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# Analysis of Behavioral and Economic Factors Affecting Activities of Daily Living Among Older Adults in Thailand

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**Abstract:**

***Introduction:*** The functional independence of older adults, as measured by Activities of Daily Living (ADL), is influenced by various behavioral and socioeconomic factors. This study aims to explore these factors among older adults in Thanyaburi District, Pathum Thani Province, Thailand.

***Methods:*** A cross-sectional study was conducted among 400 community-dwelling older adults aged 60 years and above, selected via stratified random sampling. Data on behavioral factors (exercise frequency, dietary habits, health-seeking behavior) and socioeconomic variables (income, education) were collected. ADL performance was assessed using the Barthel ADL Index, with statistical analyses involving t-tests, ANOVA, and multiple linear regression.

***Results:*** Significant differences in ADL scores were found across age groups ($p = 0.047$), marital status ($p = 0.016$), education levels ($p < 0.001$), and income brackets ($p < 0.001$). Regression analysis identified exercise frequency ($B = 0.241$, $p < 0.001$) as the strongest predictor of ADL scores. Higher income ($B = 0.049$, $p = 0.002$) and balanced dietary habits ($B = 0.068$, $p = 0.052$) also contributed positively to ADL performance. Minimal or non-significant effects were noted for age, gender, and marital status.

***Discussion:*** The findings suggest that physical activity, higher income, and balanced dietary habits are key determinants of ADL performance among older adults. These results are consistent with existing research linking regular exercise and nutrition to improved functional independence. However, further research is needed to establish causal relationships and the long-term effectiveness of interventions targeting these factors.

***Conclusion:*** Regular physical activity, a balanced diet, and higher income levels are strongly associated with better ADL performance in older adults. These findings underscore the importance of interventions promoting physical activity, nutrition, and financial well-being to support healthy aging and functional independence.

**Keywords:** Activities of Daily Living (ADL), Older adults, Behavioral determinants, Socioeconomic factors, Functional independence.



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## 1. INTRODUCTION

Thailand is rapidly transitioning into an aging society, driven by demographic shifts and advancements in healthcare [1, 2]. The increasing number of elderly individuals poses challenges in various aspects, particularly health, social care, and economic well-being [3]. Among these, the Activities of Daily Living (ADL), which measure the ability of older adults to perform essential self-care tasks, have emerged as a critical indicator of their quality of life and

independence [4, 5]. ADL encompasses basic activities such as eating, walking, dressing, and maintaining personal hygiene, all of which are vital for sustaining a dignified and self-reliant life [2, 4].

Several factors influence ADL among older adults, notably behavioral and economic aspects. Regular physical exercise, balanced dietary habits, and proactive health-seeking behavior contribute significantly to maintaining physical and mental health [5, 6]. On the other hand, economic factors, such as monthly income, play a vital role in accessing healthcare resources and other necessities that support daily living [1, 2]. Prior studies have demonstrated that elderly individuals with stable income levels and healthy lifestyles tend to exhibit higher ADL scores compared to their counterparts [5, 6]. Moreover, the lack of adequate support systems and socioeconomic disparities can further exacerbate the difficulties faced by older adults in maintaining ADL [3].

Building upon this understanding, it is essential to recognize that ADL is not merely a reflection of individual capabilities but also a product of broader social and environmental influences [2, 4]. For instance, access to community support, public healthcare services, and educational programs tailored for the elderly can enhance their ability to maintain functional independence [5, 6]. Conversely, the absence of such support structures can exacerbate the challenges faced by older adults, particularly in low- and middle-income settings [2, 3]. Social determinants such as community engagement and availability of healthcare infrastructure have been shown to significantly influence ADL outcomes in various populations [1, 5].

In the context of Thailand, cultural norms and familial dynamics also play a significant role in shaping the behaviors and economic conditions of older adults [1, 2]. The traditional family-based caregiving model, wherein children are expected to care for aging parents, has undergone considerable changes due to urbanization and migration [3, 6]. This shift often leaves elderly individuals with reduced access to direct familial support, making them more reliant on their own resources and behaviors to maintain ADL [1, 2].

Despite these complexities, there remains limited empirical evidence examining the specific behavioral and economic factors that influence ADL among Thai older adults [1, 6]. Most existing studies tend to focus on general health outcomes or specific populations, such as those with chronic illnesses or those in urban settings, leaving a gap in understanding the interplay between these determinants in the broader Thai aging population [2, 3]. Behavioral factors, including exercise frequency, dietary habits, and proactive health-seeking behaviors, have been shown in global studies to significantly affect ADL outcomes [4, 5]. Similarly, economic factors such as income stability and access to healthcare resources play a crucial role in maintaining functional independence [1, 6].

Addressing this gap, the current study seeks to analyze the impact of behavioral (*e.g.*, exercise, dietary habits, health-seeking behaviors) and economic (*e.g.*, income, access to resources) factors on ADL among older adults in Thailand. By doing so, it aims to provide actionable insights for policymakers, healthcare providers, and communities to support the well-being and independence of the country's aging population [2, 3].

## 2. METHODS

### 2.1. Study Design and Type

This study employed a cross-sectional design to examine factors influencing Activities of Daily Living (ADL) among older adults in Thanyaburi District, Thailand. Thanyaburi District is located in Pathum Thani Province, Thailand. It is a mix of urban and rural areas, which may offer a diverse range of participants with different socio-economic backgrounds, lifestyles, and health conditions. This diversity is helpful for generalizing findings to broader populations. Researchers have selected this district because it faces specific health-related challenges or aging-related issues that are representative of broader trends in Thailand or Southeast Asia. This could include issues like access to healthcare, aging population demographics, or particular health outcomes in older adults.

#### *2.1.1. Population and Sample*

The study population consisted of community-dwelling older adults aged 60 years and above residing in Thanyaburi District, Pathum Thani Province comprising males and females. The formula for sample size calculation is often attributed to Cochran's Sample Size Formula, which is widely used in survey research; where **n** represents the sample size, **Z** is the Z-value corresponding to the desired confidence level (1.96 for a 95% confidence level), **p** is the estimated proportion of the population exhibiting a characteristic (often assumed to be 0.5 if the proportion is unknown), and **E** is the margin of error (usually set at 0.05 or 5%). In this case, the researchers likely used this formula to estimate the number of participants needed, with 400 individuals selected for the study (Cochran, 1977).

A sample of 400 participants was selected using a stratified random sampling method to ensure representation from various sub districts (tambons) within Thanyaburi District. The sampling process followed a structured approach to ensure fair representation. First, the district was divided into sub districts (tambons) to achieve comprehensive geographical coverage. Next, proportional sampling was employed to allocate participants from each subdistrict based on the proportion of older adults in the population. Finally, participants were randomly chosen from a community registry of older adults, ensuring an unbiased and representative selection process.

#### *2.1.2. Inclusion Criteria*

[1] Thai citizens aged 60 years or older who were registered as residents of Thanyaburi District.

[2] Ability to communicate effectively in Thai.
[3] Willingness to provide informed consent and participate in the study.

### 2.1.3. Exclusion Criteria

[1] Older adults with severe cognitive impairment, as screened using the Mini-Mental State Examination (MMSE).
[2] Older adults with severe physical or medical conditions that prevented participation in Interviews or ADL assessments.
[3] Residents of institutional care facilities, such as nursing homes.

### 2.1.4. Measurement Tool and Variable

The study examined both independent and dependent variables to analyze the factors influencing Activities of Daily Living (ADL) among older adults. Independent variables included two main categories: behavioral and economic factors. Each variable is encoded numerically to facilitate statistical analysis. Exercise frequency is categorized as 0 (no exercise), 1 (exercises 1–2 times per week), and 2 (exercises 3 or more times per week), measuring the intensity of physical activity. Dietary habits capture the frequency of balanced meal consumption, encoded as 0 (rarely), 1 (occasionally), and 2 (daily). In a dietary habits questionnaire that captures the frequency of balanced meal consumption, the food items included should cover a range of essential nutrients to assess overall dietary quality. For proteins, the questionnaire could include items like meat (chicken, beef, pork), fish and seafood (salmon, tuna, shrimp), legumes (lentils, beans, peas), eggs, and plant-based proteins such as tofu or nuts and seeds (almonds, walnuts, sunflower seeds). Carbohydrates are represented by whole grains (brown rice, quinoa, oats, whole wheat bread) and refined grains (white rice, white bread, pasta), along with starchy vegetables like potatoes, sweet potatoes, and corn. To capture fruit consumption, the questionnaire might include fresh fruits (apples, oranges, bananas, berries) and dried fruits (raisins, dates, dried apricots), along with citrus fruits like oranges and grapefruits. For vegetables, items such as leafy greens (spinach, kale), cruciferous vegetables (broccoli, cauliflower), root vegetables (carrots, beets), and other common vegetables like tomatoes, cucumbers, and bell peppers could be included. Dairy or dairy alternatives, such as milk (cow’s milk, soy milk), yogurt (regular or Greek), and cheese (cheddar, mozzarella), would be essential for assessing dairy intake.

Health-seeking behavior reflects how often participants engage with healthcare services, categorized as 0 (only when symptoms arise), 1 (occasionally), and 2 (regularly).

Monthly income is divided into three brackets: 0 (<10,000 THB), 1 (10,000–20,000 THB), and 2 (>20,000 THB), reflecting financial stability. Healthcare access, which assesses the ease of accessing healthcare services, is encoded as 0 (difficult), 1 (moderate), and 2 (easy). These variables serve as predictors. The dependent variable, ADL Score, was measured using the Thai version of the Barthel ADL Index, a validated tool assessing participants' ability to perform basic self-care tasks. The ADL score, which is a continuous variable measuring participants' ability to perform daily self-care tasks, is the dependent variable. Higher ADL scores indicate greater independence. The index evaluates 10 key activities, such as eating, bathing, dressing, toileting, walking, and maintaining personal hygiene, with scores ranging from 0 (fully dependent) to 20 (fully independent). Additionally, demographic and economic information, such as age, gender, marital status, education level, current occupation, and monthly income, was collected to provide context and control for confounding variables. These measures offered a comprehensive framework to explore the relationship between behavioral and economic factors and ADL in older adults.

### 2.1.5. Data Collection

Data were collected through questionnaires conducted by trained researchers during the study period from 11 December 2024 to 20 December 2025.

### 2.1.6. Statistical Analysis

To evaluate the relationships between independent variables and ADL scores, both descriptive and inferential statistical methods were employed. Descriptive analysis was conducted to summarize the demographic, behavioral, and economic characteristics of the participants. Categorical variables, such as gender, exercise frequency, and dietary habits, were described using frequencies and percentages, while continuous variables, including age, monthly income, and ADL scores, were summarized using means, standard deviations, medians, and interquartile ranges. This initial analysis provided a clear overview of the dataset and informed subsequent inferential analyses.

For inferential analysis, independent samples t-tests and ANOVA were utilized to compare mean ADL scores across different demographic and behavioral groups, such as gender, exercise frequency, and dietary habits, offering insights into group differences. Multiple linear regression was employed to identify the independent contributions of behavioral and economic factors to ADL scores while controlling for potential confounding variables, such as age and gender. Standardized beta coefficients (β\betaβ) were reported to indicate the relative importance of each predictor.

To ensure the regression model's validity, multicollinearity diagnostics were performed by calculating the Variance Inflation Factor (VIF) and tolerance values, maintaining a VIF threshold of <5 to confirm the absence of multicollinearity among predictors. Model validation involved assessing the model fit using $R^2$ and adjusted $R^2$, which evaluated the explanatory power of the regression model. Additionally, residual diagnostics, including residual plots and normality tests, were examined to verify that the regression assumptions were met, ensuring the reliability and robustness of the analytical results.

### 2.1.7. Ethical Approval

The research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013. This study was approved by the Review Boards of the Ethical Committee of Rajamangala University of Technology Thanyaburi (COA No.98 RMUTT_REC No. Full 98/67).

## 3. RESULTS

The analysis evaluated the mean ADL (Activities of Daily Living) scores across various demographic and socioeconomic factors, with t-tests and ANOVA used to compare differences among groups. The results indicated several significant findings. Although the mean ADL scores were slightly higher for females (M = 4.491, SD = 0.519) compared to males (M = 4.378, SD = 0.744), the difference was not statistically significant (t=−1.581, p=0.115). There was a significant difference in ADL scores across age groups (F=2.675, p=0.047). Older adults aged 70–74 years had the highest mean ADL score (M = 4.608, SD = 0.409), while those aged 75–79 years reported the lowest mean score (M = 4.256, SD = 0.535). This suggests a potential decline in functional independence in the oldest age group. Significant differences were observed among marital status groups (F=3.501, p=0.016). Divorced individuals had the highest mean ADL score (M = 4.949, SD = 0.058), while single individuals reported the lowest (M = 4.402, SD = 0.579). Married participants had a moderate mean score (M = 4.487, SD = 0.561), indicating a possible influence of social support from marital relationships Table **1**. Education level showed a highly significant effect on ADL scores (F = 6.679, p = 0.000F=6.679, p=0.000). Participants with postgraduate degrees had the highest mean ADL scores (M = 4.972, SD = 0.050), while those with no formal education reported the lowest scores (M = 3.667, SD = 0.000). This suggests a strong positive relationship between education and functional independence.

**Table 1. Comparison of Mean ADL Scores Across Demographic and Socioeconomic Factors.**

| Factors | | N | Mean | SD | t | Sig. |
|---|---|---|---|---|---|---|
| Gender | Male | 80 | 4.378 | 0.744 | -1.581 | 0.115 |
| | Female | 320 | 4.491 | 0.519 | | |
| Age | 60–64 years | 149 | 4.474 | 0.483 | 2.675* | 0.047 |
| | 65–69 years | 170 | 4.476 | 0.668 | | |
| | 70–74 years | 42 | 4.608 | 0.409 | | |
| | 75–79 years | 39 | 4.256 | 0.535 | | |
| Marital Status | Single | 81 | 4.402 | 0.579 | 3.501* | 0.016 |
| | Married | 248 | 4.487 | 0.561 | | |
| | Widowed | 60 | 4.389 | 0.618 | | |
| | Divorced | 11 | 4.949 | 0.058 | | |
| Education Level | No formal education | 4 | 3.667 | 0.000 | 6.679** | 0.000 |
| | Primary education | 170 | 4.456 | 0.655 | | |
| | Secondary education | 102 | 4.489 | 0.522 | | |
| | Vocational diploma/Associate degree | 35 | 4.171 | 0.525 | | |
| | Bachelor's degree | 73 | 4.543 | 0.390 | | |
| | Postgraduate degree | 16 | 4.972 | 0.050 | | |
| Occupation | Unemployed | 56 | 4.639 | 0.478 | 1.962 | 0.083 |
| | Retired government official | 78 | 4.372 | 0.527 | | |
| | Trade/Business owner | 59 | 4.379 | 0.768 | | |
| | General laborer | 36 | 4.435 | 0.840 | | |
| | Homemaker | 106 | 4.520 | 0.428 | | |
| | Others (please specify) | 65 | 4.451 | 0.489 | | |
| Monthly Income | Less than or equal to 5,000 THB | 97 | 4.328 | 0.557 | 8.052** | 0.000 |
| | 5,001–10,000 THB | 105 | 4.431 | 0.481 | | |
| | 10,001–20,000 THB | 69 | 4.280 | 0.707 | | |
| | 20,001–30,000 THB | 29 | 4.655 | 0.486 | | |
| | More than 30,000 THB | 35 | 4.794 | 0.259 | | |
| | No income | 65 | 4.679 | 0.583 | | |

*p<0.05, **p<0.01.

**Table 2. Regression Analysis of Demographic, Behavioral, and Socioeconomic Factors Influencing Activities of Daily Living (ADL) Scores.**

| Factors | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95.0% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | | | Lower Bound | Upper Bound |
| (Constant) | 3.046 | .205 | | 14.836 | .000** | 2.642 | 3.449 |
| **Gender** (ref: male) | .053 | .065 | .037 | .816 | .415 | -.075 | .182 |
| **Age** (ref: 60–64 years) | -.015 | .029 | -.024 | -.517 | .605 | -.071 | .041 |
| **Marital Status** (ref: single) | .000 | .039 | .000 | .007 | .994 | -.076 | .077 |
| **Education Level** | -.016 | .022 | -.036 | -.753 | .452 | -.059 | .026 |
| **Occupation** (ref: Unemployed) | -.007 | .016 | -.022 | -.455 | .649 | -.038 | .024 |
| **Monthly Income** (ref: (<10,000 THB) | .049 | .016 | .151 | 3.120 | .002* | .018 | .080 |
| **Health Education Seeking Behavior** (ref: No formal education) | -.045 | .043 | -.070 | -1.040 | .299 | -.130 | .040 |
| **Health Check-Up Behavior** (ref: non-check-up) | .058 | .036 | .100 | 1.612 | .108 | -.013 | .129 |
| **Balanced Diet Consumption** (ref: rarely) | .068 | .035 | .106 | 1.946 | .052 | -.001 | .136 |
| **Exercise Frequency** (ref: no exercise) | .241 | .034 | .366 | 7.067 | .000** | .174 | .308 |

*p<0.05 **p<0.01.

While differences in ADL scores among occupational groups were not statistically significant (F=1.962, p=0.083), unemployed participants reported the highest mean score (M = 4.639, SD = 0.478), and retired government officials had a slightly lower mean score (M = 4.372, SD = 0.527). Other occupational groups showed similar mean scores. Income had a significant impact on ADL scores (F=8.052, p=0.000). Participants earning more than 30,000 THB per month reported the highest mean ADL score (M = 4.794, SD = 0.259), while those earning less than or equal to 5,000 THB had the lowest mean score (M = 4.328, SD = 0.557). Interestingly, participants with no income also reported relatively high ADL scores (M = 4.679, SD = 0.583), possibly reflecting support from other sources. These results highlight significant relationships between age, marital status, education level, and income with ADL scores. Higher education and income appear to contribute positively to functional independence, while age and marital status show nuanced effects, as shown in Table **1**.

The regression analysis investigated the impact of demographic, behavioral, and socioeconomic factors on Activities of Daily Living (ADL) scores, as shown in Table **2**. The constant term (B=3.046, p<0.001B = 3.046, p < 0.001B=3.046, p<0.001) provided the baseline ADL score when all other predictors were held constant. Among demographic variables, gender (B=0.053, p=0.415B = 0.053, p = 0.415B=0.053, p=0.415) showed a small positive effect, with males having slightly higher ADL scores than females, but this difference was not statistically significant. Similarly, age (B=−0.015, p=0.605B = -0.015, p = 0.605B=−0.015, p=0.605) displayed a weak negative relationship, suggesting that older participants may have slightly lower ADL scores, though the effect was not significant. Among the socioeconomic factors, monthly income (B=0.049, p=0.002B = 0.049, p = 0.002B=0.049, p=0.002) emerged as a significant positive predictor, with higher income levels associated with better ADL scores, underscoring the role of financial stability in enhancing functional independence. For health-related behaviors, health education-seeking behavior (B=−0.045, p=0.299B = -0.045, p = 0.299B=−0.045, p=0.299) had a small negative but non-significant relationship with ADL scores. Balanced diet consumption (B=0.068, p=0.052B = 0.068, p = 0.052B=0.068, p=0.052) was marginally significant, indicating that regular consumption of balanced meals may positively influence ADL scores, though the relationship was below conventional significance levels.

The strongest and most significant predictor of ADL scores was exercise frequency (B=0.241, p<0.001B = 0.241, p < 0.001B=0.241, p<0.001), which demonstrated that participants who exercised at least twice a week had significantly higher ADL scores. This finding highlights the critical role of regular physical activity in maintaining functional independence.

## 4. DISCUSSION

The findings of this study provide a comprehensive understanding of the factors influencing Activities of Daily Living (ADL) scores among older adults. The results highlight significant predictors, including exercise frequency and monthly income, while also shedding light on other behavioral and demographic variables that show trends consistent with existing literature [7-9].

Exercise frequency emerged as the strongest and most significant predictor of ADL scores (B=0.241, p<0.001). Participants who exercised at least twice a week had significantly higher ADL scores, emphasizing the role of regular physical activity in preserving functional independence. This aligns with prior research demonstrating that physical activity improves strength, balance, and cardiovascular health, all of which are essential for maintaining mobility and independence in older adults [2, 10]. Additionally, exercise reduces the risk of chronic diseases, such as hypertension and diabetes, which can

negatively impact ADL [10-12]. These findings highlight the need for targeted interventions to promote accessible and age-appropriate exercise programs for older adults.

Monthly income (B=0.049, p=0.002) also showed a significant positive association with ADL scores, underscoring the role of financial stability in supporting functional independence. Older adults with higher incomes are better positioned to access healthcare, nutritious food, and other resources that contribute to maintaining ADL [13, 14]. This finding aligns with previous studies, which have shown that socioeconomic status strongly influences health outcomes and functional capacity [6, 15]. Addressing economic disparities through financial support or subsidized health services could mitigate the adverse effects of low income on functional independence [16, 17].

Although balanced diet consumption was not statistically significant at the conventional threshold (B=0.068, p=0.052), the marginal significance suggests a trend toward its positive impact on ADL. This finding is supported by evidence indicating that proper nutrition, particularly diets rich in protein, vitamins, and minerals, is essential for maintaining muscle mass and overall physical health in older adults [12, 18]. Nutritional interventions that promote balanced diets could serve as an adjunct to physical activity in improving functional independence [4, 19].

Health check-up behavior (B=0.058, p=0.108) and health education-seeking behavior (B=−0.045, p=0.299) did not significantly influence ADL scores. However, regular health check-ups showed a positive trend, consistent with prior findings that preventive care can help identify and manage conditions that may impair functional capacity [20]. The lack of a significant effect for health education-seeking behavior may reflect limitations in the quality or application of health knowledge received, highlighting the need for more practical and tailored health education programs.

Demographic factors, including gender (B=0.053, p=0.415), age (B=−0.015, p=0.605), marital status (B=0.000, p=0.994), education level (B=−0.016, p=0.452), and occupation (B=−0.007, p=0.649), were not significant predictors of ADL scores. While gender and age showed slight trends consistent with existing studies—such as males and younger participants having marginally higher ADL scores—these effects were not statistically significant [11, 21, 22]. The lack of significance for education level contrasts with some studies suggesting that higher education is associated with better health outcomes, possibly reflecting limited variability in educational attainment within this sample.

These findings underscore the importance of promoting regular physical activity and addressing economic disparities to improve ADL outcomes among older adults. Regular physical activity has been consistently linked to improved functional independence, mobility, and overall health [5, 23]. Policymakers and healthcare providers should focus on creating community-based exercise programs tailored to older adults, ensuring accessibility regardless of income. Additionally, strategies to enhance financial support, such as income subsidies or affordable healthcare services, could mitigate the impact of low socioeconomic status, which has been shown to limit access to essential health resources [6, 15, 24]. Nutritional interventions emphasizing balanced diets are also crucial, as proper nutrition contributes significantly to physical strength and health maintenance in aging populations [2, 25-27].

Preventive healthcare initiatives, such as regular health check-ups, may further support functional independence by identifying and addressing potential health issues before they impair ADL [21, 26]. Future studies should explore the long-term effects of behavioral and socioeconomic interventions on ADL, considering potential interactions between variables such as income and health-related behaviors. For instance, the combined effects of improved exercise routines and financial stability on ADL warrant deeper investigation. Moreover, examining the quality and practical application of health education programs could provide insights into their effectiveness in improving functional independence [28, 29]. These combined efforts will better inform policies and interventions aimed at supporting healthy aging.

## CONCLUSION

In conclusion, while variables such as gender, age, education level, and health-related behaviors showed no significant impact, exercise frequency and monthly income were significant predictors, with exercise having the strongest influence. This study highlights the critical role of exercise frequency and financial stability in supporting functional independence among older adults, while also identifying potential contributions of balanced diets and preventive healthcare behaviors. These findings provide a foundation for designing targeted interventions to improve quality of life and promote healthy aging.

## LIMITATIONS

This study provides valuable insights into the factors influencing Activities of Daily Living (ADL) among older adults; however, several limitations should be considered. The cross-sectional design restricts causal interpretations, underscoring the need for longitudinal studies to examine changes over time. Additionally, reliance on self-reported data may introduce recall and social desirability biases, suggesting the incorporation of objective measures in future research. Furthermore, the sample, drawn exclusively from Thanyaburi District, may limit the generalizability of findings to other populations. Addressing these constraints in future studies will enhance the validity and applicability of the results. The research suggests that there might be external factors influencing the results that have not been fully accounted for. Confounding variables can distort the apparent relationship between the main factors being studied. For instance, in a study of aging, variables like genetics, socioeconomic status, or previous health conditions might affect the outcome, but are not adequately controlled for.

Addressing these variables will improve the accuracy of the findings. This implies that the methods used to assess behaviors (like physical activity, diet, or cognitive engagement) may need more precision or better tools. If behaviors are not accurately measured, the conclusions about their impact on aging could be misleading. More robust or validated measurement techniques would strengthen the findings.

## AUTHORS' CONTRIBUTION

The authors confirm their contribution to the paper as follows: Intra Tubklay and Issara Siramaneerat were responsible for the study conception and design. Data collection was conducted by Intra Tubklay. The analysis and interpretation of results were carried out by Intra Tubklay, Issara Siramaneerat, and Pimnapat Bhumkittipich. The draft manuscript was prepared by Intra Tubklay, Issara Siramaneerat and Pimnapat Bhumkittipich. All authors reviewed the results and approved the final version of the manuscript.

## LIST OF ABBREVIATION

| | | |
|---|---|---|
| ADL | = | Activities of Daily Living |
| VIF | = | Variance Inflation Factor |

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Review Boards of the Ethical Committee of Rajamangala University of Technology Thanyaburi (COA No.98 RMUTT_REC No. Full 98/67).

## HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

## CONSENT FOR PUBLICATION

Informed consent was obtained from the participants.

## STANDARDS OF REPORTING

Strobe guidelines were followed.

## AVAILABILITY OF DATA AND MATERIAL

The data supporting the findings of this study are available within the article. Additional datasets or materials, if required, can be provided upon reasonable request to the corresponding author.

## CONFLICT OF INTEREST

The authors declared no conflict of interest, financial or otherwise.

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