the intervention. The results of PMP revealed a significant improvement in the mental health status of middle-aged or older adults in the experimental group compared to the control group.

The effectiveness of PMP on caregivers' burden was one of the main objectives and was measured in five different aspects: time dependence, physical, developmental, social, and emotional aspects. The results gave insight into caregivers' burden in caring for middle-aged or older adults who had suffered from chronic pain. Most of the participants' caregivers expressed an overall significant improvement in the burden scale. Moreover, the caregiver's burden was related to the pain self-efficacy, depression, disability, and anxiety of older adults with chronic pain [29]. The caregiver's burden can be directly reduced, by improving the physical and mental health, together with the pain self-efficacy of older adults.

4.1 Limitations and Future Research Perspectives

The main limitation of this study was the small sample size of 60 dyads (i.e., 120 participants) in total. The results of this study may lack generalizability and are not representative of the entire population of older adults who suffer from chronic pain. Future studies with bigger sample sizes would address this limitation. Bigger sample sizes could offer a wider range of perspectives and recommendations, assisting the researchers in reaching insightful conclusions and enhancing the intervention.

5. Conclusions

During the COVID-19 pandemic, older adults and their carers were under great stress and anxiety, as well as the pain that further disrupted the health conditions of older adults. In this regard, the present study demonstrated the effectiveness of our DPM as an effective, non-pharmacological intervention that significantly improved pain situations and promoted digital-based intervention by incorporating a technological element (WhatsApp) in providing essential support and allowing older adults to stay as healthy and as happy as possible, in the community.

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Author Contributions

Mimi Mun Yee Tse, Shamay Sheung Mei Ng and Vivian Lou conceived the ideas and design of the study. Mimi Mun Yee Tse, Siu Hang Leung and Percy Poo-See Tse performed data collection. Mimi Mun Yee Tse, Shamay Sheung Mei Ng, Paul H Lee, Shuk Kwan Tang and Siu Hang Leung data analysis and interpretation. Mimi Mun Yee Tse, Vivian Lou, Raymond SK Lo and Daphne Cheung provided revisions of the manuscript. Mimi Mun Yee Tse, Shamay Sheung Mei Ng, Shuk Kwan Tang, Siu Hang Leung and Percy Poo-See Tse writing and editing. All authors contributed to the manuscript and approved the final version.

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Competing Interests

The authors have declared that no competing interests exist.

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