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Early Detection and Strengthening Exercise Program for Knee Osteoarthritis and Fall Risk among Elderly Women in Gulingan Village, Bali

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ABSTRACT

The decline in estrogen hormone levels among elderly women who have entered the menopausal phase contributes to a deterioration in their overall health condition. One of the prominent effects is a reduction in muscle performance, which in turn leads to decreased muscle strength and diminished balance control. This community service program was designed with the following objectives: (1) to enhance elderly women's understanding of the symptoms of knee osteoarthritis, its prevention strategies, management approaches, and the associated risk of falls; (2) to conduct preventive health efforts through early detection of knee osteoarthritis using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) questionnaire and goniometer, and early detection of fall risk using the Timed Up and Go (TUG) test; and (3) to provide a lower-limb muscle strengthening exercise program. The activity was attended by 52 elderly women aged over 60 years residing in Gulingan Village in July 2025. The results of the knowledge regarding knee osteoarthritis and fall risk increased from 32,7% to 82,7%. Early detection using the WOMAC questionnaire revealed that the majority of participants were at a mild risk of knee osteoarthritis (80.78%). Goniometer measurements indicated that most participants maintained a normal range of joint motion. Furthermore, early detection using the TUG test demonstrated that the majority of elderly women had a low risk of falls (80.8%). This program successfully increased awareness and preventive behavior among elderly women, highlighting the importance of early screening and home-based strengthening exercise.

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INTRODUCTION

Osteoarthritis (OA) is a degenerative joint disease that affects all load-bearing joints, including the knee. If left untreated, this condition can lead to movement limitations (Heiwer Matongka et al., 2021). Osteoarthritis causes joint pain and restricted mobility, which can interfere with daily productivity (Putri et al., 2022). The incidence of osteoarthritis is relatively high in Indonesia. The prevalence of osteoarthritis in Indonesia by age group is estimated at 5% among individuals aged 40 years, 30% among those aged 40–60 years, and as high as 65% among the elderly (BPS, 2018).

The occurrence of osteoarthritis can interfere with the daily activities and productivity of the elderly. The primary complaints commonly experienced include pain and stiffness in the knee joint, which lead to limited joint mobility, decreased muscle strength and flexibility, alterations in the knee joint's Q-angle (abnormal joint alignment) from its normal position, and reduced knee joint stability (Ekim et al., 2017).

Abnormalities in the knee joint gradually leaded to balance disturbances, thereby increasing the risk of falls among the elderly. Falls in the elderly may result in outcomes ranging from minor injuries to severe disability (Cifu et al., 2018). The prevalence of falls among elderly women is 40%, compared to 38% among elderly men, indicating a higher incidence in women. This difference is associated with the decline in estrogen levels among postmenopausal women, which increases their susceptibility to bone demineralization and joint degeneration (Mardilah, 2017).

Based on interviews conducted with several elderly women in Gulingan Village, the majority of them work as traders and farmers. On average, they work for 5 to 7 hours per day. Most of these elderly women reported experiencing mild knee pain, which occasionally interferes with their daily activities.

Based on the identified health issues among elderly women in Gulingan Village, this community service program aimed to (1) increase elderly women's knowledge about knee osteoarthritis and fall risk, (2) conduct early detection using WOMAC, goniometer, and TUG tests, and (3) promote safe lower-limb strengthening exercises. Through this initiative, it is expected that the program will promote independence, improve the quality of life, and enhance the overall well-being of elderly women in carrying out their daily activities.

METHOD

This community service activity was implemented through three main stages: the preparation stage, the implementation stage—based on the predetermined community service programs—and the evaluation stage. The activity aimed to assess the level of knowledge among elderly women regarding knee osteoarthritis and fall risk, conduct early detection of these conditions, and provide an exercise program focused on strengthening the lower limb muscles. A total of 52 elderly women aged over 60 years participated in this program. The activity was conducted in July 2025 at the Office of the Head of Gulingan Village, Mengwi, Bali. Initially, the participants completed a pre-test consisting of questions related to knee osteoarthritis and fall risk. Subsequently, the community service team delivered an educational session using simple and easily comprehensible materials on the symptoms and characteristics of knee osteoarthritis, as well as the factors contributing to an increased risk of falls among elderly women in Gulingan Village, Bali. After the educational session, the participants were given a post-test to evaluate changes in their knowledge.

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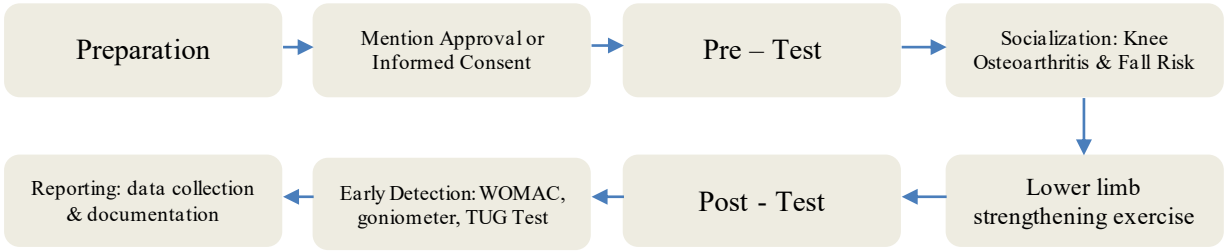

FIGURE 1. Procedural flow of the community engagement activities

Following the series of educational activities, the program continued with a medical examination. The initial stage of the examination involved the assessment of vital signs, including blood pressure, body weight, height, and respiratory rate. After completing the vital sign assessment, the community service team conducted early detection of knee osteoarthritis using the WOMAC questionnaire. WOMAC is a comprehensive instrument designed to assess osteoarthritis (OA) in elderly individuals with low to moderate activity levels. This questionnaire has been validated for use in identifying OA among pre-elderly and elderly populations (Thanaya et al., 2021). The instrument has been proven valid and reliable for measuring three primary dimensions of OA: pain, stiffness, and physical functional limitation. The use of the WOMAC enables early identification of functional impairments resulting from OA, thereby facilitating targeted and appropriate interventions (Aryanti et al., 2019). The WOMAC questionnaire consists of 24 items divided into three subscales: pain (5 items), physical function (17 items), and stiffness (2 items). The WOMAC scale scores are categorized as follows: none (0), mild (1), moderate (2), severe (3), and extreme (4). The total score range for each subscale is 0–24 for pain, 0–8 for stiffness, and 0–68 for physical function. A higher total score indicates greater severity of pain, stiffness, and physical functional impairment (Kim et al., 2020).

In addition to the WOMAC questionnaire, early detection of osteoarthritis was also conducted using a goniometer to measure the ROM in knee flexion and extension on both the right and left sides. A goniometer is a physiotherapy assessment tool used to measure joint ROM. In physiotherapy practice, ROM assessment is performed to obtain data on passive and active joint mobility, muscle length, as well as soft tissue extension, flexion, and functional ROM. For the measurement of knee extension, elderly female participants were instructed to lie supine on a flat surface with their legs extended as straight as possible. A rolled towel was placed under the ankle to assist in achieving full knee extension. For the measurement of knee flexion, participants were positioned prone and instructed to bend the knee as far as possible (Rosa, 2018).

Subsequently, early detection of fall risk was conducted using the TUG test. To assess fall risk and balance among the elderly participants, the TUG test was administered. The TUG test aims to evaluate the functional status of older adults, including mobility, balance, gait ability, and fall risk (Nurmalasari et al., 2019). The TUG test procedure was carried out as follows: (1) the participant sat on a chair with a backrest (the height of the chair was adjusted to the participant's height); (2) the knees were flexed at a 90-degree angle with arms resting on the chair; (3) the participant was instructed to stand up, walk a distance of three meters, turn around, walk back to the chair, and sit down again. The time was measured using a stopwatch, starting from the moment the participant began to stand until they were seated again. This test is recognized as a valid, reliable, and efficient tool for measuring fall risk and balance in older adults (Erawati et al., 2023). The interpretation of the TUG test results is as follows: a completion time of $\leq$ 14 seconds indicates a low risk of falling, while a time greater than 14 seconds indicates a high risk of falling (Annisa et al., 2019).

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RESULTS

The community service activity began with the administration of a pre-test questionnaire lasting approximately 10 minutes to assess the participants' level of knowledge regarding knee osteoarthritis. This was followed by a 30-minute session of socialization and education focusing on the symptoms of osteoarthritis, preventive measures, and management strategies for knee osteoarthritis and fall risk among elderly women. Most participants reported that this was their first time learning and gaining a clear understanding of knee osteoarthritis, its impacts—one of which is an increased risk of falling—and the exercises that can be performed as preventive measures. During the question-and-answer session, the participants showed great enthusiasm, asking numerous questions about the symptoms of knee osteoarthritis and the appropriate exercises to prevent its occurrence.

FIGURE 2. Participants Completing the Questionnaire and Attending the Educational Session on the Symptoms, Prevention, and Management of Knee Osteoarthritis and Fall Risk Among Elderly Women
(Source: Personal Documentation)

In this session, the elderly female participants were provided with informational leaflets containing details about the symptoms, prevention, and management of knee osteoarthritis. Additionally, the leaflet included descriptions of lower limb strengthening exercises along with their recommended training frequency and intensity. Presenting this information was considered essential as part of preventive and management efforts for knee osteoarthritis. Before concluding the educational session, participants were invited to watch an exercise demonstration video and collectively perform the lower limb strengthening exercises.

FIGURE 3. Distribution of Leaflets on Knee Osteoarthritis
(Source: Personal Documentation)

In this community service activity, five types of exercises were introduced: (1) leg swinging movements performed for one minute, (2) kicking movements repeated 30 times, (3) cycling-like leg movements performed 30 times, (4) tiptoe movements performed 30 times, and (5) ankle rotation movements performed 30 times. All exercises were conducted in a seated position.

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FIGURE 4. Lower Limb Strengthening Exercise Session with Elderly Female Participants
(Source: Personal Documentation)

After completing all educational sessions, a post-test was administered to assess participants' understanding of the symptoms, prevention, and management of knee osteoarthritis, as well as fall risk among elderly women. The post-test results indicated a significant improvement in participants' knowledge regarding knee osteoarthritis and fall risk. The initial level of understanding, as measured by the pre-test, was 32.7% (17 participants), which increased by 50% to 82.7% (43 participants) after the intervention. The following section presents the improvement in participants' understanding of knee osteoarthritis.

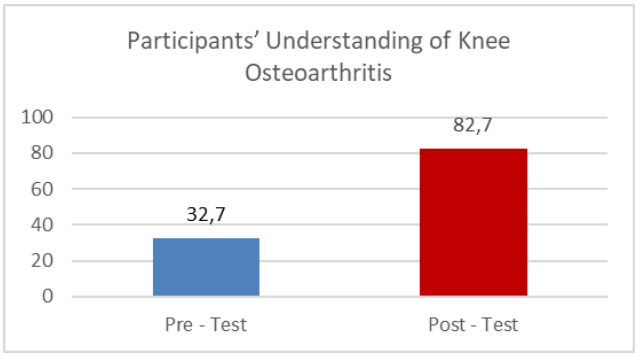

FIGURE 5. Level of Understanding Among Elderly Women Regarding Knee Osteoarthritis

After completing the series of educational sessions, the program proceeded with physical and vital sign assessments, including measurements of height, knee height, body weight, blood pressure, and oxygen saturation. These examinations aimed to ensure that the participants' physical condition and vital signs were within normal limits, allowing them to safely proceed with the early screening for knee osteoarthritis and fall risk. The results of the physical assessments indicated that all elderly female participants were in good condition and could continue to the early detection stage.

FIGURE 6. Physical and Vital Sign Examination
(Source: Personal Documentation)

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Early detection of knee osteoarthritis was conducted using a goniometer to measure the knee joint's range of motion and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) questionnaire, which consists of 24 items.

FIGURE 7. Early Detection of Knee Osteoarthritis Using the WOMAC Questionnaire and Goniometer
(Source: Personal Documentation)

In addition, early detection of fall risk was conducted using the TUG test. Individuals with a TUG test score of ≥ 13.5 seconds were classified as having a high risk of falling, whereas those with a score of < 13.5 seconds were categorized as having a low risk of falling.

FIGURE 8. Early Detection of Fall Risk Using the TUG Test
(Source: Personal Documentation)

The results of the early detection of knee osteoarthritis using the goniometer and the WOMAC questionnaire indicated that the majority of elderly female participants were classified as having a low risk of osteoarthritis.

TABLE 1. Health Examination Data of Elderly Women in Gulingan Village, Mengwi

Variable	n	Percentage (%)	Average ± Standard Deviation
Age	52	100	65,67 ± 4,422
Weight	52	100	56,30 ± 9,46
Height	52	100	150,97 ± 5,55
IMT			24,68 ± 3,66
Underweight	2	3,84	
Normal	25	48	
Overweight	12	23,07	
Obesitas	13	25	
WOMAC's Score			13 ± 11,1
Mild Symptoms (0 – 24)	42	80,78	
Moderate Symptoms (24 – 48)	9	17,3	

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Variable	n	Percentage (%)	Average ± Standard Deviation
Severe Symptoms (48 – 72)	1	1,92	
Very Severe Symptoms (72 – 96)	0	0	
Range of Motion (ROM)			
Knee Flexion			133,3 ± 16,4
Normal	34	65,4	
Limitation	18	34,6	
Knee Extention			4,6 ± 9,01
Normal	35	67,3	
Limitation	17	32,7	
Timed Up and Go test (TUG Test)			10,96 ± 2,69
Low Fall Risk	10	19,2	
High Fall Risk	42	80,8	

The data in the table were collected once, following the completion of the health education and exercise sessions. The table shows that early detection of knee osteoarthritis (genu osteoarthritis) among 52 elderly women using WOMAC questionnaire revealed that 1 participant experienced severe clinical manifestations of osteoarthritis, 9 participants exhibited moderate manifestations, and 42 participants showed mild manifestations. Furthermore, early detection of knee osteoarthritis in the same group using a goniometer to measure the ROM of the knee in the flexion position indicated that 18 participants had limited joint mobility. Similarly, measurement of knee ROM in the extension position showed that 17 participants experienced limited joint mobility. Early detection of fall risk among the 52 elderly women using the TUG test revealed that 10 participants were at high risk of falling, while 42 participants were categorized as having a low risk of falling.

DISCUSSION

Educational and exercise interventions have been shown to strengthen self-efficacy and promote exercise adherence, which subsequently contribute to improvements in functional mobility and reductions in fear of falling among older adults. Recent community-based and home-based studies have reported that strengthening programs combined with education enhance exercise self-efficacy, functional mobility, and quality of life among older women (Vaz et al., 2022a). This aligns with the responses of our participants, who reported increased confidence following the educational sessions, early screening, and guided exercises.

The early detection component in this community program incorporated the WOMAC questionnaire to assess joint-specific symptoms and functional limitations, a goniometer to measure joint range of motion, and the Timed Up and Go (TUG) test to identify fall risk. These tools provided valuable insights for participants regarding their functional health status. Evidence from 2023–2024 indicates that exercise interventions combined with educational approaches not only reduce knee osteoarthritis symptoms but also improve functional performance and overall well-being among older women (Smith et al., 2023). The finding that most of our participants presented with mild OA and low-to-moderate fall risk supports targeted primary and secondary prevention strategies, such as lower-limb strengthening

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and activity load management prior to the onset of severe disability.

According to the 2024 recommendations of the United States Preventive Services Task Force (USPSTF), strength training, balance exercises, and multicomponent exercise programs are effective in reducing fall incidence among older adults (Guirguis-Blake et al., 2024). Moreover, a randomized controlled trial of the FallFitness program in 2024 demonstrated significant improvements in falls self-efficacy and other physical parameters among community-dwelling older adults, delivered through a train-the-trainer approach—a model that could be replicated with local health cadres for program sustainability in Gulingan (Arkkukangas et al., 2024).

The recommended lower limb strengthening exercises for the prevention and management of knee osteoarthritis in elderly women are performed in a seated position. This approach aims to minimize the load on the knees during exercise. A decline in lower limb muscle strength has been shown to be associated with knee osteoarthritis (Nugraha & Kambayana, 2017). A literature review conducted by Widyasari et al. (2022) found that lower limb strengthening exercises are highly effective in improving muscle strength, enhancing knee functionality, and reducing pain among elderly individuals exhibiting symptoms of knee osteoarthritis (Widyasari et al., 2022).

Knee osteoarthritis has been associated with increased fall risk. A 2023 meta-analysis concluded that symptomatic knee OA is linked to a higher likelihood of recurrent falls, highlighting the importance of implementing preventive education, early detection, and strengthening exercises in elderly women (Zhang et al., 2023).

Given the positive responses observed among participants and their relatively mild functional status at baseline, gradual monitoring of program sustainability through engagement with local elderly health cadres is recommended. This strategy aligns with current evidence indicating that personalized and supervised home-based or community programs (including simple digital support) can enhance exercise adherence, self-efficacy, and functional outcomes in older adults with knee OA (Vaz et al., 2022b). Nevertheless, this community service program has several limitations, including a short intervention duration and the absence of medium- to long-term follow-up, which restricts the ability to confirm the sustained benefits on knee OA symptoms and fall risk.

CONCLUSION

This community service activity involved 52 elderly women from Gulingan Village and was successfully and smoothly implemented. All participants demonstrated great enthusiasm and responded positively to the program. The program effectively increased elderly women's knowledge of knee osteoarthritis and fall risk. Early detection using WOMAC, goniometer, and TUG tests identified mostly mild osteoarthritis and low fall risk. Strengthening exercises enhanced motivation and independence, improving the quality of life for participants. Future programs should include periodic follow-ups and collaboration with local health cadres to ensure long-term exercise adherence.

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