Review Article

Effects of Physical Exercise on Mental Health of Frail Older Adults: A Literature Review

Chaeyoon CHO 1,2)

1) Shimonoseki city university, Japan
2) Tohoku university, Japan

ABSTRACT

Frailty is a geriatric and physiological syndrome, which is highly prevalent in community-dwelling older adults. In particular, prevention of mental health is a key objective for successful ageing in older adults who are becoming frailty state. Therefore, the purpose of this review is to determine the effect of physical exercise on Quality of Life (QOL) and mental health of the frail older adults. A literature review of research was conducted using the PubMed, SCOPUS, Google Scholar and Web of Science electronic databases for papers published between 2016 and 2021. Randomized controlled studies were included that were aimed at the QOL and Mental health of frailty older adults. The inclusion criteria were: frailty; QOL and Health Related Quality of Life (HRQOL), Mental health (MH); physical exercise; intervention; controlled trial study and published in English. After screening, 7 research were included in this literature review (n=1038, age range: 68.9±3.9 to 85.2±7.4 years). There was a significant, positive impact on QOL and MH outcomes in 3 out of the 7 studies included in the literature review. Furthermore, there was proof that using a clinically validated measures of frailty affected the results of QOL.

< Key-words >
Frail, Older adults, Exercise, Mental health, HRQOL

chocy1127@hotmail.com (Chaeyoon CHO; Japan)

I. Background

Across the world, the older adult population is growing rapidly. It is expected that the older adult population will reach 2 billion adults in 2050 which raises serious concerns for the planning of physical and mental systems\(^1,2\). One of the most challenging aspects of older adults is the Clinical frailty\(^1\). Frailty is a geriatric syndrome and clinical state which primarily affects older adults, places the individual at a high risk of falls, disability, hospitalization, and mortality\(^3,4\). The pathophysiology of frailty is multifactorial factors and not due to normal aging, but instead causes by age and aging-related disease and lifestyle, psychological, educational, and environmental risk factors\(^5\). In the Japan, approximately 7.4% of community-dwelling older adults are frail, and the prevalence of frailty was 5.7%, 30.4%, and 35.1% for those aged 65-74, 75-84, and 85 years, respectively\(^6\). In particular, one of the most challenging issue for older adults aged over 75 years is the clinical state of frailty\(^1,6,7\). Although the prevalence of frailty varies widely depending on the instruments and defined criteria used, but there are two widely defined diagnosis for frailty: holistic assessment such as frailty index (FI) and phenotypic approach. The most commonly cited one of frailty is phenotypic and diagnostic criteria of Cardiovascular Health Study (CHS), as the presence of minimum three or five criteria: 1) unintentional weight loss, 2) low level physical activity, 3) self-reported exhaustion, 4) weakness, and 5) slow walking speed\(^8\). Furthermore, it is important to recognize that frailty exists on a spectrum ranging from pre-frail to failure in older adults aged over 65 years\(^9\).

Previous studies reported that frail older adults may health-related beneficial effects from physical exercise and interventions that targeted executive functional deficits. Moreover, supervised physical exercise is recommended as a possible intervention to reverse frailty and is safe intervention in frail older adults\(^9\). A previous review, conducted by Campbell et al and Kojima et al., demonstrated an inverse association between Quality of Life (QOL) and frailty among community-dwelling older people\(^10,11\). Also, exercise interventions are reduced frailty and positive impact on QOL or activities of Daily life (ADL)\(^10,11\). Therefore, QOL have an important effect on the performance of frail older adult.

However, the literature search of previous studies was undertaken in 2018, and not reflect the most recent literature. Therefore, the present study aims to review recently published the literature investigating the effect of physical exercise and interventions on QOL and Mental health (MH) in Frail older adults.
II. Methods

1. Data sources and search strategy
A literature search was undertaken in September 2021 using following data bases: PubMed (Medline), Cochrane, SCOPUS, Google Scholar, Web of Science for papers published between January 2016 and September 2021. The selected keywords were “Frail”, “older adults”, “Frail elderly”, “quality of life”, “QOL”, “HRQOL”, “Exercise” and “intervention”. This search strategy was adapted for all databases.

2. Study selection
Researcher independently screened all studies by reading the title and abstract; non-randomised clinical trials or randomised controlled trials (RCT) in frail older adults. In particular, frail defined clinically using Fried phenotypic diagnostic and published in English were considered for eligibility criteria.

3. Eligibility criteria
The inclusion criteria for this study were: designed as a controlled clinical trial, non-randomised clinical trial or randomized controlled trial; age of samples > 65 years, participant of frail older adults; effect of the exercise and intervention on Quality of Life (QOL); was written in English.

   Type of participants: Frail older adults.
   Type of physical exercise and intervention: All types of physical exercise; e.g., aerobic, strength, balance, resistance, stretching, and combination of these exercise. These physical exercise and intervention were compared with control group or other exercise.
   Type of outcomes measurement: Mental health (MH), Quality of Life (QOL).

The exclusion criteria were: non-human studies, participants younger than 65 years, pharmaceutical interventions; exercise and intervention without control group or usual group, QOL was not the outcome of the study.

4. Data extraction
The data were extracted from the included studies: author names, publication year, study, number of participations, characteristics of participations (age, gender, Frailty states), type of physical exercise and intervention, measured outcome, finding of primary outcome: QOL, MH, and secondary outcomes: physical function. If provided, the average(mean) and standard deviation (SD) or standard error (SE) for QOL in the groups were extracted.
III. Research Overview

1. Literature search results

From the search, 209 records were obtained. After the omission of 71 duplicates, 138 titles and abstracts were screened (Fig. 1). 138 records were read for further information, and further 119 were excluded. Most of the studies excluded at this stage did not physical exercise and intervention (n=64), the study design was not experiment (n=28) and study population was not frail older adults (n=18). After screening full-text, 19 potentially eligible recorders were identified, further 12 were excluded. The excluded full-text articles reported a study that did not measure quality of life (n=8), did no found article (n=4). Thus, a total of 7 trials were included in literature review.

2. Study characteristics

An overview of the characteristic and outcomes of studies is Table 1. All 7 studies included were RCT, no eligible controlled clinical trial and non-randomised clinical trial were identified. Total number of participations in the review was 1038, and age ranged from 68.9 ± 3.9 to 85.2 ± 7.4 years (mean ± standard deviation; SD). Sample size range from 64 to 377. These studies used 4 different criteria for frailty: Primary care of the survey of health, ageing and retirement in Europe (SHARE-FI), Fried criteria from CHS, Edmonton Frailty Scale and a 25-item self-reported screening questionnaire:
Kihon checklist\textsuperscript{10}.

<table>
<thead>
<tr>
<th>Study Author, year</th>
<th>Study Design</th>
<th>Participants Age (SD)</th>
<th>Frailty measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chitrakul et al.\textsuperscript{10} (2020)</td>
<td>RCT, single-blind, assessor blind ITT</td>
<td>n=36&lt;br&gt;69.1(3.6)</td>
<td>n=36&lt;br&gt;68.9(3.9)</td>
</tr>
<tr>
<td>Hsieh et al.\textsuperscript{10} (2019)</td>
<td>RCT, single-blind, four-arm, ITT</td>
<td>n=245&lt;br&gt;Exercise, n=79&lt;br&gt;72.0(6.0)</td>
<td>n=80&lt;br&gt;72.5(5.5)</td>
</tr>
<tr>
<td>Huang et al.\textsuperscript{10} (2020)</td>
<td>RCT, single-blind</td>
<td>n=284&lt;br&gt;AE, n=98.72 ±(4.6)&lt;br&gt;RE, n=90.72 ± (4.8)&lt;br&gt;AE+RE, n=96.72 ± (4.5)</td>
<td>n=93&lt;br&gt;72.1(4.6)</td>
</tr>
<tr>
<td>Kapan et al.\textsuperscript{10} (2017)</td>
<td>RCT</td>
<td>n=39&lt;br&gt;83.0(6.0)</td>
<td>n=41&lt;br&gt;82.5(8.0)</td>
</tr>
<tr>
<td>Mollinedo Cardalda et al.\textsuperscript{10} (2019)</td>
<td>RCT</td>
<td>n=48&lt;br&gt;TE, n=25&lt;br&gt;85.5(8.1)</td>
<td>n=29&lt;br&gt;85.2(7.4)</td>
</tr>
<tr>
<td>Sadjapong et al.\textsuperscript{10} (2020)</td>
<td>RCT</td>
<td>n=32&lt;br&gt;76.7(1.4)</td>
<td>n=32&lt;br&gt;78.9(1.3)</td>
</tr>
<tr>
<td>Tarazona Santabalbina et al.\textsuperscript{10} (2016)</td>
<td>RCT</td>
<td>n=51&lt;br&gt;79.7(3.6)</td>
<td>n=49&lt;br&gt;80.3(3.7)</td>
</tr>
</tbody>
</table>

The data are expressed as mean (SD or SE) or n, RCT: randomised clinical trials, SD: standard deviation, SE: standard error, ITT: intension to treat, AE: aerobic exercise, RE: resistance exercise, TE: TheraBand’s exercise. ME: multi-calisthenics exercise.

3. Type of physical exercise and Measurement of Quality of Life/Mental health

Five studies included an intervention that was solely physical exercise\textsuperscript{12,14,16-18}, two studies had a multi-modal intervention which included a physical exercise\textsuperscript{13,19}. Other intervention in multi-modal included Nutrition intervention\textsuperscript{10} and social support or cognitive intervention\textsuperscript{15}. The lowest frequency of exercise was twice a week\textsuperscript{14,18} and highest five a week\textsuperscript{18}. All studies included warm-up and cool-down, Five included strength.
exercise\textsuperscript{12,13,15,16,18}, Three included aerobic exercise\textsuperscript{14,17,18}, Two included balance exercises\textsuperscript{12,17} and two included resistance exercises\textsuperscript{14,17} (Table 2).

The different instruments used to determine quality of life were: Short Form 36 health survey questionnaire (SF-36)\textsuperscript{12,17} or Short Form 12 health survey questionnaire, (SF-12)\textsuperscript{13,16}, World Health Organization Quality of Life Instrument-physical, psychological, social and environmental aspects (WHOQOL-BREF)\textsuperscript{15}, World Health Organization Quality of Life Instrument-Older Adults Module (WHOQOL-OLD)\textsuperscript{15}, Euro Quality of life 5 Dimension (EQ-5D)\textsuperscript{18}, and the life satisfaction index\textsuperscript{14}. Moreover, the different outcomes used to determine mental health; Geriatric Depression Scale (GDS)\textsuperscript{12-14}, Generalized Anxiety Disorder (GAD)\textsuperscript{14}, Mini-Mental State Examination (MMSE)\textsuperscript{13-16,18}, International Physical Activity Questionnaire (IPAQ)\textsuperscript{14}, Wechsler Memory Scale-Revised Logical Memory I & II (WMS-R)\textsuperscript{14}, Mini Nutritional Assessment-Longform (MNA-LF)\textsuperscript{15}, Barthel Index (BI)\textsuperscript{14}.

4. Effects of physical exercise on various outcomes

Table 2 is overview of the effects of physical exercise on QOL and MH. From these seven studies\textsuperscript{12-18}, between group improvements in the exercise group, or deterioration in the control group, and with maintenance of the exercise group in QOL or MH measures, were reported in Three studies\textsuperscript{12,14,16}. Moreover, six studies were with in-group improvements in the exercise group\textsuperscript{12,13,15-18}.

In the seven studies from the exercise intervention on QOL and MH measures, six studies used a clinically validated measure of frailty criteria from CHS\textsuperscript{13,16-18}, FI and Kihon Check list\textsuperscript{14}, SHARE-FI\textsuperscript{15} and one study did not measure of frailty\textsuperscript{12}. In the three studies which did observe an improvement\textsuperscript{12,14,16}, two employed a clinically recognized frailty measure\textsuperscript{14,16}. These results were to suggests that using a clinically validated measure of frailty criteria impacted on the beneficial effect of exercise. In addition, all three studies which observed effect of exercise on QOL and MH (GDS, GAD) also observed an improvement in physical function\textsuperscript{12,14,16}. Of the three studies that did observe a significant, positive effect of exercise on QOL and MH measures\textsuperscript{12,14,16}, all studies reported an improvement in physical outcomes. As a result of the literature review, it would appear that significantly improved physical function do not necessarily result in improved of QOL or MH, but when physical function is increased, QOL and MH are also increased.
### Table 2
Overview of the effects of physical exercise on Mental health

<table>
<thead>
<tr>
<th>Study Author, year</th>
<th>Length of trial/ Follow-up</th>
<th>Type of physical exercise</th>
<th>QOL/MH measure</th>
<th>Main findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chittr-akul et al. (2020)</td>
<td>12weeks /24weeks</td>
<td>60min/1set, 3days/week, for total of 36 session.</td>
<td>QOL: SF-36</td>
<td>BG: ↑SF-36, GDS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>WG : ↑SF-36, GDS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;Details&gt;</td>
<td></td>
<td>Physical function: ↑Knee extension strength, hand reaction time, sway path.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multi-system physical exercise (MPE). 10min of warm-up, 45min of exercise, 5min of cool-down.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beginner: weeks 1 to 4, proprioception, muscle strengthening, reaction time, balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intermediate: weeks 5 to 8, proprioception, muscle strengthening, reaction time, balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advanced: weeks 9 to 12, proprioception, muscle strengthening, reaction time, balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hsieh et al. (2019)</td>
<td>1month 3month /6month</td>
<td>5-60 min/1set, 3-7days/week, per session or rep tailored to participants capabilities.</td>
<td>QOL: SF-12</td>
<td>BG: Exercise, Combination: ↑SF-12 MCS, GDS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>WG: Combination: ↑SF-12 MCS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Exercise: Combination of strength, flexibility, balance and endurance training.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nutrition: To maintain a desirable body weight: caloric intake achieved through designated number of servings of food.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combination: Exercise plus Nutrition</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huang et al. (2020)</td>
<td>26weeks /52weeks</td>
<td>60min/1set, 2days/week, for total of 52 session.</td>
<td>QOL: the life satisfaction index.</td>
<td>BG: AE, RE: →QOL AE+RE: ↑QOL, AE: ↑GDS, GAD.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>WG: AE: → GDS, GAD, RE, AE+RE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;Details&gt;</td>
<td></td>
<td>All exercise group: ↑FI index</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60min/1sets: Stretch 10min, Each exercise 40min, cool-down 10min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AE: 40min, 10-to15min step-in place exercise, 10-15min walking and rest intervals sets.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RE: resistance band workout (Curls, chest presses, side raises, leg presses, hip abduction, etc.) and bodyweight exercises (squats, knee-ups, calf raises and trunk curls.).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AE+RE: AE and RE 20min for each.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Kapan et al. (2017)

12 weeks / No
1h/1set, 2days/week, for total of 24 session.

Physical training and nutritional intervention (PTN):
5min warm-up and six strength exercise (mini squats, hip extension, chest press, shoulder press), two sets(12-15 repetitions).

Social support (SOSU):
Social contact, ideas for cognitive exercises (memory card, card games)

QOL:
WHOQOL-BREF, WHOQOL-OLD

MH:
MMSE, MNA-LF

WG:
↑WHOQOL-BREF; Overall QOL, Social relationship
↑WHOQOL-OLD; Past, present and future activities, social participation, ↑MNA-LF

Mollinedo Cardalda et al. (2019)

12 weeks / No
60min/1set, for total of 24 session

<Details>
10 min of warm up (Mobility of ankle, knee, hip joints)
45 min of strength exercise for the lower limbs (flexors and knee extensor, abductors, hip rotators)
5 min of cool-down with stretching of the muscles.
1-2weeks: 2 exercises were undertaken in main part, 2sets of 10 repetitions.
4-6weeks: 3 exercises were undertaken, 15 repetitions.
10-12weeks: 4 exercises were performed with the same repetitions.

QOL:
SF-12,

MH:
MMSE,

WG:
Time × Group:
SF-12 PCS↑, SF-12 MCS↑.

↑PS, ↑SF-12 PCS, PS, E↑,
↑SF12-MCS, SF, ES, EW.
↑PS, ↑SF12-MCS, ES, EW.
↑PS, ↑SF12-MCS, ES, EW.

Physical Function:
↑BI,
↑Mini-mental test,
↑FTSTS

Sadjapong et al. (2020)

12 weeks / 24weeks
Multicomponent exercise Program (MCEP).

60min/1set, 3days/week, for total of 36 session.

<Details>
5-10min of warm up.
10-20min of Chair Aerobic exercise.
1 month: 10min
2 month: 15min
3 month: 20min
25-30min of resistance exercise with TheraBand.
1 month: Reps8×2 set (Intensity 65% of 1RM)
2 month: Reps10×3 set (Intensity 75% of 1RM)
3 month: Reps12×3 set (Intensity 85% of 1RM)
10min of balance exercise.
1 month: two hands
2 month: one hand
3 month: no support.

QOL:
SF-36

WG:
↑SF-36 PCS, ↑SF-36 MCS.

Physical Function:
↑Frailty Score,
↑Strength(handgrip),
↑Burg balance score,
↑TUG
**Table 1**

| Tarazona-Santabalbina et al. 10  
(2016) | 24 weeks /No | Multi-component exercise. | QOL: EQ-5D | BG: Eq-5D, ↑BI |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>65-70min/1set, 5days/week, for 70session.</td>
<td></td>
<td></td>
<td>MH: BI, MMSE</td>
<td></td>
</tr>
<tr>
<td>10min of warm up</td>
<td></td>
<td></td>
<td>WG: ↑EQ-5D, BI, MMSE</td>
<td></td>
</tr>
<tr>
<td>10-15min of proprioception and balance exercise.</td>
<td></td>
<td></td>
<td>Physical function: ↑SPPB total score, ↑PPT, ↑PAEE</td>
<td></td>
</tr>
<tr>
<td>10-15min of aerobic exercise. (Intensity: 40% of HRmax increasing progressively to 65%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 40min of strength exercise with TheraBand. | 1month: Reps30×1-3 set  
(Intensity: 25% of 1RM) | | | |
| 2month: Reps30×3 set  
(Intensity: 25% of 1RM) | | | | |
| 3month: Reps15×8×1-3 set  
(Intensity: 50% of 1RM) | | | | |
| 4month: Reps8×3 set  
(Intensity: 50% of 1RM) | | | | |
| 5month: Reps15×8×1-3 set  
(Intensity: 75% of 1RM) | | | | |
| 6month: Reps8×3 set  
(Intensity: 75% of 1RM) | | | | |
| 5min of stretching with band, ball. | | | | |


**IV. Discussion and Conclusion**

The literature review performed provided improvement of the effects of exercise on the QOL and MH of the frail older adults. This review identified 7 studies that examined the effect of physical exercise and intervention on QOL or MH (Depression, Anxiety, etc.) in frail older adults. In summary, there was a significant effect on QOL and MH in 3 out of the 7 studies included in the literature review, there was proof that using a clinically validated measures of frailty affected the results of QOL or MH. However, the produced inconsistent finding on whether prescribed intervention and physical exercise led to a significant, positive impact on QOL and MH; therefore, it is unclear whether exercise had an effect on QOL and MH in frail older adults. These findings are broadly in line the systematic reviews of Campbell E et al., which concluded that there was no noticeable effect of exercise on QOL10. Moreover, according to these author, the systematic and meta-
analysis, concluded that it was not possible from the previous studies to examine the effect of QOL\textsuperscript{10,19}.

In this review, six studies reported an improvement in physical function outcomes. Furthermore, it was provided that there was a positive impact on QOL or MH in all papers that reported an improvement in a physical function outcome, none of the papers that did not. These results were evidence that improvements of QOL or MH (depression, anxiety) may be linked to improvement in physical function. Similarly, in the present studies results, a hypothetical pathway of interaction of exercise intervention on frailty, QOL and physical function can be seen from the figure 2, by Campbell E et al\textsuperscript{10}.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure2.png}
\caption{Pathway of interaction of Exercise interventions}
\end{figure}

In conclusion, this literature reviews which found that physical exercise and intervention seemed to have a significant, positive effect on QOL/MH in frail older adults. However, the optimum intervention and the type of physical exercise remained unclear. Future studies should focus on determining the effective of physical exercise and intervention methodology in frail older adults. Finally, more literature and systematic review study is needed to improve the underlying mechanism responsible of significant influence of physical exercise on QOL and MH outcomes in frail older adults.
References


12) Chitrakul J, Siviroj P, Sungkarat S & Sapbamrer R. Multi-System Physical Exercise Intervention for Fall Prevention and Quality of Life in Pre-Frail Older Adults: A Randomized Controlled Trial. *Int J Environ Res Public Health.*, 2020, 17(9), 3102. DOI: 10.3390/ijerph17093102


17) Sadjapong U, Yodkeeree S, Sungkarat S & Siviroj P. Multicomponent Exercise Program Reduces Frailty and Inflammatory Biomarkers and Improves Physical Performance in Community-Dwelling Older Adults: A Randomized Controlled Trial. *Int J Environ Res Public Health.*, 2020, 17(11), 3760. DOI: 10.3390/ijerph17113760


CONTENTS

ORIGINAL ARTICLES

Factors Promoting Independent Excretion in Residents of Special Nursing Homes for the Elderly
Yoshiko ENOMOTO et al. p.1

Imagined Intergroup Contact Reduces Prejudice Against Suicide Loss Survivors;
An Empirical Study with Japanese Undergraduates
Akira YAMANAKA et al. p.18

Preschool and Kindergarten Teachers’ Assessments of Children with Special Needs and Influences on Their Assessments
Yijie LIU et al. p.29

The Verification of the Reliability and Construct Validity of the Disability Awareness Program (DAP) scale:
Analysis of Cross-sectional Data and Longitudinal Data
Mamiko OTA et al. p.42

SHORT PAPER

Characteristics of Case Records and Staff Awareness in Institutions for Persons with Intellectual Disabilities
Toru SUZUKI et al. p.52

REVIEW ARTICLES

Effects of Physical Exercise on Mental Health of Frail Older Adults;
A Literature Review
Chaeyoon CHO p.61

Conceptual Analysis of Menstrual Disorders in Young Women
Eriko YAMAMOTO et al. p.73

Factors Affecting the Sense of Life Worth Living and Cognitive Function for Older Caregiver;
Current Situation and Issue based on Literature Considerations
Minji KIM et al. p.91