Asian Journal of

HUMAN SERVICES

PRINTED 2021.1030 ISSN2188-059X
PUBLISHED BY ASIAN SOCIETY OF HUMAN SERVICES

OCTOBER 2021
VOL. 21

ASIAN SOCIETY OF HUMAN SERVICES

Human Services

DOI: 10.14391/ajhs.21.61
Asian Journal of Human Services, VOL.21 61-72

REVIEW ARTICLE

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

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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.

Received
August 22, 2021

Revised
September 2, 2021

Accepted
September 13, 2021

Published
October 30, 2021

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

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Asian J Human Services, 2021, 21:61-72.

DOI: 10.14391/ajhs.21.61
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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.

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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.

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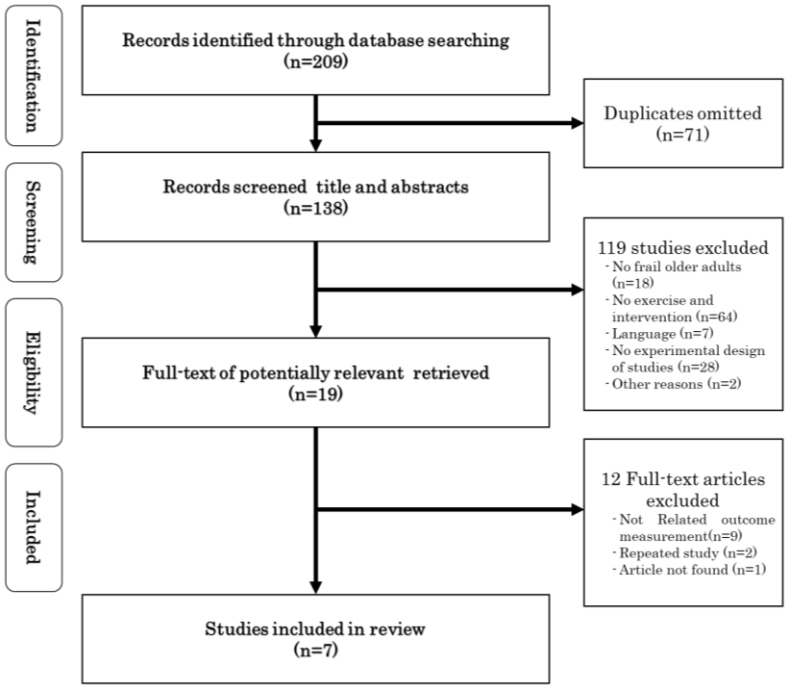
III. Research Overview

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 not found article (n=4). Thus, a total of 7 trials were included in literature review.



<Figure 1> Flow diagram of searh process

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)[12-18]. Sample size range from 64[17] to 377 [14]. These studies used 4 different criteria for frailty; Primary care of the survey of health, ageing and retirement in Europe (SHARE-FI)[15], Fried criteria from CHS [13,16-18], Edmonton Frailty Scale[18] and a 25-item self-reported screening questionnaire:

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Kihon checklist[14].

<Table 1> Overview of the included studies, characteristics and Frailty

Study Author, year	Study Design	Participations Age (SD)		Frailty measure
		Intervention	Control	
Chittrakul et al.[12] (2020)	RCT, single-blind, assessor-blind ITT	n=36 69.1(3.6) 65-69, n=24 70-74, n=8 ≥75,n=4	n=36 68.9(3.9) 65-69, n=23 70-74, n=9 ≥75,n=3	Pre-frail.
Hsieh et al. [13] (2019)	RCT, single-blind, four-arm, ITT	n=245 Exercise, n=79 72.0(6.0) Nutrition, n=83 70.4(5.3) Combination, n=83,71.6(6.0)	n=80 72.5(5.5)	Frailty five indicators by Fried criteria from CHS; 1) weightless≥3kg(or 5%), 2) exhaustion, 3) poor muscle strength, 4) slowness, 5) low physical activity.
Huang et al. [14] (2020)	RCT, single-blind,	n=284 AE,n=98,72.3(4.6) RE,n=90,72.3 (4.8) AE+RE,n=96,72.6(4.5)	n=93 72.1(4.6)	Three items out of a 25-item self-reported screening questionnaire: Kihon checklist. Frailty index (FI)
Kapan et al. [15] (2017)	RCT	n=39 83.0(8.0) 65-79, n=13 80-89, n=15 ≥90,n=11	n=41 82.5(8.0) 65-79, n=13 80-89, n=19 ≥90,n=9	Pre-frail, Primary care of the survey of health, ageing and retirement in Europe (SHARE-FI). Able to walk with or without walking aid.
Mollinedo Cardalda et al. [16] (2019)	RCT	n=48 TE,n=25 85.5(8.1) ME,n=23 83.8 (8.3)	n=29 85.2(7.4)	Frailty five indicators by Fried criteria from CHS
Sadjapong et al.[17] (2020)	RCT	n=32 76.7(1.4)	n=32 78.9(1.3)	Frailty five indicators by Fried Five criteria; 1) weight loss ≥ 4.5kg in the previous years 2) slow gait, 3) weakness, 4) exhaustion, 5) low physical activity.
Tarazona-Santabalbina et al. [18] (2016)	RCT	n=51 79.7(3.6)	n=49 80.3(3.7)	Fried frailty criteria from CHS, Edmonton Frailty Scale.

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[12,14,16-18], two studies had a multi-modal intervention which included a physical exericse[13,15]. Other intervention in multi-modal included Nutrition intervention[13] and social support or cognitive intervention[15]. The lowest frequency of exericse was twice a week[14,15] and highest five a week[18]. All studies included worm-up and cool-down, Five included strength

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exercise[12,13,15,16,18], Three included aerobic exericse[14,17,18], Two included balance exercises[12,17] and two included resistance exericse[14,17] (Table2).

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

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[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[12,14,16]. Moreover, six studies were with in-group improvements in the exercise group[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[13,16-18], FI and Kihon Check list[14], SHARE-FI[15] and one study did not measure of frailty[12]. In the three studies which did observe an improvement[12,14,16], two employed a clinically recognized frailty measure[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[12,14,16]. Of the three studies that did observe a significant, positive effect of exercise on QOL and MH measures[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 al so increased.

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<Table 2> Overview of the effects of physical exercise on Mental health

Study Author, year	Length of trial/ Follow-up	Type of physical exercise	QOL/MH measure	Main findings
Chittr-akul et al.[12] (2020)	12weeks /24weeks	60min/1set, 3days/week, for total of 36 session. <Details> Multi-system physical exercise (MPE). 10min of warm-up, 45min of exercise, 5min of cool-down. Beginner: weeks 1to 4, proprioception, muscle strengthening, reaction time, balance Intermediate: weeks 5 to 8, proprioception, muscle strengthening, reaction time, balance Advanced: weeks 9 to 12, proprioception, muscle strengthening, reaction time, balance	QOL: SF-36 MH: GDS	BG: ↑SF-36, GDS WG : ↑SF-36, GDS Physical function; ↑Knee extension strength, hand reaction time, sway path.
Hsieh et al. [13] (2019)	1month 3month /6month	5-60 min/1set, 3-7days/week, per session or rep tailored to participants capabilities. <Details> Exercise: Combination of strength, flexibility, balance and endurance training. Nutrition: To maintain a desirable body weight; caloric intake achieved through designated number of servings of food. Combination: Exercise plus Nutrition.	QOL: SF-12 MH: GDS, MMSE, IPAQ.	BG: Exercise, Combination; →SF-12 MCS, GDS WG: Combination; ↑SF-12 MCS Exercise, Combination; ↑physical function Handgrip strength 10-mgait speed lower body flexibility ↑Frailty score.
Huang et al. [14] (2020)	26weeks /52weeks	60min/1set, 2days/week, for total of 52 session. <Details> 60min/1sets: Stretch 10min, Each exercise 40min, cool-down 10min. AE: 40min, 10-to15min step-in place exercise, 10-15min walking and rest intervals sets. 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,). AE+RE: AE and RE 20min for each.	QOL: the life satisfaction index. MH: GDS, GAD, MMSE, WMS-R	BG: AE, RE; →QOL AE+RE; ↑QOL, AE; ↑GDS, GAD. WG: AE; → GDS, GAD, RE, AE+RE All exercise group; ↑FI index

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Kapan et al. [15] (2017)	12 weeks / No	1h/1set, 2days/week, for total of 24 session. <Details> Physical training and nutritional intervention (PTN): 5min warm-up and six strength exercise (mini squats, hip extension, chest press, shoulder press), two sets(12-15repetitions), 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 Physical function; ↑SPPB, ↑handgrip strength, ↑PSAE
Mollinedo Cardalda et al. [16] (2019)	12 weeks / No	60min/1set, for total of 24sesssion <Details> 10 min of warm up (Mobility of ankle, nee, hip joints) 45 min of strength exercise for the lower limbs (flexors and knee extensor -s, abductors, hip rotators) 5min 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 under taken, 15 repetitions. 10-12weeks:4 exercises were performed with the same repetitions.	QOL: SF-12, MH: MMSE,	Time × Group: SF-12 PCS↑, SF-12 MCS↑. WG: TE; ↑SF-12 PCS, PS, GH, ↑SF12-MCS, SF, ES, EW. ME; ↑ PS, ↑SF12-MCS, ES, EW. Physical Function; ↑BI, ↑Mini-mental test, ↑FTSTS
Sadjapong et al.[17] (2020)	12weeks /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. 1month: 10min 2month: 15min 3month: 20min 25-30min of resistance exercise with TheraBand. 1month: Reps8×2 set (Intensity: 65% of 1RM) 2month: Reps10×3 set (Intensity: 75% of 1RM) 3month: Reps12×3 set (Intensity: 85% of 1RM) 10min of balance exercise. 1month: two hands 2month: one hand 3month:no support.	QOL: SF-36	WG: ↑SF-36 PCS, →SF-36 MCS. Physical Function; ↑Frailty Score, ↑Strength(handgrip), ↑Burg balance score, ↑TUG

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Tarazona-Santabalbina et al. [18] (2016)	24weeks /No	Multi-component exercise. 65-70min/1set, 5days/week, for 70session. <Details> 10min of warm up 10-15min of proprioception and balance exercise. 10-15min of aerobic exercise. (Intensity: 40% of HRmax increasing progressively to 65%) 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.	QOL: EQ-5D MH: BI, MMSE	BG: →EQ-5D, ↑BI WG: ↑EQ-5D, BI, MMSE Physical function; ↑SPPB total score, ↑PPT ↑PAEE

NOTE; ADL: activities of daily living, AE: aerobic exercise, BG: differences between groups, BI: Barthel index, EQ-5D: Euro Quality of life 5 Dimension, ES: emotional state, EW: emotional wellbeing, FTSTS: Five times sit to stand test, GAD: Generalized Anxiety Disorder, GDS: geriatric depression scale, IPAQ: international physical activity questionnaire, MCS: mental component summary, ME: multi-calisthenics exercise, MMSE mini-mental state examination, MNA-LF: mini nutritional assessment-longform, PAEE: physical activity energetic expenditure, PASE: physical activity scale for the elderly, PCS: physical component summary, PPT: physical performance test, PS: physical state, GH: general health, QOL: health related quality of life, MH: mental health, RE: resistance exercise, SF: social function, SF-12: short form 12 health survey questionnaire, SF-36: short form 36 health survey questionnaire, TE: TheraBand's exercise, TUG: Timed up and go test, WG: difference with in groups, WHOQOL-BREF: World Health Organization Quality of Life Instrument-physical, psychological, social and environmental aspects, WHOQOL-OLD: World Health Organization Quality of Life Instrument-Older Adults Module, WMS-R: Wechsler Memory Scale-Revised Logical Memory Ⅰ&Ⅱ.

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 QOL[10]. Moreover, according to these author, the systematic and meta-

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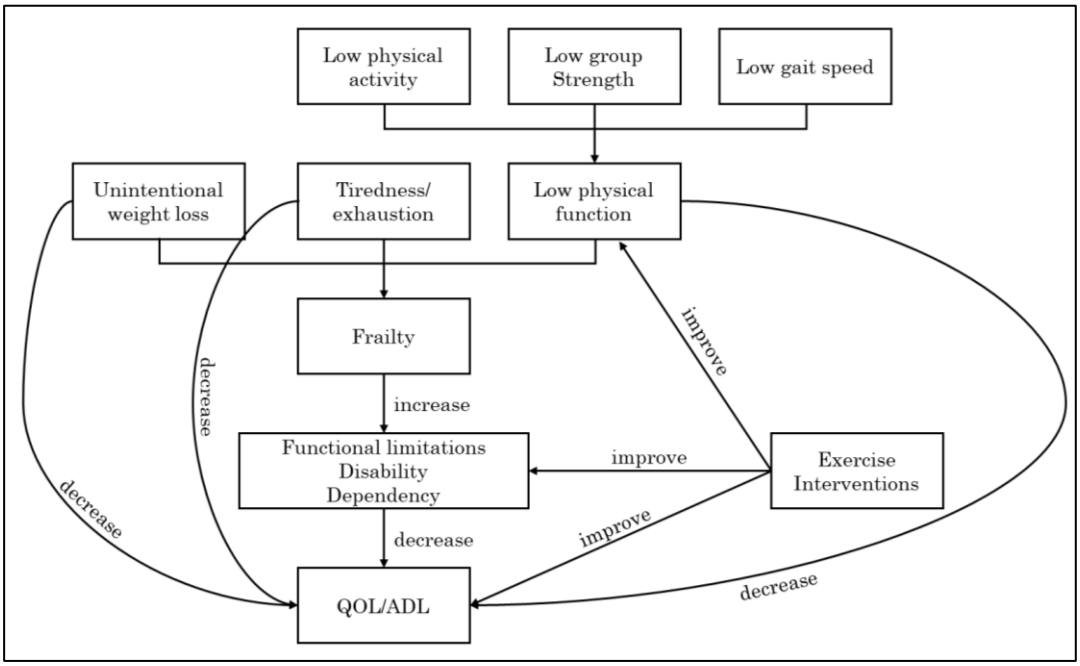
analysis, concluded that it was not possible from the previous studies to examine the effect of QOL[10,19].

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[10].



(Adapted from Campbell E et al, Exp Gerontol. 2021)

<Figure 2> Pathway of interaction of Exercise interventions

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.

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ASIAN JOURNAL OF HUMAN
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ORIGINAL ARTICLES

SHORT PAPER

REVIEW ARTICLES

PUBLISHED BY
ASIAN SOCIETY OF HUMAN
SERVICES YAMAGUCHI,
JAPAN