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Identifying Socio-ecological Predictors of Sarcopenia in the Elderly Japanese Population for Multidisciplinary Prevention Practices: A Systematic Review

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An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Preventive Science 2020

Abstract

Background: Sarcopenia is a condition that is characterized by loss of muscle mass, muscle strength, and functional muscle impairment with aging (Fuggle, Shaw, Dennison, & Cooper, 2017). In Japan, the estimated number of prevalent cases of Sarcopenia in Japanese elderly individuals was approximately 1.3 million and 1.4 million for men and women, respectively (Yuki et al., 2015). It is expected that the prevalence of sarcopenia in Japan will increase along with the aging rate and will be an economic burden to the government if this is not addressed. Since sarcopenia is generally thought to be caused by multiple factors such as environmental causes, disease triggers, inflammatory pathway activation, loss of neuromuscular junctions, and hormonal changes (Walston, 2012), there is a need to understand sarcopenia by using a socioecological approach to understanding predictors that may help to reduce the morbidity from sarcopenia in the elderly Japanese population.

Objective: To identify socio-ecological predictors of Sarcopenia for understanding the current status and for multidisciplinary prevention practices in the elderly Japanese population.

Data Sources: A systematic search of published literature was done in Pubmed, PsycINFO, EMBASE, PsycINFO, Web of Science, Scopus, Medical Online from the year of 2013- 2020.

Data Collection: In the first screening stage, an online search was done with the following keywords: “sarcopenia” AND “elderly” AND “Japan” AND “risk factor” AND “prevention”. Removal of duplicates and exclusion of references irrelevant to this systematic review was performed. In the second step, the selected studies were further screened to meet the inclusion criteria. Screening was conducted to find research studies dealing with specific diseases (e.g., cancer, heart disorder, liver dysfunction, diabetes mellitus). Studies dealing with Japanese populations that were not specific to a given disease, studies with animal subjects, or studies with full-text unavailable, were excluded.

Results: Of 669 articles identified through the online database search, 12 articles are reviewed following the inclusion criteria.

Conclusion: Most of the articles mentioned the individual level associated factors of sarcopenia. There were only a few papers that described the interpersonal, organizational, and community-level factors with none at the policy level. A socio-ecological framework for sarcopenia among the elderly Japanese population was suggested in this review. Further studies that define indicators would be required for a multidisciplinary approach to sarcopenia among the aging Japanese society.

Key Words: sarcopenia, socio-ecological, Japanese, elderly

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List of Abbreviations

EWGSOP: European Working Group on Sarcopenia in Older People

AWGS: Asian Working Group for Sarcopenia

Abbreviation in the Table 5

ADL Activity of Daily Life

BMI: Body Mass Index

DVS: Dietary Variety Score

ODI: Oswestry Disability Index

HR: Hazard Ritio

TBW: Total Body Weight

DM: Diabetes Mellitus

COPD: Chronic Obstructive Pulmonary Disease

CC: Calf Circumference

BMD: Bone Mineral Density

GDS: Geriatric depression scale

OR: Odds Ratio

SMI: Skeletal Muscle Mass Index

YMA: Young Adult Mean

CKD: Chronic Kidney Disease

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I am grateful to Dr. Linelle Blais for watching over me as a time keeper and providing a lot of constructive advice throughout whole the process of this systematic review. I would also like to thank Dr. Kotani Kazuhiko for some useful suggestion about sarcopenia as a field expert. The rest of my thanks goes out to my friends of EMPH students in RSPH who cheered me, and all staff who supported me throughout these two years.

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Chapter I: Introduction

Life expectancy among the young and the elderly has changed in recent years. According to the World Bank (The World Bank, 2017), the average life expectancy has increased from 52.6 years in 1960 to 72.2 years in 2017 across the world, and the total population aged 65 and above has also increased from 150 million to 677 million in the same period. Accordingly, the global average life expectancy increased by 5.5 years between 2000 and 2016, the fastest increase since the 1960s (WHO, 2018). Therefore, supporting the health needs of an elderly society will be critical to the future of public health.

Although Japan has the highest percentage of elderly people in the world in 2017 (33% aged 60 or over) and is projected to remain so through 2050 (42% aged 60 or over), life expectancy in Japan has also been increasing. As the life expectancy has increased, the structure or prevalence and distribution of diseases in society has changed (Lozano et al., 2012), hence, there is a need for the public health sphere to move towards approaches different from which have been adopted in the past. One of the diseases that developed because of changes in life expectancy and structure of the disease is sarcopenia. People experience weakness, muscle weakness, and loss of physical activity, and increased physical disability; these states are called, “Sarcopenia” (Santilli, Bernetti, Mangone, & Paoloni, 2014). Sarcopenia is a syndrome which is characterized by loss of muscle mass, muscle strength, and muscle functional disorder as a person gets older (Fuggle et al., 2017).

Despite the fact that the systematic review of worldwide estimates of sarcopenia prevalence vary from 9.9% to 40.4%, depending on the definition used, the prevalence of sarcopenia can be estimated from 6% to 12% from the large-scale studies (Shimokata et al., 2018). The overall

estimate of prevalence was 10% (95% CI: 8-12%) in men and 10% (95% CI: 8-13%) in women. The prevalence was higher among non-Asian than Asian individuals in both genders (Shafiee et al., 2017). Considering that Japan has the highest percentage of elderly people in the world, it is expected that the prevalence of sarcopenia in Japan will increase proportionally with the aging rate and will be an economic burden to the government if not addressed. In fact, studies showed higher healthcare costs for Sarcopenic patients than for non-Sarcopenic patients (Bruyère, Beaudart, Ethgen, Reginster, & Locquet, 2019). In Japan, the estimated prevalence of sarcopenia in Japanese elderly men and women were approximately 1.3 million and 1.4 million, respectively, approximately 60% of which had both low muscle mass and low muscular strength (Yuki et al., 2015).

Since the cause of sarcopenia is generally thought to be caused by multiple factors such as environmental causes, disease triggers, inflammatory pathway activation, loss of neuromuscular junctions, and hormonal changes (Walston, 2012), there is a need to understand the current status for sarcopenia and defining socio-ecological predictors in order to reduce the morbidity from sarcopenia in the elderly Japanese population.

Chapter II: Review of Literature

1. Introduction

The main purpose of this literature review is to identify the socio-ecological predictors of sarcopenia for multidisciplinary prevention practices among the Japanese elderly. This chapter reviews previous literature, research, and systematic reviews from Japan and Asian countries. Furthermore, this chapter provides a systematic summary of the definition of sarcopenia, its

epidemiology, signs and symptom, causes, pathophysiology, diagnosis, public health impact and management from previous studies and literature.

The life expectancy of Japan is steeply rising; consequently, the prevalence of sarcopenia is expected to increase. Yet, the set of criteria in diagnosing sarcopenia is different among the major groups of Europe and Asia, and previous systematic reviews demonstrate the discrepancies in prevalence of sarcopenia among these groups. In this situation, one of the most important things is to justify how to approach sarcopenia prevention, and this entails the consideration of the aggravating factors, alleviating factors, and preventive measures. However, it is necessary to address not only factors at the intrapersonal level, but also factors at the interpersonal, community level, organizational, and systems levels impacting sarcopenia including public policy.

2. Diagnosis

The importance of sarcopenia in geriatric medicine was recognized early on, but its definition and diagnosis remained without international agreement. This review presents the latest guidelines from the main groups of the European Working Group on Sarcopenia in Older People (EWGSOP) and the Asian Working Group for Sarcopenia (AWGS). Sarcopenia was assigned an individual International Statistical Classification of Diseases and Related Health Problems code in 2016, which stimulated diagnostic and therapeutic trials internationally. Japan published clinical practice guidelines for sarcopenia in 2018, which systematically reviewed the latest evidence and promoted awareness. The EWGSOP issued an updated consensus in 2019 (EWGSOP 2). Sarcopenia is a progressive and generalized skeletal muscle disorder that is associated with increased likelihood of adverse outcomes including falls, fractures, physical disability and mortality. The modification

to the original operational definition of sarcopenia by EWGSOP was a major change at that time, as it added muscle function to former definitions based only on detection of low muscle mass (Cruz-Jentoft et al., 2010).

3. Epidemiology

A review of epidemiology studies from Asian countries that used the AWGS 2014 criteria discovered that the prevalence of sarcopenia ranged from 5.5% to 25.7%, with male predominance (5.1%-21.0% in men vs 4.1%-16.3% in women); the prevalence became more consistent at 7.3% to 12.0% when only studies with more than 1000 male and female participants were included (Makizako, Nakai, Tomioka, & Taniguchi, 2019). Higher age may be the most important factor among numerous reported risk factors, but household status, lifestyle, physical inactivity, poor nutritional and dental status, and diseases (osteoporosis as well as metabolic diseases) were also independently associated with sarcopenia. In particular, the likelihood of developing sarcopenia is significantly correlated with the number of cardiometabolic risk factors, notably diabetes, hypertension, and dyslipidemia. The pathogenesis of sarcopenia may involve satellite cell senescence, loss of motor neurons, less active neuromuscular junctions, hormonal status, pro-inflammatory cytokines, decreased mitochondrial function, abnormal myokine production, and weight loss accompanying decreased appetite. In terms of longer-term clinical outcomes, AWGS-defined sarcopenia was significantly associated with increased risks of physical limitations at 4 years, slowness at 7 years, and increased mortality rate at 10 years, but not of hospitalization. In a 4-year follow-up study of 1,099 older Japanese people, osteoporosis was associated with the development of sarcopenia, but no reciprocal relationship was evident (Yoshimura et al., 2017) .

4. Summary of current problem

The definition and diagnosis of sarcopenia are still evolving as new findings challenge current understanding. For example, there is limited Asian data and there is controversy about using the term sarcopenia where muscle wasting may predominantly be due to coexisting conditions such as cachexia or paralysis. Nevertheless, the AWGS decided against following a recent trend to consider all muscle wasting as sarcopenia and therefore retains its original definition of "age-related loss of skeletal muscle mass plus loss of muscle strength and/or reduced physical performance," without reference to comorbidity. AWGS 2019 retains the age cutoffs at either 60 or 65 years old, depending on how each country defines "older people". Although sarcopenic features may occur in younger adults, the underlying pathophysiology should be investigated rather than simply pursuing a diagnosis of sarcopenia. Although the diagnosis criteria have been determined by AWGS in 2019, the use of a socio-ecological model to identify and understand factors contributing to sarcopenia has not been mentioned among Japanese population. This systematic review focus on socio-ecological determinants of sarcopenia among Japanese population study.

Chapter III. Methodology

l1. Introduction

The goal of this literature review is to identify the socio-ecological factors of sarcopenia for each level of prevention practices (e.g., intrapersonal or individual, interpersonal, organizational, community, and systems or public policy level) among the Japanese elderly population. While there is previous research about sarcopenia in Japan, there are actually no papers which clearly

mention the socio-ecological factors related to sarcopenia among the Japanese population. Therefore, we reviewed the ecological predictors along with the database research of literature. As very little research used the term “ecological” we extracted risk factors, and positive as well as negative effect factors.

2. Literature Search Methodology

This systematic review adheres to the guideline of Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA).

(i) Search Strategy

The search was conducted in seven electronic databases: MEDLINE (via Pubmed), PsycINFO, EMBASE, PsycINFO, Web of Science, Scopus, Medical Online between January 2013 and January 2020. The keywords search terms were: “sarcopenia” AND “elderly” AND “Japan” AND “risk factor” AND/OR “prevention” (Table 1). Data was extracted according to a standardized form to including following: authors, journal name, year of publication, city and country, participants, type of population, mean age, detailed groups with sample size, associated factors.

The list of references of articles was also reviewed for any additional papers as well as specialized journals and textbooks that were associated with sarcopenia. In addition, gray literatures such as report and conference presentations were considered using the google search engine to further ensure that pertinent articles were not missed. English and Japanese articles were reviewed.

(ii) Data extraction

For this systematic review, the following inclusion criteria were used (Table 2): 1) The full texts is available; 2) published between 2013 and April 13, 2020; 3) written in English or Japanese 4) all studies had to be case–control, longitudinal or cross-sectional designs; 5) assessment of sarcopenia had to be implemented according to the sarcopenia consensus criteria (e.g., AWGS2019, EWGSOP or EWGSOP 2 definition of sarcopenia); 6) community dwelling participants aged 65 years and older among the Japanese population; and, 7) the prevalence of sarcopenia in Japanese elderly population had to be reported. To provide additional knowledge about the prevalence of sarcopenia among Japanese elderly population, the associations of sarcopenia and socio-ecological factors as a secondary outcome measure were investigated. Excluded cases were the following: young population or with low daily activity due to other specific health conditions such as diabetes, cancer, liver disease, chronic obstructive pulmonary disorder (COPD), kidney failure, rheumatoid arthritis, cognitive disorder, neurologic disorder, and others shown in Table 3.

(iii) Analysis plan

The lead author, J.S., extracted relevant data from each included article and assessed risk of bias using RoBANS (Risk of Bias Assessment Tool for Nonrandomized Studies: Table 4） (Kim et al., 2013). The following data were extracted: authors, journal name, year of publication, country, objective of the study, sex, mean age, sample size, design, tools used to assess muscle mass, muscle strength and physical performance, prevalence of sarcopenia, outcome, conclusion, presence of conflicts of interests, and potential funding.

Table 1: Search strategy

1. (' sarcopenia'/exp OR sarcolemma)
2. AND (' elderly'/exp OR elderly)
3. AND (' japan'/exp OR japan)
4. AND (' risk AND factor'/exp OR 'risk AND factor' OR (('risk'/exp OR risk) AND factor))
5. AND (' prevention'/exp OR prevention))

Table 2: Inclusion criteria

Text availability	Full text
Publication date	From April 13, 2013 to April 13, 2020
Language	English and Japanese
Design	Case–control, longitudinal or cross-sectional designs
Participants	Human, Age at least 65 years old
Diagnosis	Based on the EWGSOP 2 definition (presence of low muscle mass + either low muscle strength or low physical performance) or AWGS2019
Outcome	Report of at least one outcome of sarcopenia

Table 3: Excluded reasons

Research engine	Excluded reasons
Pubmed	Unclear distinction of sarcopenia from other diseases 79, Not mentioning sarcopenia factors 9, DM 19, , Gastric cancer 17, Esophageal cancer 15, Urethral cancer 16, Hepatocellular carcinoma 23, Lung cancer 13, Rectal cancer 14, Renal cell carcinoma 3, Cervical cancer 2, Oral cancer 2, Pancreatic cancer 5, Cholangiocarcinoma 2, Ovarian cancer 1, Unknown cancer 1, Hematologic Disorder 1, Hemodialysis 5, Peritoneal dialysis 1 , Rheumatoid arthritis 4, Heart disorder 14, CKD 4, Liver transportation 1, COPD 1, Age<50 years old 1, Alzheimer disease 1, Kidney transportation 1, Sepsis1, aortic aneurysm 1, Bowel perforation 1, Post-orthopedic surgery 1, Esophageal peristalsis 1, Osteoporosis 1, Post-cardiac surgery 1, Stroke 1, Head trauma1, Limb ischemic disease 1, Groin hernia 1, Vague definition of sarcopenia 1
EM Base	Duplicate 80, Unclear distinction of sarcopenia from other diseases 19, Liver disorder 5, Heart disorder 5, DM 6, Lung cancer 5, Gastric cancer 3, Animal 3, Rheumatoid arthritis 2, Hemodialysis 2, Hematologic Disorder 1, Hepatocellular carcinoma 1, COPD 1, Genetic issue, Not Japanese, Bowel perforation 1, Post-orthopedic surgery 1
Scopus	Duplicate 89, Unclear distinction of sarcopenia from other diseases 14, Not Japanese 13, Liver disorder 6, DM 5, Prostate cancer 1, Heart disorder 1, Hepatocellular carcinoma 1, Unable to access to full text 1
Psycho INFO	Duplicate 6, Animal 1
Web of Science	Unclear distinction of sarcopenia from other diseases 12, Duplicate 14, Spine surgery 1, Prostate cancer 1, Heart disorder 1
Medical Online	Unclear distinction of sarcopenia from other diseases 14, Unable to access to full text 3

Table 4: Risk of bias with the Risk of Bias Assessment tool for Non-randomized Studies (RoBANS)

Study	Selection		Performance	Detection	Attrition	Reporting
	Selection of participants	Confounding variables	Measurement of exposure	Blinding of outcome assessments	Incomplete outcome data	Selective outcome reporting
	•Low •High •Unclear	•Low •High •Unclear	•Low •High •Unclear	•Low •High •Unclear	•Low •High •Unclear	•Low •High •Unclear
Tanaka et al. (2018)	High	Low	Low	Low	Low	Low
Murakami et al. (2015)	Low	High	High	Low	Low	Low
Hayashi et al. (2019)	Low	High	Low	Low	Low	High
Momoki et al. (2017)	High	Low	Low	Low	Low	High
Kamo et al. (2018)	High	High	Low	Low	Low	High
Takahashi et al. (2018)	Low	High	High	Low	Low	High
Tanimoto et al. (2013)	High	High	Low	Low	Low	High
Ishii et al. (2014)	Low	Low	High	Low	Low	Low
Maeda et al. (2016)	High	Low	Low	High	Low	High
Tanishima et al. (2017)	High	High	High	Low	Low	Low
Akune et al. (2014)	Low	High	Low	Low	Low	Low

Figure 1: Literature search flow diagram

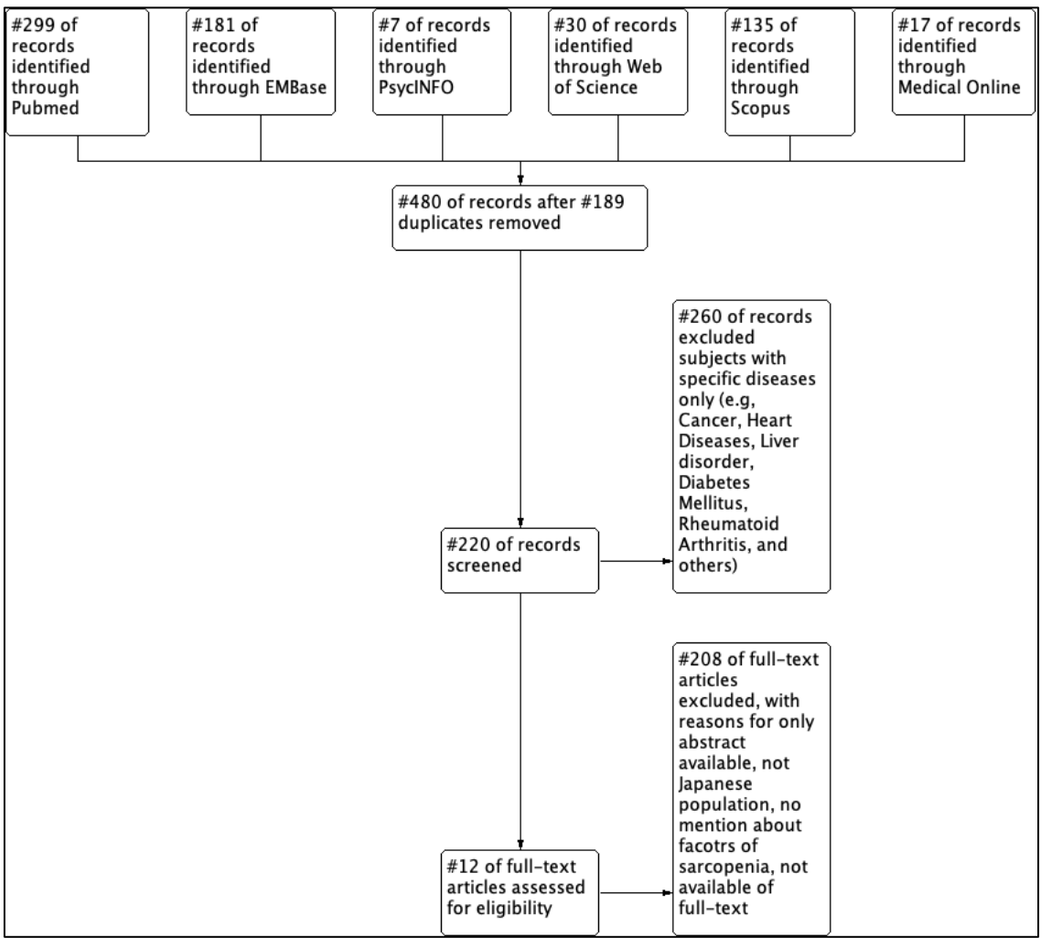


Table 5. Characteristics of 12 included studies

Author, year	Design and period	Sample size	City	Mean age (Years)	Participants, Age	Sarcopenia Criteria	Prevalence of Sarcopenia	Effect Measure	Associated factors
Tanaka et al. (2018)	Prospective cohort study	2,044	Kashiwa, Japan	73.0 ± 5.5	Community-dwelling individuals, ≥65 years old	AWGS	N = 118 (5.2 %)	HR	Oral status assessed 16 measures
Murakami et al. (2015)	Cross-sectional Study	761	Itabashi, Tokyo	73.0 ± 5.1	Community-dwelling individuals, 65-85 years	EWGSOP	N = 138 (18.4%)	OR	Age BMI Chewing ability
Hayashi et al. (2019)	Cross-sectional study	432	Toyota, Aichi, Japan	72.5 ± 4.7	Community-dwelling individuals, 65–85 years	AWGS	N = 41 (9.5%)	OR	GDS-15 score BMI SMI Walking speed Depression status
Momoki et al. (2017)	Cross-sectional study	331	Nara, Japan	77.7 ± 6.8	Community-dwelling individuals only women, ≥65 years old	AWGS	N = 39 (21.0%)	OR	Age≥75 years BMI<18.5 kg/m^2 or≥25 kg/m^2 DVS≥9 Loco-motive syndrome Living alone Living with children and/or grandchildren
Kamo, Ishii, Suzuki, and Nishida (2018)	Cross-sectional study	288	Two cities, Japan (Not mention specific name)	86.4 ± 7.7	Nursing home residents, age≥65 years	AWGS	N = 112 (44.8%)	OR	Gender BMI
Takahashi, Maeda, and Wakabayashi (2018)	Cross-sectional study	312	Kochi, Japan	76.0 ± 7.5	Outpatient visited a Dental Clinic	AWGS	N = 86 (30.8%)	Correlation coefficient	Oral health‐related quality of life Oral health status
Tanimoto et al. (2013)	Cross-sectional study	1074	Osaka, Japan	Male 77.1 ± 6.0 Female 77.8 ± 5.7	Community-dwelling individuals ≥65 years	EWGSOP	N = 160 (29.2%)	OR	(Women) Live alone Poor exercise habits (Men) Masticatory ability and a low dietary variety
Ishii et al. (2014)	Prospective cohort study	2044	Kashiwa, Chiba, Japan	73.1 ± 5.5	Community-dwelling individuals, ≥65 years	EWGSOP	N = 359 (36.3%)	OR	Metabolic syndrome in men Abdominal obesity in men
Maeda and Akagi (2017)	Cross-sectional study	619	Kumamoto, Japan	83.0 ± 8.2	Admitted to our geriatric hospital, age≥65 years	AWGS	N = 417 (67.4%)	OR	Cognitive impairment Stroke Hemiplegia
Tanishima, Hagino, Matsumoto, Tanimura, and Nagashima (2017)	Cross-sectional study	216	Hino, Tottori, Japan	73.5 ± 7.8	Individuals who underwent an annual town-sponsored medical check-up	AWGS	N = 12 (5.5%)	Correlation coefficient	(Positive) Mean ODI Low %YMA BMI (Negative) Walking speed
Akune et al. (2014)	Cross-sectional study	2,674	Itabashi, Tokyo and Hidakagawa,	Male 75.7 ± 5.9	Participated who were interested in participating in	EWGSOP	N = 129 (13.8 % in men and	OR	Age BMI

			Taiji, Wakayama, Japan	Feamle 74.4 ± 6.1 (women)	the study 21–97 years		12.4 % in women)		Chair stand time One-leg standing time Exercise habit in middle age
Su, Hirayama, Han, Izutsu, and Yuki (2019)	Cross-sectional study	310	Sapporo, Hokkaido, Japan	76.0±5.8	Community dwelling older people, ≥65 years	EWGSOP2	N = 45 (14.5%)	OR	(Positive) Nutritional state Smoking Consuming alcohol Obesity Diabetes Taking more than four prescription drugs/ day (Negative) BMI and TBW

Chapter IV: Results

1. Study Selection

The literature selection process was conducted on 9 June, 2020, and this process is shown in Figure 1. A total of 669 papers were screened from Pubmed (n=299), the EM Base (n=181), PsycINFO (n=7), Web of Science (n=30), Scopus (n=135), Medical Online (n=17). In the first screening, 282 duplicates were excluded. On the second screening, abstracts of 387 papers were reviewed. Among papers searched via Pubmed, some were excluded because the target population has specific diseases as shown in Table 3. Finally, Figure 1 shows the full-text review of the remaining 12 citations after 208 were excluded.

2. Descriptive findings from the systematic review

The target population of this systematic review is Japanese elderly who are more than 65 years old. The included articles were those published from April 13, 2013 to April 13, 2020, written in English or Japanese, designed as case–control, longitudinal or cross-sectional study for human aged more than 65 or over. Diagnosis should be based on the EWGSOP, EWGSOP 2 definition or AWGS2019. Finally, 12 articles were considered for evaluation in the review (Table 5).

In the first data extraction, six full text articles are assessed for eligibility to review. However, since the purpose of this thesis is to identify socio-ecological factors of sarcopenia in elderly Japanese population, it was a situation where the objective was not fully achieved. Therefore, review was expanded from a 5-year period to an 8-year period in order to increase the number of searches. The number of hits in the literature search is updated daily, so the first review had to be

redone from the beginning. The EMBase has the function of excluding duplicate documents from Pubmed, but other search tools checked the abstracts of the documents one by one and checked if they were worth the review.

Among final reviewed twelve articles, there were two longitudinal studies (prospective cohort study) and ten cross-sectional studies. Almost all of the subjects were community dwelling older people (8 out of 12 articles). The rest were just single individuals. One was a nursing home resident, one was a patient who admitted to a specific hospital, one was a dental clinic outpatient, and one was an individual who took an annual medical checkup in a town in Japan. Only one study collected data on participants aged 21-97 years who were interested in participation, and from this population, those greater than 65 years old were chosen as subjects.

The criteria for diagnosis of sarcopenia based on AWGS EWGSOP, EWGSOP2 numbered 7, 5, and 1 articles, respectively. Prevalence of sarcopenia varies from 5.2% to 44.8% based on these different criteria.

Several factors associated with sarcopenia are as follows (Table 5): oral status, Age, BMI (Body Mass Index), chewing ability, GDS-15(Geriatric Depression Scale) score, SMI (Skeletal Muscle Mass Index), walking speed, depression status, DVS≥9 (Dietary Variety Score), loco-motive syndrome, living alone, living with children and/or grandchildren, gender, oral health related quality of life (OHRQoL), exercise habits in middle age, masticatory ability, low dietary variety, metabolic syndrome, abdominal obesity in men, cognitive impairment, stroke, hemiplegia, ODI (Oswestry Disability Index), %YMA (Young Adult Mean), chair stand time, one-leg standing time, nutritional state, smoking, consuming alcohol, obesity, DM(Diabetes Mellitus), taking more

than four prescription drugs/day, and TBW (Total Body Weight). the sarcopenia risk factors of BMI, age, exercise habits, walking speed, and oral health status were cited, respectively, in 7, 3, 2, 2, and 2 papers.

3. Analysis of major themes and findings

Unfortunately, this systematic review did not find any papers regarding the Japanese public policy and organizational level approach for sarcopenia prevention. Figure 2 shows the number of papers at which level in multiple level approach for sarcopenia. As you can see, 66.7 % of papers researches individual risk factors. Even though the research period was widened to 5 years, there are no papers that mention socio-ecological levels beyond the individual and interpersonal levels for sarcopenia among Japanese elderly population.

4. Methodological quality

Assessment of the risk of bias was performed according to RoBANS which is a testing tool for evaluation of the risk of bias for nonrandomized researches, showed moderate reliability and promising validity (Table 4).

In two articles, researchers used data collected in previous research. These resources were considered highly biased. As for incomplete outcome data, since sarcopenia is a disorder of aging, some of the participants had died during follow up period. However, where researchers followed the subjects thoroughly, these studies were assessed as low bias.

In one paper, researchers conducted a questionnaire survey which asked participants about lifestyle information. The survey was interviewer-administered comprising of 400 items.

However, the questions for the participants were for back when they were 25-50 years old. This may possibly include reporting bias as well as recall bias.

Chapter V: Discussion

1. Introduction

Sarcopenia is a disorder that is described by degenerative loss of skeletal muscle mass and strength, impair daily life among the elderly, and has been increasing in the world, especially, in the Asian individuals. The estimated number of prevalence of sarcopenia in the Japanese elderly population is approximately 2.7 million and Japan had the most elderly population in 2017, and it is projected to remain so through 2050. In addition, Sarcopenia causes much economic burden. The cause of sarcopenia is generally thought to be caused by multiple factors such as environmental issues, disease triggers, inflammatory pathway activation, loss of neuromuscular junctions, and hormonal changes, which are all thought to contribute in different ways and extent. These causes are also impacted by the social setting of people with sarcopenia which may improve or diminish the probability of sarcopenia, risks related with sarcopenia, and quality of care. Because of this complexity, there is a need for interventions based on the different socio-ecological factors or social context contributing to an individual's experience with sarcopenia.

The purpose of this thesis is to understand the current status and identify existing literature on the socio-ecological predictors of sarcopenia in the elderly Japanese population to determine appropriate multidisciplinary prevention practices. By reviewing the existing literature on Sarcopenia, the definition of sarcopenia and along with the its possible risk factors and solutions will be identified and discussed.

Throughout this systematic review, almost all majority of studies reviewed were involved only individual level factors for sarcopenia with only a few involving community-level, and organizational level factors, and none involving policy level factors. However, despite this limitation, a socio-ecological framework was suggested in this section (Figure 3).

2. Summary of study

No studies addressed sarcopenia within the fuller socio-ecological context beyond individual and interpersonal levels. Among 12 articles, the individual level associated factors of sarcopenia are oral status, age, BMI, chewing ability, GDS-15 score, SMI, walking speed, depression status, DVS score, loco-motive syndrome, OHRQoL, masticatory ability, low dietary variety, metabolic syndrome, abdominal obesity in men, cognitive impairment, stroke, hemiplegia, ODI, %YMA, chair stand time, one-leg standing time, nutritional state, smoking, consuming alcohol, obesity, DM, taking more than four prescription drugs/day, and TBW.

As for interpersonal level, poor exercise habit in middle age, living alone, and living with children and/or grandchildren are mentioned in reviewed articles. Regarding community and organizational level, living status is relevant in these levels. Unfortunately, at the policy level, there have been no studies conducted yet from the references examined.

3. Discussion of key results

The importance of sarcopenia in geriatric medicine was recognized early on, but its definition and diagnosis remained unchanged without international agreement. In 2010, after a wide range of discussions from Europe and Asia, a unified view was presented. According to previous studies, the pathology of sarcopenia is caused by a variety of factors rather than just a single factor, and it

is not thought that basic medical intervention alone can effectively prevent it. Therefore, it was thought to be necessary to elucidate and include socio-ecological theory and to the approach to sarcopenia and to start this systematic review. However, most of the studies (66.7 %) targeting Japanese people were basic studies which targeted individuals with criteria shown in the Figure 2. Researchers have mentioned the need for a social approach, but no specific socio-ecological model has been proposed.

Figure 3 illustrates the socio-ecological model among the Japanese elderly population based on the present review. Different levels combine to affect population health, and each level of influence can affect health-related behavior. This systematic review provides several factors which are individual, a few interpersonal, organizational, and community factors. However, the approach from a policy level was not mentioned in any of the reviewed articles. As an important part of preventive science in public health, it should be engaged.

Figure 4 demonstrates the demographic structure in the transition, namely, the population pyramid which was adopted from the Japanese National Institute of Population and Social Security Research, in the age group structure of the Japanese population, there is a marked decrease in the younger population (under 15 years old) and a large increase in the aged population (65 years and older), and the declining birthrate and aging population are rapidly increasing as well. From the 1950's "mountain type" structure of the aging population, there are irregularities due to two baby booms, but currently it is "bell shaped". It is estimated that in 2050, the declining birthrate will further advance and the population distribution will change to a "pot type". What people must expect from the shape of this demographic pyramid is that the number people in the younger

generations that will support it is decreasing, and we will not be able to support the increased number of older people who receive nursing care.

R. Brownson, Fielding, and Maylahn (2009) categorized three types of evidence in the implementation of public health policies (Table 6). The first type of evidence is the strong link between risk and disease. However, in many cases, there is not much “absolute certainty” regarding the causal relationships between risk and disease, and various factors are combine and interact in a complex manner. Nevertheless, it should be considered how much risk there is and how much priority should be given to countermeasures against that risk. The second type of evidence includes comparing the effects of interventions on certain risks. It is natural that interventions are often not just single interventions, but different strategies. However, it is necessary to prioritize based on effectiveness. In each case, a policy that “must do this” based on the evidence will be selected as to which is the most effective final effect, and decide to invest a limited budget and human resources. (Rychetnik, Hawe, Waters, Barratt, & Frommer, 2004) suggests that type 3evidence should be considered and include the following: information on the design and implementation of an intervention; the contextual circumstances in which the intervention was implemented; and information on how the intervention was received. Type 3 evidence tells us ‘‘how something should be done’’. This type 3 evidence is also important in improving the quality, availability, and use of all three types of evidence in public health decisions.

Evidence-based public health (EBPH) involves gathering evidence and then developing guidelines that will help teams make decisions in the field (R. C. Brownson, Fielding, & Green, 2018). Although this review lacked policy levels, politics is a non-negligible part of decision making. The role of health

and public health professionals is to inform decision makers about the balance between the benefits and harms of evidence and intervention for the population.

In decision-making on public health measures, not only effectiveness and efficiency but also other aspects must be considered from various perspectives such as fairness, ethics, politics, financial feasibility, and cultural background. The advantages of making decisions in teams are that more information and knowledge are available, different options are presented, and there is a general agreement among the people involved in the decision and ease of implementation. On the downside, several disadvantages are that it takes time to make a decision, the decision can be a compromise agreement, and that there is a risk of a loud voice taking over the group.

Table 6. Comparison of types of scientific evidence in the field of public health

Characteristic	Type 1	Type 2	Type 3
Relevance	Severity and preventability of diseases and its risk factors	The impact of specific intervention on health improvement	Information on the adaptation and translation of an effective intervention
Common setting	Clinic or controlled community	Socially intact groups or community wide	Socially interact groups or community wide
Quantity	More	Less	Less
Suggestion	Something should be done about it	This intervention should be done specifically	How something should be done

Figure 2: Percentage of reviewed articles by socio-ecological categories.

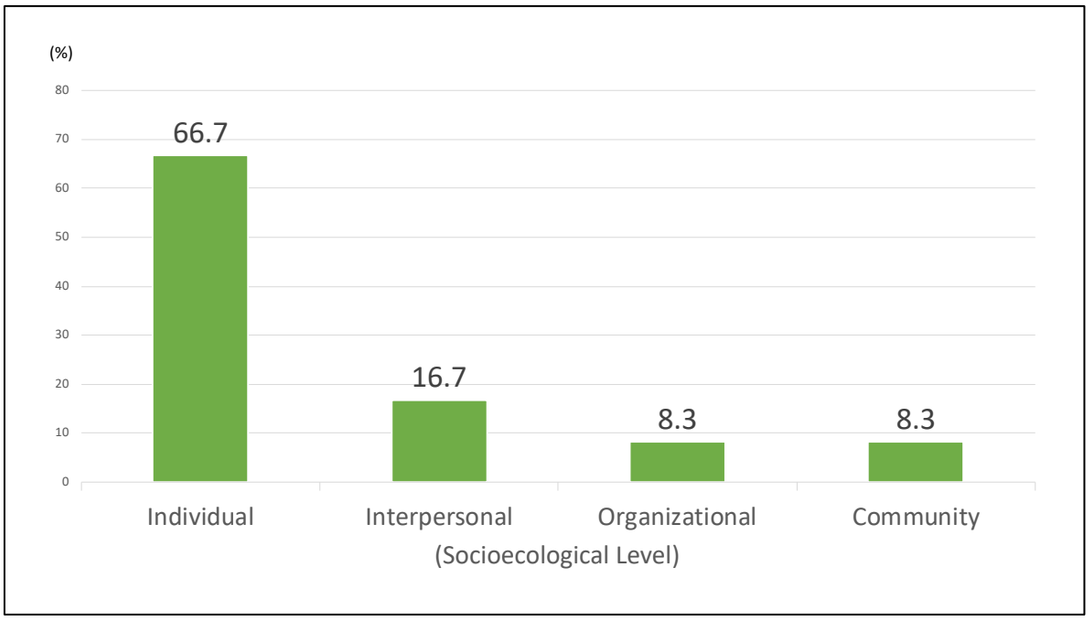


Figure 3: Socio-ecological model among Japanese elderly population.

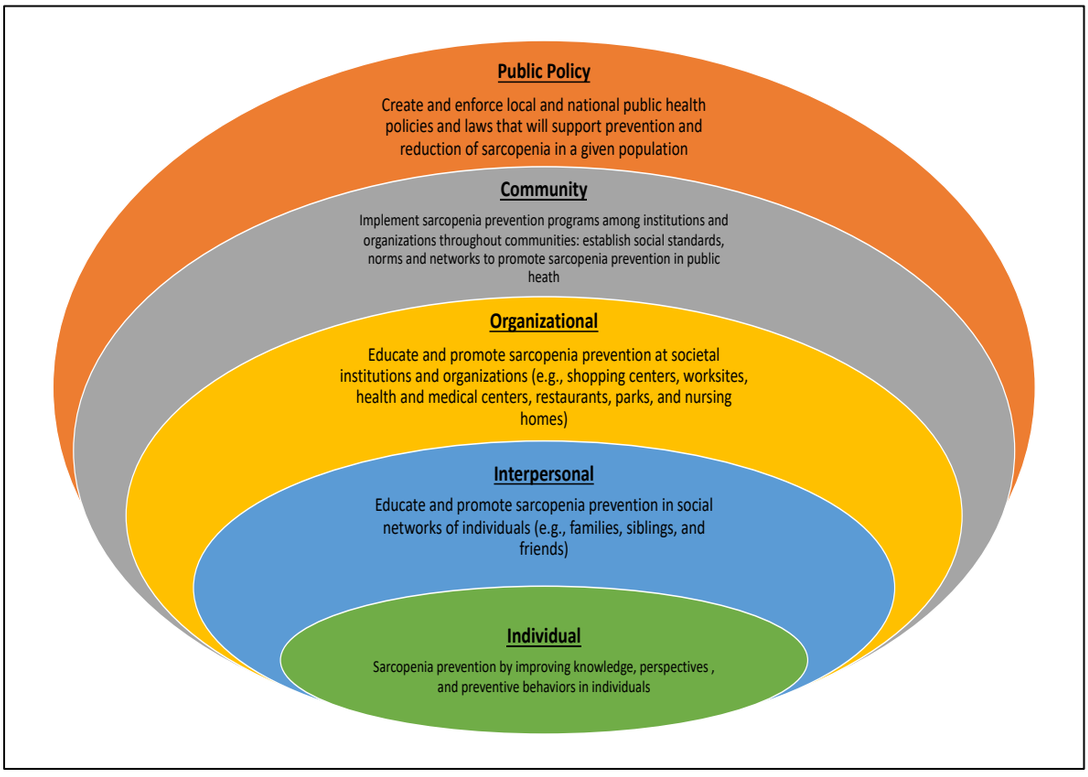
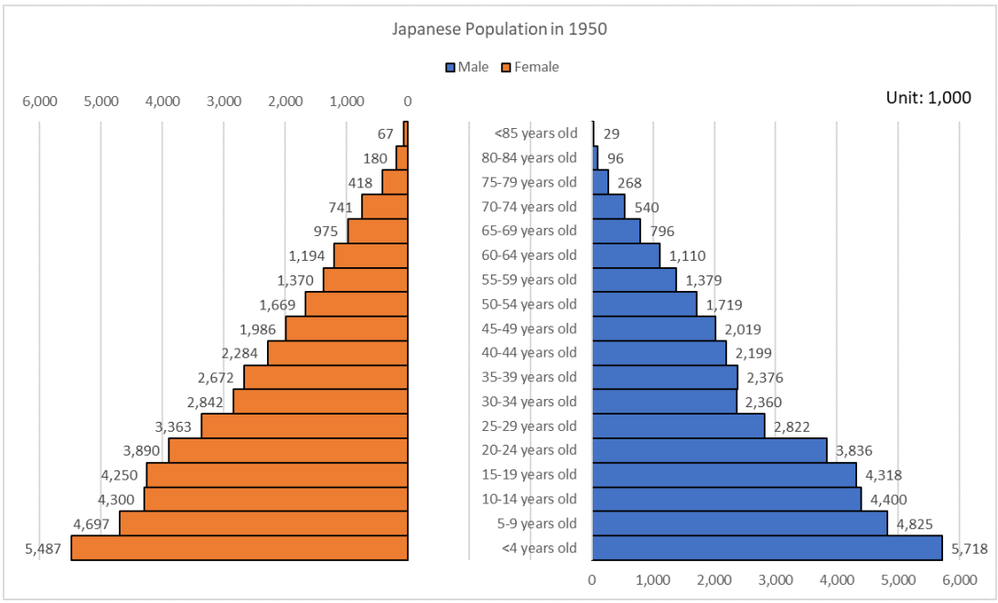
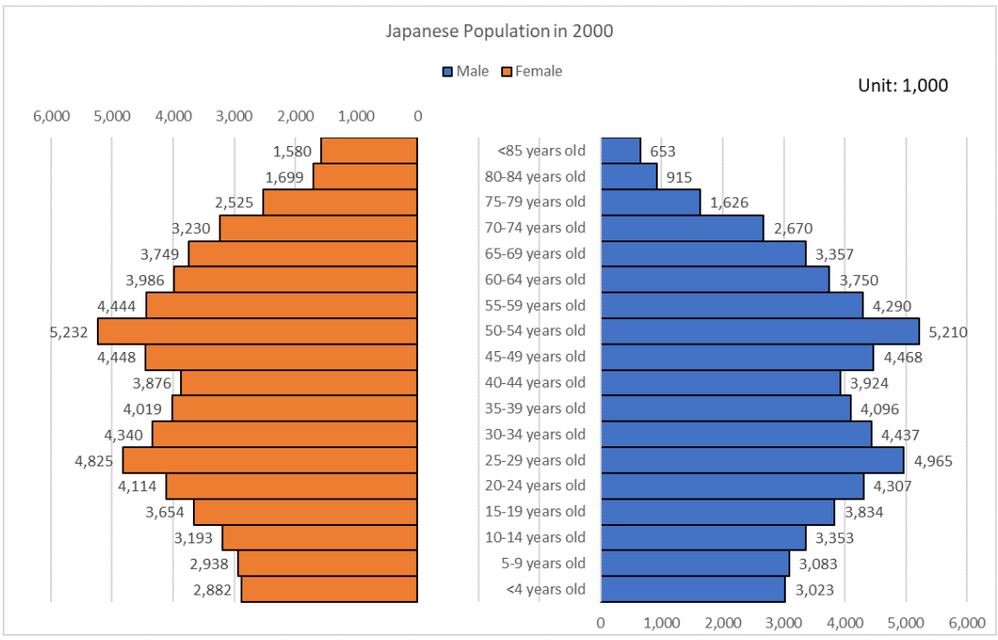
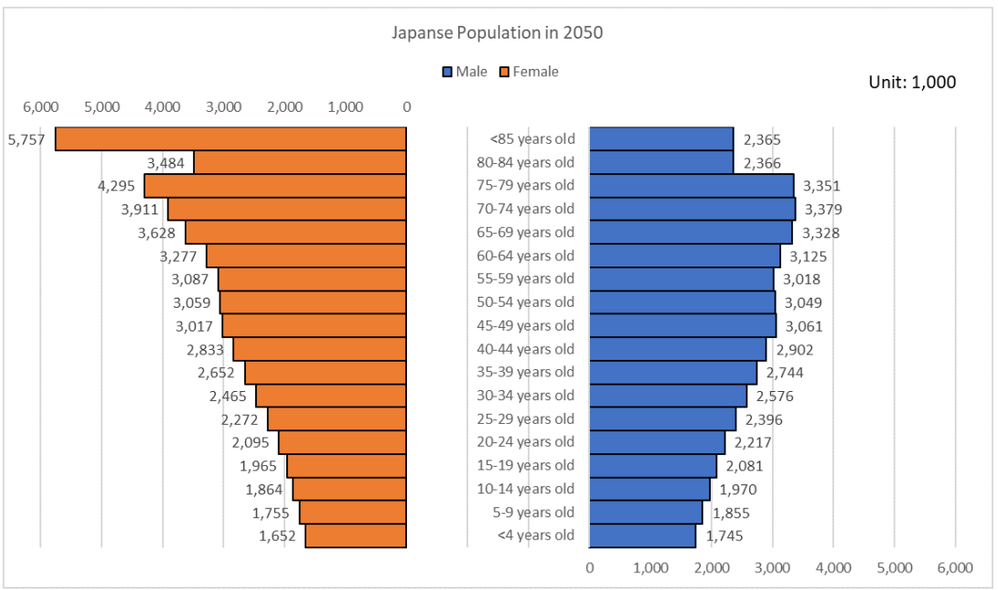


Figure 4. Japanese Population Change 1950-2050 (Adopted from the National Institute of Population and Social Security Research).







4. Limitations

This systematic review has several limitations. First, the results cover only the Japanese elderly population. The health insurance system is different in each country, hence this result would not apply for other countries. However, since the life expectancy in the world is increasing from 1950 year by year, there are some possibility to help introduce the EBPH approach in other countries.

In addition, the definition of sarcopenia has been changing. In 2010, the European Working Group on Sarcopenia in Older People (EWGSOP) published a sarcopenia definition that was widely used worldwide; this definition fostered advances in identifying and caring for people at risk for or with sarcopenia. In early 2018, the EWGSOP2 was updated with scientific evidence that had accumulated since the first version. On the other hand, diagnosing sarcopenia in Asian people requires considerations owing to anthropometric and cultural or lifestyle-related differences compared to Western contemporaries; for example, some factors are a relatively smaller body size, higher adiposity, and less mechanized, and less physically active lifestyle. Twenty-five AWGS members participated in a consensus meeting held in 2019, and the updated AWGS consensus was approved unanimously. Specifically, AWGS 2019 introduced “possible sarcopenia,” defined by low muscle strength with or without reduced physical performance, which is recommended for use in primary health care and preventive services, but not in hospital or research settings. Because of this update, the more research will be held in clinical settings, and the research work will expand.

Moreover, the search term "socio-ecological predictor", which shows did not have any hits, and therefore, "risk factor" was the next search term. This is because the term, the concept of "socio-ecological" perspective is not common in Japan. However, at the same time, it should be noted that

proposing and utilizing a “social-ecological” framework of sarcopenia among the Japanese elderly population is the main strength and objective of this review. The change in search keywords gave a comprehensive set of references that were used in this study.

Chapter VI: Conclusion

1. Implications

Based on the updated 2019 AWGS definition, future research will likely increase the accuracy of studies on sarcopenia and reporting on its prevalence, positive/ negative predictors, and socio-ecological factors. Since the factors impacting sarcopenia are many and are impacted by social factors at multiple levels mentioned in this review, a comprehensive approach for sarcopenia will require more research on social factors at the organizational, community and systems/policies levels and more complex multifactorial research and multilevel intervention design and delivery as shown in the proposed socio-ecological model.

2. Recommendations

The approach to sarcopenia, which can be said to be a disease of the elderly, will definitely become a public health problem in the next generation. This literature review of research on sarcopenia in Japanese elderly suggests that there is limited focus on socio-ecological factors. To address the expected health crisis early, there needs to be a proactive response now that takes an Evidence Based Public Health approach that expands, adopts and adapts proven translational research and interventions for sarcopenia in Japan using a multilevel framework such as the socio-ecological model ..

Socio-ecological approaches to public health interventions provide a framework for understanding the importance of the dynamic interrelations between a person and his or her

environment, and the context within which they exist, recognizing the complexity of human situations. The being said, all levels have supplementary roles for each other. Therefore, research and strategy for the policy level for sarcopenia among Japanese elderly population will needed to be taken into action, hopefully.

Further research studies which certify the effectiveness of several activities (e.g., community exercise programs, nutrition classes, family exercise), behavioral changes, and educational training for health professionals should be conducted to validate the socio-ecological approach. Therefore, social approaches other than fundamental intervention like medication for sarcopenia need to be tackled in a multidisciplinary way.

3. Conclusion

The present systematic review was conducted to identify the ecological predictors of sarcopenia among the Japanese elderly. Most of articles mentions the individual level associated factors of sarcopenia, and others were described as interpersonal, organizational, and community level factor, albeit no policy level. Socio-ecological framework for sarcopenia among Japanese elderly population was suggested in this review.

In conclusion, increased awareness of socio-ecological approach is crucial for the best current practice in order to implement sarcopenia countermeasure for Japanese aging people. Further studies that define key indicators as measurable components are needed to adopt a multidisciplinary approach to sarcopenia that will definitely be a difficult public health problem under the situation in an increasingly aging population.

Conflict of Interest

All authors declare that: (i) no support, financial or otherwise, has been received from any organization that may have an interest in the submitted work; and (ii) there are no other relationships or activities that could appear to have influenced the submitted work.

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