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LITERATURE REVIEW
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Management of Micro Nutrition and Health Impacts on the Elderly: Literature Review

Manajemen Gizi Mikro dan Dampak Kesehatan pada Lansia: Literature Review

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ABSTRACT

Background: The population of elderly worldwide is increasing unnoticed, including in Indonesia. The world's population is aging, and many elderly people experience age-related malnutrition, including deficiencies in some micronutrients. Malnutrition in the elderly is a serious condition when the nutritional needs of the elderly do not match their food intake.
Objectives: This systematic review broadly reviews various micronutrient problems and health impacts on the elderly in several countries.
Methods: Systematic review following PRISMA guidelines. Several databases have been accessed; the PubMed, Google Scholar, and ScienceDirect databases used a combination of MESH terms and relevant keywords. The inclusion criteria applied were studies written in English, evaluating relevant topics, providing full text, and published studies from 2017-2022
Discussion: Many disorders associated with aging are related to micronutrient deficiencies. Various factors cause micronutrient deficiencies in the elderly, but inadequate food intake is the main factor influencing this deficiency. Nutritional deficiencies experienced by the elderly are closely related to decreased immune function. The results of this review explain that the elderly experience malnutrition due to a lack of the following nutrients: vitamin D, folic acid, calcium, and vitamin B12.
Conclusions: Micronutrient deficiency in the elderly causes a variety of comorbidities that reduce the elderly's quality of life in old age, such as heart disease, high blood pressure, diabetes, electrolyte imbalance, dementia, and anemia. The development of food-based dietary guidelines and health promotion regarding elderly nutrition in several countries should be recommended, and it is also necessary to update national food intake references.

INTRODUCTION

The population of elderly worldwide is increasing unnoticed as time goes by[1]. It is estimated to reach 500 million with an average age of 60 years and is expected to reach 1.2 billion in 2025, and will continue to increase with an estimate of reaching more than 2 billion in 2050[2]. From 1990 to 2025, Indonesia's older people population is expected to multiply. One of the nations whose populations are beginning to age structurally is Indonesia, which is projected to have the world's fastest-growing elderly population [1]. Based on data from the Central Statistics Agency (BPS) shows that the elderly population numbered 14.4 million in 2000, totaling 23.9 million in 2013[3]. Projections from the UN also stated that the percentage of elderly in Indonesia will reach 25% in 2050, or around 74 million elderly[4].

Aging is often seen as a weakness and a disability. Nonetheless, age-related functional changes in the elderly vary significantly, and they may have different dietary and nutritional needs[5]. Changes commonly experienced by the elderly are physiological changes, changes in psychosocial behavior, and cognitive changes[3]. The world's population is aging, and many elderly people experience age-related malnutrition, including deficiencies in some micronutrients. To help the elderly maintain their independence and prevent declining health status, adequate nutritional intake is crucial[2].

One of the nutritional problems experienced by some Indonesian people today is hidden hunger or "hidden hunger." Humans who lack vital vitamins and minerals, called micronutrients, are said to be suffering from "hidden hunger"[6]. Global Hunger Index data for 2020 shows that Indonesia is in the 70th position out of

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107 countries and this condition is experienced by around 20-40 percent of the population. Its broadest definition refers to a persistent lack of micronutrients, specifically vitamins and minerals, which can have serious, long-lasting repercussions. The cause of hidden hunger is a lack of micronutrients caused by a lack of fruit and vegetable consumption. Anaemia can also be the cause of hidden hunger[7].

Malnutrition in the elderly is a serious condition when the nutritional needs of the elderly do not match their food intake. This condition can also be referred to as malnutrition or unbalanced nutrition in the elderly, leading to the following two conditions: malnutrition (not getting enough nutrients) and excess nutrition (getting more nutrients than needed)[8]. Suppose an aged person has a reduced income, less access to appropriate, safe, and nutritious food, has functional restrictions, eats unsafe food, uses coping methods to "stretch" their diet, or has several chronic illnesses. In that case, they are more likely to suffer from malnutrition. The elderly with various chronic diseases and those recently hospitalized are at risk of experiencing malnutrition[7]. This review aims to broadly review various micronutrient problems and health impacts on the elderly in several countries.

METHODS

Study Design and Search Strategy

A systematic review was conducted to review broadly various micronutrient problems and health impacts on the elderly in several countries. The report followed the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines. A search was conducted in the PubMed, Google Scholar, and ScienceDirect databases using a combination of the following Medical Subject Heading (MeSH) terms and relevant keywords in a different order: 'aged,' 'malnutrition,' and 'micronutrient.' Boolean operators, such as AND, OR, and NOT, are used in searches.

Study Selection and Outcome Measure

The inclusion criteria applied in selecting scientific articles were quantitative study, written in English, evaluating the relevant topic, providing full text, and the study was published starting in 2017-2022. Case reports, animal studies, letters to the editor, study reviews, and abstracts without the complete text were excluded from this study.

Data Extraction

The authors independently screened the included articles' titles and/or abstracts using standard Microsoft Excel forms. To address disagreements in consensus, a third external collaborator was consulted. Three independent research team members formally assessed article quality using Centre of Evidence-Based Medicine appraisal (CEBMa) tools for cross-sectional studies and Critical Appraisal Skills Programme (CASP) tools for cohort studies. Every systematic review includes a procedure for critiquing or evaluating the research evidence. This evaluation aims to evaluate a study's methodology and ascertain how well it has addressed the possibility of bias in its planning, execution, and analysis.

Data Abstraction and Synthesis

According to a thorough evaluation of the literature, the analysis is based on the findings and recommendations of each study. In order to identify subthemes and themes, relevant results are extracted, sequenced, and examined in the first step. All authors contributed to the synthesis's findings. The following data is presented in Table 3. Table 3 presents authors, year, country, aim, study type, data collection, participant and sample size, types of micronutrient deficiencies, and treatment.

RESULTS AND DISCUSSION

Screening Results and Assessment of Article Quality

A total of 421 articles were found in 3 databases. After being examined abstract, the year, topics, and languages, as many as 103 entered the initial screening. There are eight studies accessed for eligibility. A total of 1 study was irrelevant age of the respondent; therefore, they are excluded. A total of 7 articles were analyzed. PRISMA flow chart is presented in Figure 1. The articles analyzed have the quality of the moderate category and are presented in Table 1 and Table 2.

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Flowchart Study Selection

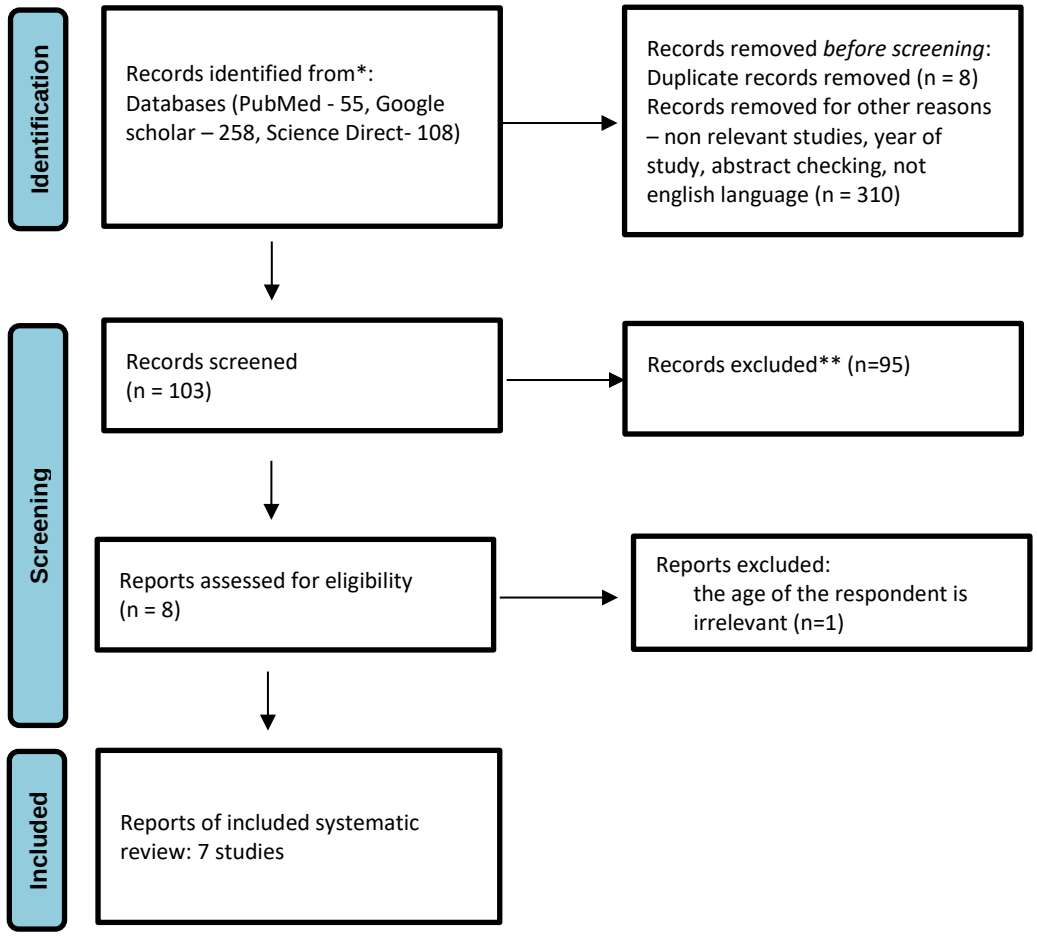

Figure 1. Prisma flow research

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Table 1. Article quality assessment for cross-sectional design study using Centre of Evidence-Based Medicine (CEBM) appraisal tools

Author, year	Did the study address a focused question/issue?	Is the research method (study design) appropriate for answering the research question?	Is the method of selection of the subjects (employees, teams, divisions, organizations) clearly described?	Could the way the sample was obtained introduce (selection)bias?	Was the sample of subjects representative regarding the population to which the findings will be referred?	Was the sample size based on pre-study considerations of statistical power?	Was a satisfactory response rate achieved?	Are the measurements (questionnaires) likely to be valid and reliable?	Was the statistical significance assessed?	Are confidence intervals given for the main results?	Could there be confounding factors that have not been accounted for?	Can the results be applied to your organization?	Quality
Conzade (2017)[9]	Y	Y	Y	Y	Y	Y	Y	C	Y	Y	Y	Y	M
Arazo-Rusindo (2021)[11]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	M
Dewiasty (2022)[30]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	M
Sharma (2017)[31]	Y	Y	Y	Y	Y	Y	C	C	Y	Y	Y	Y	M
Chamba (2021)[32]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	M

Notes: Y = yes, C= can't tell, N = No, M= moderate overall quality, L = low overall quality

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Table 2. Article quality assessment for cohort study using Critical Appraisal Skills Programme (CASP) tools

Author, year	Did the study address a focused issue?	Was the cohort recruited acceptably?	Was the exposure accurately measured to minimize bias?	Was the outcome accurately measured to minimize bias?	Have the authors identified all-important confounding factors?	Have they taken account of the confounding factors in the design and/or analysis?	Was the follow-up of subjects complete enough?	Was the follow up of subjects long enough?	What are the results of this study?	How precise are the results?	Do you believe the results?	Can the results be applied to the local population?	Do the results of this study fit with other available evidence?	What are the implications of this study for practice?	Quality
Das, A., Cumming (2021)[8]	Y	Y	Y	Y	C	Y	Y	Y	Y	Y	Y	Y	Y	Y	M
Zhu (2020)[33]	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	C	Y	Y	M

Notes: Y = yes, C= can't tell, N = No, M= moderate overall quality, L = low overall quality
Further information for the question "What were the results of this study" has been presented in Table 3.

Table 3. Characteristic of research

Authors, Year	Country	Aim	Study type	Data Collection	Participant	Sample size	Types of Micronutrient Deficiencies	Treatment
Conzade (2017)[9]	Germany	KORA-Age study in Augsburg, Germany, was used to determine the prevalence of subclinical vitamin D, folate, vitamin B12, and iron deficits among older persons aged 65 to 93.	Cross-sectional	A self-administered health questionnaire	Older people aged 65 and over	1079	Vit. D, Folic Acid, Calcium	Using serum nutritional biomarkers
Arazo-Rusindo (2021)[11]	Chile	An aged group of PACAM beneficiaries from Santiago de Chile's Metropolitan Region was the subject of this study, which assessed their nutritional health, intake of micronutrients, and blood levels of those nutrients.	Cross-sectional	A questionnaire, food recall, laboratories	Older people aged 60 and 80 years.	182	25-hydroxyvitamin D, calcium, and vitamin B12	A particular program for the elderly called PACAM (Programa de Alimentación Complementaria del Adulto Mayor)

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Authors, Year	Country	Aim	Study type	Data Collection	Participant	Sample size	Types of Micronutrient Deficiencies	Treatment
Das, A., Cumming (2021)[8]	Australia	To look at variations in older men's micronutrient consumption over three years and see if there are any correlations between socioeconomic, health, lifestyle, and meal-related characteristics and these changes in intake	Cohort study	Self-report questionnaires, interviewer-administered questionnaires, and a wide range of clinical assessments.	Older people aged 70 years and over.	1705	Vitamin D, Kalsium (Ca), dan Magnesium (Mg)	Suggestion to Multivitamin or specific micronutrient supplementation
Dewiasty (2022)[30]	Indonesia	To learn more about the features of older Indonesian adults who use or avoid dairy products and their nutritional deficiencies.	Cross-sectional	A structured questionnaire, mini nutritional status assessment (MNA), Nutrisurvey software	Older adults aged 60 years or older who lived in their own houses (community-dwelling)	194	Protein, calcium, vitamin D, and vitamin B12.	Milk/dairy consumption
Zhu (2020)[33]	Netherland	To determine vitamin status in older people with high and low socioeconomic status (SES), a population already at greater risk of micronutrient insufficiency, and to determine whether any potential differences therein were mediated by diet quality.	Cohort study	Laboratories (plasma, serum, urine samples), Anthropometric measurements and blood pressure, a semi-quantitative self-reported food frequency questionnaire (FFQ)	Older adults aged 60 -75 years	1605	Folic acid and the vitamins B6, B12, D, A, E, and K	SES-tailored public health strategies
Sharma (2017)[31]	India	To impress about vitamin D deficiency in an area with ample sunlight, such as Rajasthan, with emphasis on early diagnosis and intervention.	Cross-sectional	Detailed history and physical examination, vitamin D status measurement.	Age group 50 to 82 years	A total of 121 males and 83 females (total: 204)	Vitamin D	Proper food fortification, vitamin D supplementation
Chamba (2021)[32]	Tanzania, East Africa	To assess the prevalence of anemia, its severity, and the level of vitamin deficit among elderly Tanzanian hospital patients.	Cross-sectional	A structured questionnaire, Blood samples	Hospitalized adults aged 60 years and above	156	Iron, vitamin B12, folate	N/A

Notes: N/A : Not Applicable

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Aim of the Research

A total of seven articles were published to assess the nutritional status and micronutrient intake of older adults aged 60 and up. This research also describes the prevalence of diseases caused by micronutrient deficiencies and their treatments. This study investigates the effects of providing the elderly with different food and supplements.

Methods and Techniques of Analysis

Most of the research included in the review is quantitative research. Data were primarily collected using a structured questionnaire, in some articles also using anthropometric measurements, blood samples, and laboratory examination. Quantitative research is cross-sectional - survey type. Respondents of elderly involved ages ranging from 50 years and 82 years and over.

Finding

The results of this study indicated that the problem of nutritional inadequacy in the elderly is a nutritional problem encountered by diverse countries. Micronutrient deficiencies in the elderly can be caused by various factors, mainly due to inadequate food intake. Low food intake in the elderly can be influenced by socioeconomic status, culture, physical activity, and other social factors. Based on the seven countries that have been reviewed, it is stated that each country has almost the same type of micronutrient deficiency. Every elderly in various countries has a vitamin D deficiency. The rest is iron, vitamin B12, calcium, and folate. Lack of micronutrients in the elderly will lead to poor quality of life in old age. The Elderly who has malnutrition will be more susceptible to diseases. Diseases that accompany older adults with malnutrition are heart disease, high blood pressure, diabetes, electrolyte imbalance (hypokalemia, hypocalcemia), and decreased brain function, which will lead to dementia and anemia. The description of the included studies is presented in Table 3.

Micronutrient Deficiency in Elderly

Many disorders associated with aging are related to micronutrient deficiencies. The elderly are one of the groups at risk of experiencing micronutrient deficiencies. Many older people, including the infirm and those living in institutions, rely on ready-to-eat meals with variable, frequently subpar nutritional quality for most of their daily nutritional needs[6]. Micronutrient deficiency is a form of specific malnutrition[9]. Various factors cause micronutrient deficiencies in the elderly, but inadequate food intake is the main factor influencing this deficiency, especially the lack of vitamin D[2]. Poor eating patterns in the elderly10 cause less food intake. Diet in the elderly is influenced by ethnicity, economy, culture, and social factors. Age has an impact in addition to diet because aging brings about significant physiological changes such as sensory alterations (decreased olfactory function), decreased oral health (tooth loss), decreased saliva production, and swallowing issues. The elderly will no longer enjoy eating foods high in micronutrients and will consume far fewer of them due to all these dysfunctions[11]. Nutritional deficiencies experienced by the elderly are closely related to decreased immune function[12]. Vitamins C and D, B6 and B12, folic acid, trace minerals, zinc (Zn), and iron are among the nutrients directly connected to the body's immune system[13].

Vitamin D Deficiency

An essential component of both innate and adaptive immune system function is vitamin D. Moreover, cathelicidin antimicrobial peptide gene activation in activated monocytes and macrophages depends on vitamin D[14]. Many studies have been conducted in recent years on vitamin D insufficiency, which is still a persistent issue in public health. According to some studies, vitamin D deficiency affects people of all ages, genders, and ethnicities worldwide and is a significant public health issue[13].

Vitamin D insufficiency raises the likelihood of sarcopenia in the elderly and is linked to fractures, falls, poor physical performance, and maybe age-related cognitive impairment[15]. In addition, vitamin D deficiency can accelerate the age-related decline in the expression of vitamin D receptors in skeletal muscle[16]. Serum vitamin D levels in aged people can be used to predict the degree of functional decline and skeletal muscle atrophy[17]. According to studies, vitamin D insufficiency is highly prevalent in the aged population, and muscle VDR levels decline with aging[2].

Many illnesses, including autoimmune conditions like type 1 diabetes, rheumatoid arthritis, and multiple sclerosis, have been linked to vitamin D insufficiency. In addition to type 2 diabetes and several types of cancer, vitamin D insufficiency is linked to cardiovascular disease (including stroke), infectious diseases (bacterial, viral, and fungal), and infectious diseases (colorectal, breast, and prostate gland). Recent research has revealed that 25-hydroxyvitamin D impacts many diseases and mortality[18].

Folate

Folate is essential for the brain and nervous system, especially mood and cognitive function as we age[8]. Low folate levels in serum, red blood cells, and cerebrospinal fluid, elevated plasma homocysteine levels, and an increased prevalence of depression and dementia in senior individuals are all indicators of folate insufficiency. There is proof that a folate shortage may contribute to cognitive loss in the aging brain, raising the likelihood of vascular dementia and Alzheimer's disease while occasionally causing reversible dementia. This result may be due to methylation-related processes or homocysteine-mediated vascular or neurotoxic mechanisms. It is well-known that, in some neuropsychiatric diseases, depression may act as a precursor to dementia[19].

An extensive nationwide sample of aged people was used in the study to investigate the relationship between serum folate insufficiency and the risk of dementia development and all-cause death. A greater risk of dementia (HR = 1.68; 95% CI 1.32 to 2.13; p<0.001) and all-cause death (HR = 2.98; 95% CI 2.52 to 3.52; p<0.001) was found when serum folate insufficiency was

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present compared to absence. A biomarker that can be used to identify people at risk of dementia and death is serum folate levels[20].

Calcium

It takes a lifetime to build and maintain healthy bones. One of them has to do with calcium. According to a study, some people can lower their risk of fractures, osteoporosis, and diabetes by consuming enough calcium[21]. According to a study, older people frequently have hypocalcemia, which is potentially fatal. It was shown that 97 (24.1%) older people had hypocalcemia. Hypocalcemia was observed in 75 (26.2%) of the 286 participants in the 60–74 age group out of the total 286 participants and 22 (19%) of the 116 participants in the >74 age group. 44 (24.3%) of the 181 male individuals and 53 (24%) of the 221 female participants had hypocalcemia[22].

Ordinary aged people have a calcium balance that is out of equilibrium, which causes them to lose bone mass. In the US, adults 65 and older typically take roughly 600 and 480 mg of calcium daily, respectively. The elderly consume less calcium than the young, and their lower absorption rates further lower their adequate intake. The requirement for calcium is also effectively increased by other nutrients like protein and fiber, which are ingested in excess. When estrogen is withheld during menopause, intestinal calcium absorption, and renal calcium retention become less effective, increasing the need for an effective calcium intake[23].

Vitamin D has a connection to the issue of calcium insufficiency. The main element in keeping calcium homeostasis is vitamin D. Growing evidence points to the elderly's low vitamin D levels as the cause of the altered calcium balance with aging[24].

Vitamin B 12

The clinical signs of vitamin B 12 deficiency in the elderly are prevalent (> 20%), but they are sometimes overlooked because they are modest. These clinical manifestations are also potentially dangerous, particularly from the standpoints of neuropsychiatry and hematology[25]. The cobalamin-food malabsorption syndrome, pernicious anemia, inadequate dietary intake, and malabsorption are the main contributors to deficiency, accounting for more than 60% of all cases[26].

The elderly have a very high incidence of undiagnosed vitamin B12 deficiency, yet no identifiable risk category should be screened. Consequently, it is appropriate to screen the aging population by employing biochemistry. The early detection of vitamin B12 insufficiency is crucially determined by general practitioners[27].

Due to many causes, such as inadequate consumption of foods derived from animals and aging-related declines in intestinal B12 absorption ability, specific sub-group populations are at risk of subclinical vitamin B12 deficiency. While a plant-based diet raises the risk of B12 deficiency, consuming animal products has some detrimental health effects and negatively influences ustainability[28].

Dementia patients have a 7.5% frequency of vitamin B12 deficiency. Shorter duration, more severe dementia, and macrocytosis were all related to it. Six weeks and 12 weeks after beginning vitamin B12 treatment, the median Mini-Mental Status Examination (MMSE) score significantly improved[29].

Prevention and Intervention

According to studies conducted in Germany, elderly people unable to follow dietary recommendations can benefit from frequent micronutrient supplementation in the optimum dosage, which can help them avoid chronic diseases by raising low micronutrient levels[9]. Increases in BMD (Bone Mineral Density), muscle strength, decreased falls, and fractures in the elderly have all been linked to vitamin D and calcium supplementation. The impact of interactions with all vitamin Ds on metabolic pathways can be seen in the human vitamin D status. Hence, any condition that disrupts a person's metabolic processes can impact the levels of 25-hydroxyvitamin D in the blood[18].

The Chilean government established PACAM (Programa de Alimentación Complementaria del Adulto Mayor), a particular program for the elderly, in 1998. This complementary feeding program for older people was created to preserve health and activity levels in the future, lower acute morbidity and functional decline, lower health disparities, and provide complementary food for the elderly. With about 70% of the elderly being delivered, the PACAM food distribution in the Chilean region was deemed successful. However, it was discovered that the PACAM diet did not help maintain acceptable serum levels of certain significant micronutrients, such as vitamin B12, presumably due to its poor absorption due to individuals' stomach atrophy[11]. The elderly Indonesian population may not be getting enough vitamin B12 due to diet-related reasons. Animal-derived foods like meat, milk, eggs, fish, and shellfish are good sources of vitamin B12. In order to prevent vitamin B12 insufficiency in at-risk groups, it is crucial to select food sources with a high natural vitamin B12 content[15].

The incidence of vitamin D insufficiency in the aged population can be reduced by consuming dairy products. Dewiasty's research from Indonesia demonstrates that consumers of dairy products are primarily women and people with higher monthly earnings. They are less likely to suffer from malnutrition and have fewer co-morbid conditions, particularly hypertension, diabetes, and dyslipidemia. In addition, people who consume dairy products have lower protein, calcium, vitamin D, and vitamin B-12 deficiency rates than those who do not. For micronutrients (calcium, vitamin D, and vitamin B12), differences in deficit were more pronounced and statistically significant for both sexes[30].

CONCLUSIONS

Micronutrient deficiency in the elderly causes a variety of comorbidities that reduce the elderly's quality of life in old age, such as heart disease, high blood pressure, diabetes, electrolyte imbalance, dementia, and anemia. The development of food-based dietary guidelines in several countries should be recommended, and it is also necessary to update national dietary intake references. There is a need for health promotion related to increasing knowledge about nutritional intake and

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quality of diet in the elderly which can contribute to a healthy aging process, thereby increasing their quality of life [15]. Therefore, clinical health workers can further promote routine screening for malnutrition in at-risk populations

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