Research Article

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# Trends and Disparities in Non-Communicable Diseases among Thai Older Adults: Analysis of National Health Examination Surveys, 2008-2020

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**Abstract:** One of the leading health concerns among Thai older adults is non-communicable diseases (NCDs). Understanding their long-term trends and disparities is crucial for guiding public health policy in the aging Thai society. This study was aimed to investigate the prevalence and trends of NCDs, including their associated sociodemographic, socioeconomic, behavioral risk factors, and caregiver needs among Thai individuals aged 60 and over from 2008 to 2020. In this study, public secondary data from three National Health Examination Surveys (NHES); NHES 4 (2008–2009), NHES 5 (2014), and NHES 6 (2019–2020) were used to determine the prevalence and trends of NCDs, including sociodemographic, socioeconomic, behavioral risk factors, and caregiver needs. Using secondary data limits the study to descriptive statistics, precluding inferential tests and the determination of causal relationships. The findings showed that the prevalence and trends of obesity, diabetes mellitus, and hypertension increased in all age groups between 2008 and 2020, while those of hypercholesterolemia decreased. Health-related behaviors showed reductions in smoking and physical activity in the overall population of all groups, but increases in heavy alcohol consumption and adequate intake of fruits and vegetables. Moreover, the need for caregiver assistance among the older population increased, suggesting a growing demand for long-term care services. The rising prevalence of NCDs and growing dependence on caregiver assistance among Thai older adults highlight an urgent public health challenge. A comprehensive national policy needs to prioritize NCD prevention, healthy aging promotion, and sustainable long-term care systems for both older adults and their caregivers.

**Keywords*:*** Non-communicable diseases, Aging society, Public health policy

## INTRODUCTION

Globally, population aging is accelerating. People aged 65 and above will reach 1.5 billion by 2050, with women comprising around 54% of this group (1). Since 2023, Thailand has become a completely aged society, resulting from the population aged 60 and above reaching 20% of the total population. Additionally, Thailand is approaching a super-aged society due to the older population surpassing 30% of its population by 2040 (2). The demographic shift, with the predominance of women among the older adults, raises critical concerns for health systems and social welfare in terms of formulating context-specific policies, as aging comes with progressive declines in physical, mental, and social capacity, heightened risk of disability, and substantial financial needs for care (3-5).

Non-communicable diseases (NCDs) are the leading causes of morbidity, disability, and death in the older adults, particularly in low- and middle-income countries (6). Hypertension is the most prevalent NCD, affecting approximately 60 percent of the older population globally (7). The risk of NCDs is basically influenced by sociodemographic, socioeconomic, behavioral, and environmental factors (7, 8). Gender disparities affect the prevalence of NCDs differently; obesity is more common among women, while smoking remains higher in men (9, 10). Aging is associated with a higher multimorbidity prevalence caused by NCDs (7), while socioeconomic disadvantage contributes to poorer health outcomes and functional decline stimulation in the older adults (11, 12). Education reveals a mixed and context-dependent association with NCDs (7). For risk behaviors, smoking, alcohol consumption, physical inactivity, and inadequate fruit and vegetable intake can amplify NCD prevalence (7, 13).

Like other countries, NCDs account for 74% of all deaths in Thailand (14). Among the Thai older adults, more than 50% live with hypertension, around 20% with diabetes mellitus, and nearly 33% with obesity (15). Hypercholesterolemia and stroke usually result in long-term impairments that increase reliance on caregiver support and unmet needs in Thailand, especially among the oldest-old and those without family caregivers (15, 16). Gender differences, aging, socioeconomic inequality, and health risk behaviors increase the prevalence of NCDs in Thailand (14, 17), especially for those older adults with low education or living in rural areas (13, 18).

Thailand has responded to the issues stated above by implementing multiple initiatives, e.g., the National Health Development Plan, Universal Health Coverage (UHC) program, and participation in the WHO Decade of Healthy Aging (2020–2030), in order to support healthier lives throughout life stages and to guarantee equal access to healthcare (5, 14, 17). However, clear evidence on how rapid demographic, social, and behavioral changes impact NCDs among older Thai adults remains limited (5, 19). To ensure the precision, adaptability, and sustainability of future strategies, filling the aforementioned knowledge gap is necessary.

In this study, three waves of the National Health Examination Survey were analyzed for sociodemographic and socioeconomic changes (e.g., age, gender, education, and region), including health behaviors related to the occurrence of NCDs, national trends in NCD prevalence among Thai older adults, and caregiver needs between 2008 and 2020. These informative data will help prepare targeted policy interventions in terms of promoting healthy aging and advancing long-term care reform. This research will contribute to Thailand's commitments under the Sustainable Development Goals (SDGs), specifically for Target 3.4 on reducing premature NCD mortality, and Target 3.8 on achieving UHC, by indicating trends and gaps to strengthen equity-focused planning and enhance the readiness for Thai older adults within the UHC framework.

## METHODS

### *Study Design and Data Sources*

This study used secondary data publicly accessible from the National Health Examination Survey (NHES) series, a national health monitoring tool conducted every five years by the Health Systems Research Institute under the Ministry of Public Health, Thailand. Data from NHES 4 (2008–2009), NHES 5 (2014), and NHES 6 (2019–2020) were analyzed to identify trends in sociodemographic, socioeconomic, and health characteristics affecting the NCD prevalence among Thai older adults, including unmet caregiver needs.

The NHES implemented a strict multistage sampling methodology to recruit national representativeness. This involved the systematic random selection of provinces, districts, enumeration areas, and individual participants aged 60 and above from both sexes (15, 20, 21). These participants were categorized into a group of 60–69, 70–79, and 80 years old and over in this study. The total numbers of older adults were 9,210 for NHES 4, 7,365 for NHES 5, and 9,234 for NHES 6. The consistency of the sampling methodologies across the surveys guarantees the reliability of trend analysis in this study.

### *Variables and Indicators*

Key variables from three domains (15, 20, 21) were analyzed in this study. The first key domain was sociodemographic and socioeconomic characteristics. These variables were explained as follows: The age group consisted of young-old (60–69 years), mid-old (70–79 years), and oldest-old (80 years and above). Gender was analyzed for the distribution of male and female populations. Geographic region data were collected from the north, central, northeast, and south of Thailand, including Bangkok. Educational attainment consisted of six categories, e.g., no formal education, primary education, secondary and vocational education, sub-bachelor education, bachelor's degree and above, and others. Median monthly income (in Thai Baht) per person was used as a key indicator of economic well-being, with a limit of income trend analysis to the 2008–2014 period resulting from the consistent data report.

The second key domain was health risk behaviors affecting the occurrence of NCDs. These four parameters were described as follows: Regular smoking was defined as current daily smoking. Heavy alcohol consumption focused on self-reported heavy alcohol consumption in the past 30 days, with a limit of trend analysis to the 2014–2020 period due to the consistent data report. Getting enough physical activity was defined based on the total metabolic equivalent was more than 600 minutes/week. Consuming adequate portions of fruits and vegetables was set as consuming fruits and vegetables at least 5 servings per day.

The last key domain was the prevalence of five major NCDs and a key indicator of functional status. The prevalence of four major NCDs: Obesity (body mass index ≥ 25 kg/m$^2$), hypercholesterolemia (total cholesterol ≥ 240 mg/dL), diabetes mellitus (fasting plasma glucose ≥ 126 mg/dL or with medication history), and hypertension (mean systolic BP ≥ 140 mmHg, diastolic BP ≥ 90 mmHg, or with medication history) was determined from clinical and laboratory data. Older individuals who self-reported a history of paralysis were defined as having a paralysis history. For a direct indicator of functional independence, caregiver assistance needs were measured for those older adults requiring assistance for daily living.

### *Data Analysis*

Percentages and unweighted counts provided by the public aggregated reports of the NHES were analyzed. Descriptive statistics, including proportions and medians, were used to describe the characteristics of the variables and indicators stated above. Trends were investigated by comparing the proportions and medians across the surveys. While the magnitude and direction of the trends were examined by interpreting the change of percentage over a decade, inferential statistical tests or establishing causal relationships between variables were not possibly determined because this study used aggregated public data.

### *Ethical Consideration*

This study used publicly available, de-identified secondary data; therefore, in line with the guidelines of Declaration of Helsinki, the International Conference on Harmonization-Good Clinical Practice (ICH-GCP), and the Health Information System Development Office (HISO), the Ministry of Public Health, Thailand, no additional ethical approval was required by the Institute of Public Policy and Development.

## RESULTS

### *Overview of sociodemographic characteristics of Thai older adults*

The demographic profiles of this study showed distinct patterns of change across variables (Table 1). The total unweighted number of older adults revealed a fluctuating trend, decreasing from 20.03% between NHES 4 and NHES 5 to 25.38% between NHES 5 and NHES 6, and then to 0.26% between NHES 4 and NHES 6. Regarding sex distribution, the proportion of females showed a continuous increase from 51.07% (NHES 4) to 55.80% (NHES 5) and remained constant in NHES 6, indicating a persistent demographic majority establishment among Thai older adults. Conversely, the male proportion decreased from 48.93% to 44.20% over the same period and then remained constant in NHES 6. The age structure formed a distinct polarization. The young-old experienced a continuous increase in its

share across all demographic subgroups, as shown by the overall proportion rising from 54.91% (NHES 4) to 59.31% (NHES 5) to 61.97% (NHES 6), while the mid-old showed a continuous decline in its overall proportion. Conversely, the overall proportion of the oldest-old remained constant at around 10% across survey rounds. However, the sex categories of each age group had fluctuating patterns. Regionally, Bangkok increased its share of older residents by 7.65% between NHES 4 and 5, with the proportional share of females showing a continuous increase across all surveys, while other regions and their sex categories exhibited fluctuating patterns. Notably, a full analysis of regional shifts over the entire period was constrained as the format of the older adult number in each region in NHES 6 was different.

**Table 1.** Sociodemographic characteristics of Thai older adults according to the National Health Examination Surveys 2008–2009, 2014 and 2019–2020. (Unweight)

| Main characteristic | Subcategory | Sex | NHES 4 (%) | NHES 5 (%) | NHES 6 (%) | % Change between NHES 4 and NHES 5 | % Change between NHES 5 and NHES 6 | % Change between NHES 4 and NHES 6 |
|---|---|---|---|---|---|---|---|---|
| **Number of older adults** | **-** | Overall | 100 | 100 | 100 | -20.03 | 25.38 | 0.26 |
| | | Male | 48.93 | 44.2 | 44.2 | -27.76 | 25.38 | -9.43 |
| | | Female | 51.07 | 55.8 | 55.8 | -12.63 | 25.38 | 9.55 |
| **Age Group** | **60–69 years** | Overall | 54.91 | 59.31 | 61.97 | -13.62 | 31 | 13.15 |
| | | Male | 55.4 | 58.7 | 60.9 | 5.96 | 3.75 | 9.93 |
| | | Female | 54.4 | 59.8 | 62.8 | 9.93 | 5.02 | 15.44 |
| | **70–79 years** | Overall | 34.94 | 30.73 | 27.95 | -29.68 | 14.05 | -19.79 |
| | | Male | 34.8 | 30.6 | 28.5 | -12.07 | -6.86 | -18.1 |
| | | Female | 35.1 | 30.9 | 27.5 | -11.97 | -11 | -21.65 |
| | **≥80 years** | Overall | 10.15 | 9.97 | 10.08 | -21.5 | 26.84 | -0.43 |
| | | Male | 9.8 | 10.8 | 10.6 | 10.2 | -1.85 | 8.16 |
| | | Female | 10.5 | 9.3 | 9.7 | -11.43 | 4.3 | -7.62 |
| **Region** | **Bangkok** | Overall | 8.95 | 12.04 | N/A | 7.65 | N/A | N/A |
| | | Male | 7.8 | 7.8 | 10.3 | 0 | 32.05 | 32.05 |
| | | Female | 10 | 15.4 | 16.7 | 54 | 8.44 | 67 |
| | **North** | Overall | 22.88 | 22.67 | N/A | -20.79 | N/A | N/A |
| | | Male | 23.2 | 23.9 | 23 | 3.02 | -3.77 | -0.86 |
| | | Female | 22.6 | 21.7 | 19.1 | -3.98 | -11.98 | -15.49 |
| | **Central** | Overall | 23.15 | 24.49 | N/A | -15.43 | N/A | N/A |
| | | Male | 23.3 | 24.3 | 21.2 | 4.29 | -12.76 | -9.01 |
| | | Female | 23 | 24.6 | 22 | 6.96 | -10.57 | -4.35 |
| | **Northeast** | Overall | 22.78 | 22.47 | N/A | -21.12 | N/A | N/A |
| | | Male | 23.2 | 24.5 | 25.1 | 5.6 | 2.45 | 8.19 |
| | | Female | 22.4 | 20.9 | 21.7 | -6.7 | 3.83 | -3.13 |
| | **South** | Overall | 22.25 | 18.34 | N/A | -34.07 | N/A | N/A |
| | | Male | 22.5 | 19.5 | 20.4 | -13.33 | 4.62 | -9.33 |
| | | Female | 22 | 17.5 | 20.5 | -20.45 | 17.14 | -6.82 |

Sources: Thailand NHES 4 (20), NHES 5 (21), NHES 6 (15). As the format of older adult number in each region in NHES 6 is different from the others; this data set is not included for analysis in this study. NHES: National Health Examination Survey; N/A: Not available.

*Educational trends in Thai older adults*

Participants exhibited a clear generational shift in educational attainment across the NHES waves (Table 2). Among adults aged 60–69 years, educational deprivation showed a continuous decrease, dropping from 8.70% (NHES 4) to 6.30% (NHES 5), and further to 5.70% (NHES 6), thereby reflecting a -34.48% change over the period. Primary education remained dominant among more than three-quarters of participants, displaying a constant trend across the surveys. Secondary and vocational education showed a decrease from 8.70% (NHES 4) to 4.30% (NHES 5), followed by a slight increase to 4.50% (NHES 6), resulting in a decrease of -48.28% overall. Sub-bachelor education revealed a continuous increase around threefold, from 1.30% (NHES 4) to 4.10% (NHES 5) and finally to 5.70% (NHES 6). Bachelor's degrees and higher exhibited a decrease from 2.30% (NHES 4) to 1.20% (NHES 5), followed by an increase to 1.50% (NHES 6), resulting in a net decrease of -34.78%. Surprisingly, the "Other" category increased around tenfold, from 0.40% (NHES 4) to 4.00% (NHES 5) and then to 4.50% (NHES 6), indicating expansion in non-traditional or informal education pathways.

**Table 2.** Trends in education level of Thai older adults according to the NHES waves.

| Age Group | Education Level | NHES 4 (%) | NHES 5 (%) | NHES 6 (%) | % Change between NHES 4 and NHES 5 | % Change between NHES 5 and NHES 6 | % Change between NHES 4 and NHES 6 |
|---|---|---|---|---|---|---|---|
| 60–69 years | No formal education | 8.7 | 6.3 | 5.7 | 27.59 | -9.52 | -34.48 |
| | Primary education | 78.6 | 80.2 | 78.1 | -2.04 | -2.62 | -0.64 |
| | Secondary and vocational education | 8.7 | 4.3 | 4.5 | 50.57 | 4.65 | -48.28 |
| | Sub-bachelor education | 1.3 | 4.1 | 5.7 | -215.38 | 39.02 | 338.46 |
| | Bachelor's degree and above | 2.3 | 1.2 | 1.5 | 47.83 | 25 | -34.78 |
| | Others | 0.4 | 4 | 4.5 | -900 | 12.5 | 1,025.00 |
| 70–79 years | No formal education | 14.6 | 12.9 | 7.4 | 11.64 | -42.64 | -49.32 |
| | Primary education | 77.8 | 77.6 | 79.4 | 0.26 | 2.32 | 2.06 |
| | Secondary and vocational education | 5.1 | 1.7 | 3.7 | 66.67 | 117.65 | -27.45 |
| | Sub-bachelor education | 0.8 | 4.3 | 5.2 | -437.5 | 20.93 | 550 |
| | Bachelor's degree and above | 1.1 | 0.8 | 1.3 | 27.27 | 62.5 | 18.18 |
| | Others | 0.6 | 2.7 | 3 | -350 | 11.11 | 400 |
| ≥80 years | No formal education | 26.5 | 14.8 | 17.4 | 44.15 | 17.57 | -34.34 |
| | Primary education | 67.9 | 79.4 | 77.3 | -16.94 | -2.64 | 13.84 |
| | Secondary and vocational education | 4 | 1 | 1.5 | 75 | 50 | -62.5 |
| | Sub-bachelor education | 0.5 | 3.3 | 2.9 | -560 | -12.12 | 480 |
| | Bachelor's degree and above | 0.3 | 0.6 | 0.2 | -100 | -66.67 | -33.33 |
| | Others | 0.9 | 1 | 0.7 | -11.11 | -30 | -22.22 |

Sources: Thailand NHES 4 (20), NHES 5 (21), NHES 6 (15). The data of education levels are reported solely as percentages due to the absence of raw counts in the publicly accessible summaries of the NHES cycles. NHES: National Health Examination Survey.

Regarding individuals aged 70–79 years, educational deprivation showed a continuous decrease from 14.60% (NHES 4) to 12.90% (NHES 5) and to 7.40% (NHES 6), indicating a decrease by -49.32% overall. Primary education exhibited a fluctuating trend by slightly decreasing from 77.80% (NHES 4) to 77.60% (NHES 5) before rising to 79.40% (NHES 6). Secondary and vocational education demonstrated a decrease from 5.10% (NHES 4) to 1.70% (NHES 5), followed by an increase to 3.70% (NHES 6), resulting in a net decrease of -27.45%. Sub-bachelor education revealed a continuous increase from 0.80% (NHES 4) to 4.30% (NHES 5) and further to 5.20% (NHES 6), with an increase by 550.00% overall. Bachelor's degrees and above exhibited a fluctuating trend by increasing from 1.10% (NHES 4) to 0.80% (NHES 5) and to 1.30% (NHES 6), with a net increase of 18.18%. The "Other" category inclined continuously from 0.60% (NHES 4) to 2.70% (NHES 5) and then to 3.00% (NHES 6), with an overall increase of 400.00%.

For adults aged 80 years and above, this group retained a distinctly lower educational profile. No formal education showed a decrease from 26.50% (NHES 4) to 14.80% (NHES 5), followed by an increase to 17.40% (NHES 6), resulting in a net decrease of -34.34%. Primary education dominated the group among more than 60% of participants, exhibiting an increase from 67.90% (NHES 4) to 79.40% (NHES 5), followed by a slight decrease to 77.30% (NHES 6), with a net increase of 13.84%. Secondary and vocational education revealed a decrease from 4.00% (NHES 4) to 1.00% (NHES 4), followed by an increase to 1.50% (NHES 6), resulting in a net decrease of -62.50%. Although higher education remained rare,

**Table 3.** Trends in median per capita monthly income among Thai older adults by the age group and geographic regions according to the NHES waves.

| Age group | Region | NHES 4 (Baht) | NHES 5 (Baht) | % Change between NHES 4 and NHES 5 |
|---|---|---|---|---|
| **60–69 years** | Overall | 3,000 | 4,000 | 33.33 |
| | Bangkok | 5,000 | 8,000 | 60 |
| | North | 3,000 | 2,600 | -13.33 |
| | Central | 4,000 | 5,600 | 40 |
| | Northeast | 2,000 | 2,600 | 30 |
| | South | 4,000 | 5,000 | 25 |
| **70–79 years** | Overall | 2,000 | 3,000 | 50 |
| | Bangkok | 3,000 | 9,000 | 200 |
| | North | 1,500 | 3,000 | 100 |
| | Central | 3,000 | 3,000 | 0 |
| | Northeast | 1,500 | 2,000 | 33.33 |
| | South | 2,500 | 3,000 | 20 |
| **≥80 years** | Overall | 1,000 | 2,900 | 190 |
| | Bangkok | 2,000 | 6,000 | 200 |
| | North | 1,000 | 3,000 | 200 |
| | Central | 2,000 | 2,800 | 40 |
| | Northeast | 1,000 | 2,000 | 100 |
| | South | 1,500 | 2,500 | 66.67 |

Sources: Thailand NHES 4 (20), NHES 5 (21). As median per capita monthly income disaggregated by the age group and regions are not reported in NHES 6 (15), the capacity to conduct the comparisons for this indicator remains constrained to earlier NHES waves. NHES: National Health Examination Survey.

sub-bachelor education showed an increase from 0.50% (NHES 4) to 3.30% (NHES 5), followed by a slight decrease to 2.90% (NHES 6), resulting in an increase nearly fivefold overall. Bachelor's degrees and above exhibited a fluctuating trend by increasing from 0.30% (NHES 4) to 0.60% (NHES 5) and then decreasing to 0.20% (NHES 6), resulting in a net decrease of -33.33%. The "Other" category demonstrated a fluctuating trend by increasing from 0.90% (NHES 4) to 1.00% (NHES 5) and then decreasing to 0.70% (NHES 6), with a net decrease of -22.22%.

### *Income trends among Thai older adults*

Between 2008 and 2014, the median per capita monthly income increased across all age groups (Table 3). The highest gains were observed in the oldest-old with a 190.00% increase, followed by those aged 70–79 and 60–69 years, respectively. Bangkok consistently had the highest median incomes and strongest growth across all age groups, highlighting the capital economic concentration. Conversely, the Northeast maintained the lowest median incomes across all age groups. While income decreased in the North for those aged 60–69 years by 13.33%, and stagnated in the Central region for those aged 70–79 years, indicating emerging economic vulnerability to these groups and regions.

### *Trends in health behaviors affecting NCDs in Thai older adults*

Analysis of tobacco use, alcohol consumption, physical activity, and dietary patterns showed different trends (Table 4). Although smoking prevalence decreased across all age groups and sexes over the entire period, with the largest overall percentage decrease observed in females aged 70-79 years, the smoking rate in males remained higher than in females. A decline in smoking was specifically continuous from NHES 4 to NHES 6 for the overall population aged 60-69 years and for all males and females aged 60-69 years. Yet, a fluctuating trend was observed in the overall 70-79 years by decreasing 31.11% between NHES 4 and NHES 5 before increasing to 8.60% between NHES 5 and NHES 6, and in the overall >80 year group, with a decrease of 35.51% between NHES 4 and NHES 5 before increasing to 28.09% between NHES 5 and NHES 6. The male subgroups in the mid-old and oldest-old groups also followed this fluctuating trend. However, the smoking prevalence in females aged >80 years decreased 58.62% between NHES 4 and NHES 5, then increased to 50.00% between NHES 5 and NHES 6.

Conversely, heavy alcohol consumption among older adults increased continuously in all age groups and sexes where data was available (NHES 5 to NHES 6), as data from NHES 4 was not included for analysis. The highest increase rate was found in females aged 70-79 years (1,400.00%) and females aged 60-69 years (1,060.00%) between NHES 5 and NHES 6, but the highest rates in NHES 6 were still seen in males. The overall rate for those aged >80 years increased 640.00% between NHES 5 and NHES 6.

For adequate physical activity, it showed a fluctuating trend, resulting in an overall decrease in all age groups between NHES 4 and NHES 6. For example, the 60-69-year-old overall group showed a 0.88% increase between NHES 4 and NHES 5, followed by a decrease of 13.23% between NHES 5 and NHES 6, resulting in a net -12.47% decrease. The only exception was for females aged >80 years, which showed an increase of 55.42% between NHES 4 and NHES 5, followed by a decrease of 25.30% between NHES 5 and NHES 6, resulting in a 16.10% increase over the entire period. However, this group revealed the lowest percentage of physical activity in all surveys in NHES 4 and NHES 6. While consuming adequate fruits and vegetables increased in all age groups and sexes across the surveys. The largest overall percentage increase was observed in the oldest-old (129.63%), with a fluctuating trend found in the sex categories of each age group

**Table 4.** Trends in health behaviors associated with non-communicable diseases among Thai older adults according to the NHES waves.

| Behaviors | Age Group | Sex | NHES 4 (%) | NHES 5 (%) | NHES 6 (%) | % Change between NHES 4 and NHES 5 | % Change between NHES 5 and NHES 6 | % Change between NHES 4 and NHES 6 |
|---|---|---|---|---|---|---|---|---|
| Regular smoking | 60–69 years | Overall | 17.5 | 16 | 12.7 | -8.57 | -20.63 | -27.43 |
| | | Male | 35.3 | 31 | 26.1 | -12.18 | -15.81 | -26.06 |
| | | Female | 3.1 | 2.8 | 2.3 | -9.68 | -17.86 | -25.81 |
| | 70–79 years | Overall | 13.5 | 9.3 | 10.1 | -31.11 | 8.6 | -25.19 |
| | | Male | 24.9 | 19 | 20.7 | -23.69 | 8.95 | -16.87 |
| | | Female | 4 | 1.7 | 1.6 | -57.5 | -5.88 | -60 |
| | ≥80 years | Overall | 13.8 | 8.9 | 11.4 | -35.51 | 28.09 | -17.39 |
| | | Male | 24.9 | 18.8 | 21 | -24.5 | 11.7 | -15.66 |
| | | Female | 5.8 | 2.4 | 3.6 | -58.62 | 50 | -37.93 |
| Heavy alcohol consumption in the past 30 day | 60–69 years | Overall | N/A | 3.5 | 12.5 | N/A | 257.14 | N/A |
| | | Male | N/A | 7 | 21.1 | N/A | 201.43 | N/A |
| | | Female | N/A | 0.5 | 5.8 | N/A | 1,060.00 | N/A |
| | 70–79 years | Overall | N/A | 1.7 | 7.9 | N/A | 364.71 | N/A |
| | | Male | N/A | 3.6 | 14 | N/A | 288.89 | N/A |
| | | Female | N/A | 0.2 | 3 | N/A | 1,400.00 | N/A |
| | ≥80 years | Overall | N/A | 0.5 | 3.7 | N/A | 640 | N/A |
| | | Male | N/A | 1.2 | 4.9 | N/A | 308.33 | N/A |
| | | Female | N/A | 0 | 2.7 | N/A | N/A | N/A |
| Getting enough physical activity | 60–69 years | Overall | 79.4 | 80.1 | 69.5 | 0.88 | -13.23 | -12.47 |
| | | Male | 80.6 | 80.5 | 70.7 | -0.12 | -12.17 | -12.28 |
| | | Female | 78.5 | 79.8 | 68.7 | 1.66 | -13.91 | -12.48 |
| | 70–79 years | Overall | 64.5 | 68.7 | 56.6 | 6.51 | -17.61 | -12.25 |
| | | Male | 69.2 | 72.1 | 61.3 | 4.19 | -14.98 | -11.42 |
| | | Female | 60.5 | 66 | 52.9 | 9.09 | -19.85 | -12.56 |
| | ≥80 years | Overall | 39.6 | 51.5 | 38.6 | 30.05 | -25.05 | -2.53 |
| | | Male | 40.7 | 53.2 | 40 | 30.71 | -24.81 | -1.72 |
| | | Female | 32.3 | 50.2 | 37.5 | 55.42 | -25.3 | 16.1 |
| Adequate fruit and vegetable consumption | 60–69 years | Overall | 15.9 | 24.2 | 28.1 | 52.2 | 16.12 | 76.73 |
| | | Male | 16.7 | 22.6 | 28.4 | 35.33 | 25.66 | 70.06 |
| | | Female | 15.3 | 25.6 | 28 | 67.32 | 9.37 | 83.01 |
| | 70–79 years | Overall | 9.9 | 17.7 | 22.2 | 78.79 | 25.42 | 124.24 |
| | | Male | 10.4 | 18.3 | 21.2 | 75.96 | 15.85 | 103.85 |
| | | Female | 9.5 | 17.3 | 23 | 82.11 | 32.95 | 142.11 |
| | ≥80 years | Overall | 8.1 | 11.4 | 18.6 | 40.74 | 63.16 | 129.63 |
| | | Male | 7.5 | 13.1 | 18.4 | 74.67 | 40.46 | 145.33 |
| | | Female | 8.6 | 10.3 | 18.8 | 19.77 | 82.52 | 118.6 |

Sources: Thailand NHES 4 (20), NHES 5 (21), NHES 6 (15). Health behaviors affecting the development of non-communicable diseases in the older participants are reported solely as percentages due to the absence of raw counts in the publicly accessible summaries of the NHES waves. As the format of heavy alcohol consumption in NHES 4 is different from the others; this data set is not included for analysis in this study. NHES: National Health Examination Survey; N/A: Not available.

**Table 5.** Trends in non-communicable diseases and caregiver assistance needs in older adults according to the NHES waves.

| Health Indicator | Age Group | Sex | NHES 4 (%) | NHES 5 (%) | NHES 6 (%) | % Change between NHES 4 and NHES 5 | % Change between NHES 5 and NHES 6 | % Change between NHES 4 and NHES 6 |
|---|---|---|---|---|---|---|---|---|
| Obesity | 60–69 years | Overall | 35.6 | 41.4 | 42.6 | 16.29 | 2.9 | 19.66 |
| | | Male | 26.4 | 30.9 | 32.7 | 17.05 | 5.83 | 23.86 |
| | | Female | 43.1 | 50.7 | 50.3 | 17.63 | -0.79 | 16.71 |
| | 70–79 years | Overall | 25.5 | 32.1 | 36 | 25.88 | 12.15 | 41.18 |
| | | Male | 18.6 | 24.1 | 28.5 | 29.57 | 18.26 | 53.23 |
| | | Female | 31.3 | 38.4 | 42 | 22.68 | 9.38 | 34.19 |
| | ≥80 years | Overall | 12.8 | 17.6 | 19.2 | 37.5 | 9.09 | 50 |
| | | Male | 11.3 | 11.3 | 16.8 | 0 | 48.67 | 48.67 |
| | | Female | 13.9 | 21.6 | 21.1 | 55.4 | -2.31 | 51.8 |
| Hypercholesterolemia | 60–69 years | Overall | 27.4 | 20.4 | 26.3 | -25.55 | 28.92 | -4.01 |
| | | Male | 20.2 | 15.9 | 21.3 | -21.29 | 33.96 | 5.45 |
| | | Female | 33.2 | 24.5 | 30.1 | -26.2 | 22.86 | -9.34 |
| | 70–79 years | Overall | 25.2 | 18.2 | 20.3 | -27.78 | 11.54 | -19.44 |
| | | Male | 19 | 15.1 | 13.2 | -20.53 | -12.58 | -30.53 |
| | | Female | 30.2 | 20.6 | 26 | -31.79 | 26.21 | -13.91 |
| | ≥80 years | Overall | 20.4 | 15.1 | 18.6 | -25.98 | 23.18 | -8.82 |
| | | Male | 15.5 | 9.9 | 14.7 | -36.13 | 48.48 | -5.16 |
| | | Female | 24.2 | 18.5 | 21.7 | -23.55 | 17.3 | -10.33 |
| Diabetes mellitus | 60–69 years | Overall | 16.7 | 19.2 | 20.7 | 14.97 | 7.81 | 23.95 |
| | | Male | 13.6 | 16.1 | 18.6 | 18.38 | 15.53 | 36.76 |
| | | Female | 19.2 | 21.9 | 22.3 | 14.06 | 1.83 | 16.15 |
| | 70–79 years | Overall | 15.8 | 18.8 | 21.3 | 18.99 | 13.3 | 34.81 |
| | | Male | 14.3 | 15 | 17.2 | 4.9 | 14.67 | 20.28 |
| | | Female | 17.1 | 21.8 | 24.6 | 27.49 | 12.84 | 43.86 |
| | ≥80 years | Overall | 11.5 | 11.8 | 16.2 | 2.61 | 37.29 | 40.87 |
| | | Male | 12.9 | 12.4 | 13.1 | -3.88 | 5.65 | 1.55 |
| | | Female | 10.5 | 11.3 | 18.5 | 7.62 | 63.72 | 76.19 |
| Hypertension | 60–69 years | Overall | 44 | 48.4 | 55 | 10 | 13.64 | 25 |
| | | Male | 42.8 | 47.2 | 53.5 | 10.28 | 13.35 | 25 |
| | | Female | 44.9 | 49.5 | 56.2 | 10.24 | 13.54 | 25.17 |
| | 70–79 years | Overall | 51.7 | 56.8 | 67.2 | 9.86 | 18.31 | 29.98 |
| | | Male | 51.1 | 52.6 | 67 | 2.94 | 27.38 | 31.12 |
| | | Female | 52.3 | 60.1 | 67.4 | 14.91 | 12.15 | 28.87 |
| | ≥80 years | Overall | 55.9 | 64.9 | 76.8 | 16.1 | 18.34 | 37.39 |
| | | Male | 53.9 | 58.7 | 74.7 | 8.91 | 27.26 | 38.59 |
| | | Female | 57.4 | 68.9 | 78.5 | 20.03 | 13.93 | 36.76 |

**Table 5.** Trends in non-communicable diseases and caregiver assistance needs in older adults according to the NHES waves. (Continued)

| Health Indicator | Age Group | Sex | NHES 4 (%) | NHES 5 (%) | NHES 6 (%) | % Change between NHES 4 and NHES 5 | % Change between NHES 5 and NHES 6 | % Change between NHES 4 and NHES 6 |
|---|---|---|---|---|---|---|---|---|
| Paralysis history | 60–69 years | Overall | 3 | 2.3 | 2.8 | -23.33 | 21.74 | -6.67 |
| | | Male | 2.9 | 2.7 | 3.8 | -6.9 | 40.74 | 31.03 |
| | | Female | 3 | 2 | 2 | -33.33 | 0 | -33.33 |
| | 70–79 years | Overall | 4.3 | 4 | 2.9 | -6.98 | -27.5 | -32.56 |
| | | Male | 6.2 | 4.7 | 3.5 | -24.19 | -25.53 | -43.55 |
| | | Female | 2.7 | 3.4 | 2.5 | 25.93 | -26.47 | -7.41 |
| | ≥80 years | Overall | 3.5 | 1.5 | 3.5 | -57.14 | 133.33 | 0 |
| | | Male | 3.2 | 2.2 | 4.8 | -31.25 | 118.18 | 50 |
| | | Female | 3.8 | 1 | 2.4 | -73.68 | 140 | -36.84 |
| Unmet caregiver need | 60–69 years | Overall | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Male | 1 | 1.8 | 3.5 | 80 | 94.44 | 250 |
| | | Female | 2 | 1.5 | 5.1 | -25 | 240 | 155 |
| | 70–79 years | Overall | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Male | 1 | 1.7 | 5.2 | 70 | 205.88 | 420 |
| | | Female | 3 | 2.8 | 6.6 | -6.67 | 135.71 | 120 |
| | ≥80 years | Overall | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Male | 3 | 1.3 | 7.7 | -56.67 | 492.31 | 156.67 |
| | | Female | 3 | 2.5 | 4.7 | -16.67 | 88 | 56.67 |

Sources: Thailand NHES 4 (20), NHES 5 (21), NHES 6 (15). NCDs and unmet caregiver needs are reported solely as percentages due to the absence of raw counts in the publicly accessible summaries of the NHES cycles. Due to the different reporting formats of unmet caregiver needs across the national surveys and from that of NCDs, overall estimates for unmet caregiver needs are not calculated in this study. NHES: National Health Examination Survey; NCDs: Non-communicable diseases, N/A: Not available.

### *Trends in NCDs and unmet caregiver needs among Thai older adults*

The prevalence of obesity, diabetes mellitus, and hypertension increased across all age groups and sexes over the survey periods, especially for the oldest-old, who seemed to have the highest rates, indicating worsening metabolic and cardiovascular health (Table 5). Obesity showed a continuous increasing trend in all age groups and both sexes throughout the NHES waves, with the highest overall percentage change between NHES 4 and NHES 6 (50.00%) in the oldest-old group.

The prevalence of diabetes mellitus also continuously increased across all age groups and sexes between NHES 4 and NHES 6, with the most significant overall increase of 40.87% observed in the oldest-old group. The trend for hypertension revealed a continuous increase in all subgroups, with the highest overall percentage increase from NHES 4 to NHES 6 in the oldest-old (37.39%). In contrast, the prevalence of hypercholesterolemia and paralysis history remained stable or slightly declined. Hypercholesterolemia generally showed a decrease from NHES 4 to NHES 5, followed by an increase from NHES 5 to NHES 6 across all age groups and sexes, resulting in an overall decline between NHES 4 and NHES 6 in most subgroups. For example, the overall change in the young-old was -4.01%, and in the mid-old was -19.44%. Paralysis history generally showed a fluctuating trend throughout the entire period in all age groups. The males in the young-old and oldest-old groups showed the highest prevalence of paralysis history. While the trend of unmet caregiver need increased in all age groups, it especially increased for men. For example, the percentage of male older adults aged 70–79 with unmet caregiver needs showed a continuous increase

from NHES 4 to NHES 6, with an overall change of 420.00%. The unmet caregiver need for men aged >80 was also observed to have an overall increase of 156.67%, although it showed a decrease between NHES 4 and NHES 5, followed by an increase between NHES 5 and NHES 6 (492.31%).

## DISCUSSION

NHES has provided valuable health data in Thailand since 1991, but its policy impact is limited due to methodological inconsistencies, duplication with other surveys that provide a more appropriate data platform for monitoring and evaluation of data required for public health policy formation, a lack of in-depth information on health problems for strategic development and planning, gaps in coordination, the absence of a long-term strategic framework, and the restricted availability of secondary data. Policymakers and researchers outside the core survey team often encounter barriers in accessing and applying NHES datasets for independent evaluation or policy design, diminishing the potential impact of this national resource. Strengthening governance, standardizing methods, and ensuring wider data accessibility are capable of ensuring NHES provides better informed evidence-based policy (22, 23).

### *Sociodemographic and socioeconomic trends*

This study draws a comprehensive overview of the evolving sociodemographic characteristics and health of Thai older adults over a decade, thereby generating important trends with direct implications for NCD prevention, long-term care, and health equity. While the substantial fluctuations in the unweighted overall count of older adults showed a decrease of -20.03% between NHES 4 and NHES 5 and an increase of 25.38% between NHES 5 and NHES 6, suggesting the changes in survey methodology or unweighted data artifacts, the relative compositional changes are more indicative of ongoing demographic and health service needs. The data shows a persistent feminization of the aging population, with females increasing from 51.07% (NHES 4) to 55.80% (NHES 6) and the influx of participants newly entering older adulthood increasing from 54.91% (NHES 4) to 61.97% (NHES 6), particularly in Bangkok where the overall proportion increased from 8.95% (NHES 4) to 12.04% (NHES 5). These findings raise the issue of not only changing age structure and population distribution but also emerging longevity trends within the Thai older population.

Likewise, some other studies report that a feminization of its aging population is associated with higher NCD burdens among women, especially in urban contexts, resulting from poor literacy levels and economic status, dependency on others, limited social security enrollment, the inequity of economic and health care access, health risk behaviors, high daily life activity limitation, and comorbidity (4, 24-29). These demographic shifts address the need for gender-sensitive aging policies, especially for enhancing social protection and health care access. The continuous increase in the 60-69 age group aligns with Thailand's accelerating aging society and reinforces the policy need for prioritized NCD prevention strategies (5). Some previous studies suggest that using preventive strategies adopted for NCDs in younger and adult populations is found to be more cost-effective to decrease the occurrence of NCDs and delay their onset than clinical management later in life, especially for the programs that involve a social-support dimension used in low-income groups in richer western countries (30-32). Given the increase in the 60–69 age group, Thailand should prioritize scaling up such health promotion and prevention programs for the newly-entering older adults. Crucially, specific policy action must be taken in three areas, e.g., health infrastructure tailored to manage NCDs among older women, social security coverage to ensure economic independence, and caregiving support systems to alleviate the burden associated with increased longevity and dependency.

The educational shifts among Thai older adults across the NHES cycles revealed critical policy implications for public health and social service design. A reduction of educational deprivation, a dominance of primary education, and an increase in sub-bachelor education observed in all age groups across the NHES reflect substantial gains in basic literacy and schooling among more recent birth cross-sectional studies, possibly due to shifts in educational policies, e.g., the Student Loan Fund policy (1996), the National Education Act (1999), and the 15-year Free Education Program (2009) (33, 34). Notably, the most proportional declines in no formal education were

reported between NHES 5 and NHES 6, with a -42.64% decrease in the 70–79 age group, suggesting accelerated gains in basic schooling during this later period. In contrast, the sub-bachelor education attainment growth showed immense percentage change between NHES 4 and NHES 5, e.g., rapid increases of -215.38% in the 60–69 group, -437.50% in the 70–79 group and -560.00% in the >80 group, indicating rapid entry into this level before slowing down or slightly reversing in the subsequent period. Additionally, an increase in the "Other" education category, especially for the younger old, suggests a successful expansion in non-formal or lifelong learning pathways (35). This expansion was explosive between NHES 4 and NHES 5, as evidenced by the initial rapid increases of -900% in the 60–69 age group and -350.00% in the 70–79 age group. These results indicate rapid uptake, followed by sustained growth between NHES 5 and NHES 6, e.g., an increase of 12.50% in the 60-69 age group, confirming the consistent establishment of non-formal educational routes, possibly reflecting the successful implementation of the Act for the Promotion of Non-Formal and Informal Education, B.E. 2551 (2008) (36). These educational attainment shifts hold positive impacts for health literacy, enhancing service accessibility, and promoting civic engagement. Therefore, public health policy interventions should be deliberately tailored to educational gradients within older populations, using communication strategies and service formats that match a more educated public, as observed in Ethiopia, Brazil, Estonia, Cuba, and Nigeria. However, policymakers must remain cautious, as evidence from China, Brazil, Jordan, and Chile suggests that the relationship between education and healthcare utilization is mixed and context-dependent (37). Policymakers must continuously and iteratively evaluate programs to ensure optimal and equitable resource allocation.

Thai older adult income trends reveal progress between 2008–2014. However, median per capita income among Thai older individuals was near or below the national poverty line of 2,172 baht reported in 2008 (38), with the oldest-old receiving a median of only 1,000 baht. By 2014, all groups had surpassed the national poverty line of 2,647 baht (38); nevertheless, the oldest-old and those in the North and Northeast regions still faced a high poverty risk, suggesting persistent disparities, as similarly seen in Malaysia (39). Some previous studies indicate that higher income increased healthcare utilization in Chile, Peru, and others, while contrasting results were reported in Brazil and China (37). Given evidence that income inequality undermines health equity and increases NCD risk, policy responses must enhance sub-national interventions to protect the most vulnerable groups from poverty, its associated health risks, and inequitable health access (40).

### *Behavioral risk patterns related to non-communicable diseases*

The trends in health behaviors among Thai older adults observed across the NHES waves provide crucial insights for policymakers seeking to control the prevalence of NCDs in Thailand. In this study, the prevalence of regular smoking has declined consistently across all age and sex groups between NHES 4 and NHES 6, suggesting successful tobacco control efforts. This success is possibly due to implementing a comprehensive strategy targeting various aspects of tobacco use, from taxation to public awareness, that aligns with the WHO Framework Convention on Tobacco Control (41). Interestingly, the overall decrease in regular smoking was observed primarily in the initial period (NHES 4 to NHES 5) across all age and sex groups, with a subsequent rebound in prevalence among the 70-79 years and >80 years groups between NHES 5 to NHES 6. This indicates a lack of sustained enforcement or cessation support of these participants.

Additionally, heavy alcohol consumption increased across all age groups from NHES 5 to NHES 6, especially among the oldest-old. This rapid increase is even more pronounced in women, with an increase of 1,060.00% in the group of 60–69 years and an increase of 1,400.00% in the group of 70–79 years. This indicates a new challenge for NCD prevention and aligns with findings that alcohol has become a growing contributor to disease burden among older populations globally (42). Therefore, targeted and high-impact interventions must be considered to curb heavy alcohol use among older adults, especially focusing on the oldest-old and females in Thailand.

Moreover, the overall decrease in physical activity across all age groups between NHES 4 and NHES 6 highlights the promotion of chronic disease risks. This necessitates the development of public health policies specific to age-appropriate, gender-sensitive, and community-accessible physical activity programs to restore the protective effects of exercise against NCDs (43).

Finally, the increase in adequate fruit and vegetable consumption across all groups over the survey period suggests some progress in dietary behavior change, aligning with the WHO Global Strategy for Food Safety (2022-2030) (44). To sustain and promote this positive trend, broader structural interventions in food systems, e.g., subsidizing healthy foods, regulating marketing, and improving access to fresh produce, are necessary.

### *Trends in non-communicable diseases and caregiver assistance needs*

The trends identified across the NHES waves underscore an escalating crisis of NCDs in Thailand, demanding urgent policy re-calibration. An alarming acceleration of obesity, diabetes mellitus, and hypertension prevalence among Thai older adults has been reported between NHES 4 and NHES 6, highlighting the growing chronic disease burden. This data aligns with global evidence of accelerating metabolic risks and NCD burden among aging populations, with Southeast Asia experiencing the fastest increases (45). While a temporary overall decrease in the prevalence of obesity and diabetes mellitus was once observed across all age and sex groups, excluding diabetes mellitus in the oldest-old between NHES 5 to NHES 6, suggesting that policies aimed at alleviating the increasing trend of these NCDs may have had a transient effect during that period. The prevalence of hypercholesterolemia displayed a fluctuating trend. Initially, a substantial decrease in hypercholesterolemia was observed across all age and sex groups from NHES 4 to NHES 5, suggesting a period of successful policy intervention or heightened awareness. However, the prevalence rebounded strongly in NHES 6, suggesting a critical failure in the sustainability of national lipid control and public health programs.

Regarding the outcome of this uncontrolled NCD acceleration, the prevalence of paralysis history has remained stable or even decreased in some age groups over the survey period, suggesting improvements in acute stroke care and survival rates. Nevertheless, an overall increase in paralysis history was observed in the young-old and oldest-old groups between NHES 5 and NHES 6, signaling a dramatic increase in severe NCD-related complications in these participants.

Like other countries, an increasing unmet caregiver need for the Thai older population is reported. This problem leads to the concern of higher risk of negative health outcomes, institutionalization, and health system strain (46). Solving these challenges to ensure that Thailand achieves SDG Target 3.4 by reducing premature NCD mortality and SDG Target 3.8 by supporting universal health coverage is of importance. Strategic investments in NCD health promotion, long-term care infrastructure, caregiver support, and equity-driven service delivery will be crucial for supporting Thai older adults with or without NCDs.

### *Policy implications*

Thailand's demographic aging transition and rising NCD burden require policy recalibration to achieve the SDG Target 3.4 and 3.8 goals. To solve rising geriatric multimorbidity and fragmented care, strengthening the primary care system is crucial. In this context, Korea's Community Integrated Care model is highly feasible for strengthening Thailand's primary care system by proposing a critical solution to manage increasing geriatric multimorbidity and delaying institutionalization. Its feasibility depends on an administrative and operational upgrade of existing infrastructure (47). Integrating this model into Thailand's decentralized Subdistrict Health Systems through setting local centers as the primary coordination hubs, leveraging their physical proximity and community trust to form multidisciplinary care teams, and formally convening existing resources, e.g., primary care nurses, social workers, and the extensive network of Public Health Volunteers, can deliver holistic home-based assessments and coordinated services that address the medical, functional, and social needs of older adults. This community-centric approach promotes the UHC system's efficiency via its

preventive and coordinated care, ensuring the system remains financially sustainable while improving health outcomes for the growing oldest-old population.

Simultaneously, expanding long-term care resources to address the unmet caregiver need issue is also important. The Japanese Long-Term Care Insurance (LTCI) system can be used to reduce caregiver burden and delay institutionalization in Thailand by providing a sustainable, structured funding mechanism for community-based care. The core principle of this model is to blend financing via dedicated social contributions with general taxation (48). Thailand can adapt the LTCI framework by launching pilot programs focused on high-need provinces and vulnerable populations. These pilots can test the feasibility of dedicated LTC funding streams within the Thai socio-economic context, e.g., retained general taxation, earmarked social contribution/premium possibly through a payroll tax for the working population or a contribution from pension income, leveraging existing social security reserves or national pension fund reserves towards LTC services for contributors as they age, and means-tested co-payment introduced for higher-income users to promote financial responsibility and supplement the service pool, demonstrating the benefits of a pooled fund in standardizing the quality and availability of non-medical services that are essential for supporting family caregivers and effectively keeping older adults healthy at home.

Moreover, recalibrating NCD prevention frameworks is essential due to the rising prevalence of alcohol consumption and physical inactivity among Thai older adults. Digital platforms, functioning as a key enabling technology to provide support for remote health coaching and accessible NCD services, can facilitate the delivery of gender- and context-sensitive interventions (49), ensuring that personalized advice and behavioral support can reach diverse older populations residing in different geographic locations. This platform will help Thailand effectively address health disparities and promote the enhancement of universal health system equity.

Finally, equity-focused fiscal policies, e.g., conditional cash transfers (CCTs), regional health infrastructure investment, and age-friendly transport systems (50, 51), are crucial to overcome the geographic and socioeconomic disparities in health access. For example, CCTs can solve socioeconomic barriers through the provision of financial support to ease the financial burden of care for low-income older adults. Investing in regional health infrastructure ensures long-term care services are available in underserved and rural areas, thereby addressing geographic inequities and distributing specialized resources more equitably. Implementing age-friendly transport systems ensures that older adults, especially those with mobility limitations or chronic dependency, can consistently and affordably access these decentralized health services. This helps create an equitable framework that links resources, care, and the vulnerable population, together with addressing issues like unmet caregiver need.

### *Limitation*

There are several limitations in this study. Analyses were restricted to publicly released summary tables by NHES, precluding the use of sampling weights, confidence intervals, or statistical tests. Findings should be interpreted as descriptive and hypothesis-generating rather than inferential. Some variables were not consistently measured across survey rounds (e.g., alcohol consumption patterns), limiting comparability over time. Observed trends may be affected by changes in measurement protocols and definitions across surveys. Caregiver need was measured only in broad categories, restricting the assessment of intensity or quality of care. Causal relationships cannot be inferred because of the cross-sectional survey design. Despite these limitations, this research offers valuable national insights into long-term trends in NCDs and related disparities among Thai older adults, highlighting priorities for strengthening health policy, service delivery, and future research.

## CONCLUSION

Longitudinal NHES data was used to determine demographic and health transitions among Thai older adults. Findings reveal an increasing feminization trend of the older population alongside persistent income and regional disparities. Despite educational gains, the nation confronts several severe public health challenges, e.g., an increase in NCD prevalence, including diabetes and hypertension, together with the elevation of detrimental health behaviors, particularly increased alcohol consumption and physical inactivity. These lead to an urgent need for policy alignment to meet SDG Targets 3.4 and 3.8. Reforms must prioritize strengthening primary care systems for multimorbidity, including expanding the long-term care resources and implementing gender-sensitive NCD prevention. Last but not least, enhancing NHES data governance is crucial for robust evidence-based policy formulation.

## CONFLICTS OF INTEREST

The author declares no conflicts of interest related to this study.

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