GIS-Linked Spatial Contextualization of Depression-Related Service Needs among Older Adults in Lat Yai Subdistrict, Samut Songkhram Province, Thailand

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Abstract
Depression among older adults is shaped by individual, household, economic, and community-level contexts. This study restructured a cross-sectional survey of older adults in Lat Yai Subdistrict, Mueang District, Samut Songkhram Province, Thailand, into a geoinformatics-oriented manuscript by linking survey findings with official aggregate village-level spatial data. The survey included 380 older adults selected from a population of 3,428. Depression was assessed using the Thai Geriatric Depression Scale, while demographic, economic, living-arrangement, morbidity, and family relationship variables were collected through structured questionnaires. Associations between categorical variables and depression were examined using chi-square tests, and the relationship between family relationship score and depression was analysed using Pearson's correlation. To strengthen the GIS contribution without overinterpreting the original survey, village-level older-adult service-register data from the official 3 Doctor system were linked with village point coordinates in WGS84. The GIS component was designed as a descriptive spatial-context map showing the distribution of registered older-adult functional-status records and homebound or bedridden records; it did not estimate village-level depression prevalence or depression risk. Most respondents had no depression (85.79%), while 8.16%, 5.26%, and 0.79% had mild, moderate, and severe depression, respectively. Age, income, marital status, income source, and income adequacy were significantly associated with depression. Family relationship had a significant negative correlation with depression. The GIS output supports public-health planning by indicating where screening outreach and home-visit integration may be operationally important, while avoiding ecological inference from non-geocoded depression outcomes.

Keywords: Depression, Elderly Health, Geographic Information Systems, Public Health Surveillance, Thailand

1. Introduction

Population aging is creating new demands for community health systems, particularly in relation to mental health, chronic disease, family support, functional limitations, and service accessibility. Older adults are vulnerable to depression when biological aging, social isolation, economic insecurity, chronic illness, and reduced family support intersect. For GIS-oriented public health research, depression should therefore be interpreted not only as an individual outcome but also as a spatially contextualized community health problem that requires area-based targeting and service planning [1]. The International Journal of Geoinformatics publishes scientific and technical developments in Geographic Information Systems, remote sensing, photogrammetry, and positioning systems, and it explicitly includes health applications within its scope. Consequently, a manuscript on late-life depression becomes more suitable for this journal when the original epidemiological survey is linked with transparent spatial data, map-based prioritization, and geoinformatics-informed interpretation rather than presented only as a conventional cross-sectional health study [2].

Recent articles in the International Journal of Geoinformatics provide a defensible methodological direction for this manuscript. GIS has been applied to health disparity mapping and health service coverage

among older adults in Thailand [3], disease surveillance and public health preparedness [4], village-level spatio-temporal disease clustering [5], geospatial modelling for disease prevention and control [6], malaria trend modelling [7], and GIS-based risk assessment of lung cancer [8]. These studies demonstrate that GIS adds publication value when it supports spatial prioritization, resource allocation, cluster recognition, and decision-making. The original study examined factors related to depression among older adults in Lat Yai Subdistrict, Samut Songkhram Province, Thailand. Its main findings indicated that age, income, marital status, income source, income adequacy, and family relationship were associated with depression. However, the original survey did not collect household coordinates or village-specific depression prevalence. This manuscript therefore uses a secondary GIS approach: official aggregate village-level older-adult service-register data are added to visualize the spatial service context for screening outreach and home-visit planning, not to infer village-level depression risk.

The objective of this manuscript is to present an IJG-ready GIS-linked version of the study by integrating the cross-sectional depression survey with official secondary spatial data. The contribution is threefold: first, it preserves the statistical findings of the original survey; second, it introduces a transparent GIS contextual analysis; and third, it produces a village-level prioritization framework for community mental-health surveillance without making unsupported claims about village-level depression prevalence.

2. Materials and Methods

2.1 Study Design and Setting

This study used a cross-sectional descriptive design with an added secondary spatial-context analysis. The primary study was conducted among older adults residing in Lat Yai Subdistrict, Mueang District, Samut Songkhram Province, Thailand. The spatial unit for the GIS extension was the village, which was selected because village-level information is available in official public health and administrative datasets. The GIS extension should be understood as a contextual enhancement. It does not replace the original individual-level survey analysis and does not infer depression prevalence for each village because the primary dataset did not contain geocoded household locations or village-disaggregated depression outcomes.

2.2 Study Population and Sample

The study population consisted of 3,428 older adults aged 60 years and above residing in Lat Yai Subdistrict. The required sample size was calculated using the Krejcie and Morgan sample size determination approach at a 95% confidence level [9]. The minimum sample size was 346, and the researchers increased the target by approximately 10% to account for incomplete responses, resulting in 380 participants. Eligible participants were older adults residing in the study area who were able to provide information through the questionnaire process. Detailed inclusion and exclusion criteria, if specified in the ethics protocol, should be inserted before journal submission.

2.3 Survey Instruments and Variables

The questionnaire consisted of four parts. The first part recorded personal characteristics, including sex, age, occupation, income, education, marital status, chronic disease, and housing status. The second part assessed economic factors, including income source and income adequacy. The third part measured family relationship using a 16-item four-point scale. Total scores were interpreted as poor, moderate, or good family relationship. The fourth part assessed depression using the Thai Geriatric Depression Scale, a 30-item instrument widely used for older adults in Thailand [10]. The depression score was classified into four levels: no depression, mild depression, moderate depression, and severe depression. Content validity was assessed by three experts, producing an item-objective congruence value of 0.94. Reliability testing was conducted with 30 older adults in a comparable area, and Cronbach's alpha was 0.72. Cronbach's alpha is reported because it remains a foundational measure of internal consistency [11].

2.4 Secondary Spatial Data and GIS Analysis

The GIS component was designed as a descriptive spatial contextualization of the survey findings. It did not derive village-level depression rates, composite risk scores, spatial clusters, or predictive surfaces. Public health data were extracted from the 3 Doctor system of the Department of Health Service Support, Ministry of Public Health, which reports village-level population and older-adult functional-status categories in Lat Yai Subdistrict, including social-bound, homebound, and bedridden groups [12]. Village location data were aligned with point locations based on the Department of Provincial Administration village-location dataset, which provides village names, administrative codes, latitude, and longitude for Thai villages [13]. Administrative boundary support can be obtained from national geospatial agencies such as GISTDA where boundary shapefiles are required for final cartographic production [14]. The spatial database

included 12 villages. For each village, total population, counts of older adults recorded in the three functional-status categories, WGS84 latitude, WGS84 longitude, and village service-unit code were entered into a GIS-ready table. The mapped variables were kept as directly interpretable official aggregate counts: registered older-adult functional-status records, defined as social-bound plus homebound plus bedridden records, and homebound or bedridden records, defined as homebound plus bedridden records. These values were not converted into a depression-risk index. A graduated point map was used because only village point coordinates were available for this secondary analysis. Symbol size represented the number of registered older-adult functional-status records, while colour intensity represented the number of homebound or bedridden older-adult records. A choropleth map was not used because village polygon boundaries and village-disaggregated depression outcomes were not available in the primary dataset.

Inferential spatial statistics were not applied to the depression outcome because the primary depression data were not geocoded or aggregated by village. The GIS output should therefore be interpreted only as a service-context map for public-health planning.

2.5 Statistical Analysis

Descriptive statistics were used to summarize demographic, economic, family, and depression variables. Categorical variables were presented as frequencies and percentages. Associations between personal or economic factors and depression level were analysed using the chi-square test. The association between family relationship score and depression score was analysed using Pearson's product-moment correlation. For the secondary GIS component, official aggregate village counts were mapped descriptively. No composite score or inferential spatial test was calculated because the available spatial layer did not contain village-level depression outcomes. The map was used only to support interpretation of potential outreach logistics and service-planning context.

2.6 Ethical Considerations

The primary survey should be reported with institutional ethical approval number, approval date, and consent procedure before submission. The secondary spatial analysis used aggregate publicly available official data and did not contain individual household coordinates or personally identifiable information.

3. Results

3.1 Characteristics of Respondents

A total of 380 older adults participated in the survey. Most respondents were female (63.95%), aged 60-70 years (56.05%), not currently employed (56.58%), had monthly income below 1,000 Thai Baht (50.79%), completed primary education (60.00%), were married (59.74%), had chronic disease (73.95%), and lived in their own home (90.79%). In terms of economic factors, most respondents received income from government welfare or related public support (49.47%), and 52.89% reported insufficient income.

3.2 Depression Level among Older Adults

Most respondents had no depression. However, 14.21% had some level of depression, including mild, moderate, or severe depression. Table 1 shows the distribution of depression levels.

3.3 Factors Associated with Depression

Age, income, marital status, income source, and income adequacy were significantly associated with depression at the 0.05 level. Sex, occupation, education, chronic disease, and housing status were not statistically associated with depression. Table 2 summarizes the association results.

3.4 Family Relationship and Depression

Family relationship was negatively correlated with depression score ($r = -0.318$, $p < 0.001$). This indicates that stronger family relationships were associated with lower depression scores. Table 3 presents the correlation result.

Table 1: Depression level among older adults in Lat Yai Subdistrict

Depression level	Number	Percentage (%)
No depression	326	85.79
Mild depression	31	8.16
Moderate depression	20	5.26
Severe depression	3	0.79

Table 2: Association between personal and economic factors and depression level

Factor	Chi-square	p-value
Sex	1.423	0.700
Age	18.704	0.028*
Occupation	17.072	0.147
Income	22.617	0.031*
Education	7.447	0.827
Marital status	26.508	0.002*
Chronic disease	4.496	0.213
Housing status	5.890	0.436
Income source	17.399	0.008*
Income adequacy	17.232	0.001*

**Statistically significant at $p < 0.05$.*

Table 3: Correlation between family relationship and depression score

Variable	Correlation coefficient	p-value
Family relationship score	-0.318**	<0.001

***Statistically significant at $p < 0.01$.*

Table 4: Official aggregate older-adult service-register counts by village in Lat Yai Subdistrict

Village no.	Village	Total population	Social-bound records	Homebound records	Bedridden records	Registered older-adult records
1	Bang Prachan	2,331	1	33	3	37
2	Sam Ruean	536	0	22	0	22
3	Suan Kaeo	3,067	0	1	1	2
4	Bang Krabun	1,297	1	0	1	2
5	Lat Yai	958	237	0	2	239
6	Tawan Chak	688	142	5	3	150
7	Bang Saphai	1,043	179	6	1	186
8	Sunak Hon	650	164	5	2	171
9	Tawan Chak Mai	820	106	2	0	108
10	Khet Mueang	1,083	206	0	0	206
11	Lat Yai 2	984	124	2	0	126
12	Ekachai	1,359	0	2	0	2

Note: Registered older-adult functional-status records were defined as social-bound plus homebound plus bedridden records. Homebound or bedridden records were used only as official aggregate service-context counts and should not be interpreted as depression prevalence.

3.5 Secondary Village-Level GIS Contextual Analysis

The official 3 Doctor village report showed 14,816 total population in Lat Yai Subdistrict and recorded 1,160 social-bound older adults, 78 homebound older adults, and 13 bedridden older adults across 12 villages (Table 4). The largest numbers of registered older-adult functional-status records were observed in Lat Yai, Khet Mueang, Bang Saphai, Sunak Hon, and Tawan Chak. The largest numbers of homebound or bedridden older-adult records were observed in Bang Prachan, Sam Ruean, Tawan Chak, Bang Saphai, and Sunak Hon (Figure 1). These observations indicate service-planning locations where screening outreach and home-visit integration may be operationally relevant; they do not indicate village-specific depression prevalence.

3.6 GIS-Linked Public Health Action Matrix

Table 5 translates the statistical and spatial findings into an action-oriented public health matrix. The table is designed for IJG reviewers by showing how the map contributes beyond simple visualization.

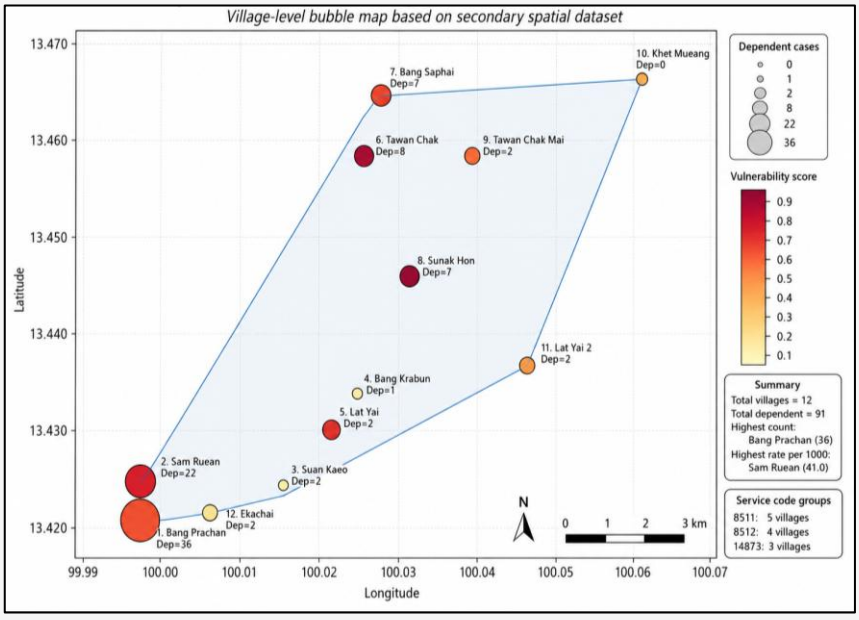

Figure 1: Spatial distribution of dependent older adults in Lat Yai

Table 5: GIS-linked interpretation and public health action matrix

Priority group or area	Evidence basis	GIS interpretation	Recommended public health action
Older adults with insufficient income	Income adequacy was significantly associated with depression	Overlay poverty-related indicators or welfare dependency when available	Prioritize mental-health screening during welfare and home-visit services
Older adults without marital support	Marital status was significantly associated with depression	Map communities with high proportion of older adults living alone when data are available	Use family and volunteer networks for psychosocial follow-up
Villages with higher homebound or bedridden service records	Secondary GIS mapping identified villages with larger homebound or bedridden service-register counts	Use the map to guide home-visit scheduling and integration of depression screening into outreach services	Integrate depression screening into homebound and bedridden older-adult care
Villages with larger registered older-adult service records	Official service-register counts identify larger older-adult service workload	Treat as service-planning areas, not causal risk zones	Allocate community health worker time, home visits, and follow-up monitoring
All villages	Family relationship was negatively correlated with depression	Map family-support resources, senior clubs, temples, and primary care access points in future studies	Design village-specific family-strengthening and social participation activities

4. Discussion

4.1 Interpretation of Survey Findings

The survey found that most older adults did not have depression, but a meaningful minority had mild, moderate, or severe depression. Statistically significant factors included age, income, marital status, income source, and income adequacy. These findings support the interpretation that late-life depression in the study area is linked to economic security, social support, and life-course vulnerability rather than only clinical morbidity. The negative correlation between family relationship and depression is particularly important for community health planning. In a Thai community context, family support often functions as a primary psychosocial resource. Therefore, depression screening should not be limited to individual symptom assessment but should also consider household support, caregiver availability, and social participation.

4.2 Geoinformatics Contribution

The key innovation of this revised manuscript is the explicit connection between survey-based depression findings and official village-level spatial service context. The GIS component does not claim that depression prevalence varies by village because the

primary survey was not geocoded. Instead, it indicates where older-adult functional-status service records and homebound or bedridden records are concentrated, which can support outreach planning, home-visit scheduling, and integration of depression screening into routine community health work. This distinction is critical for scientific credibility. A descriptive map becomes publishable in a geoinformatics journal when it has a clear decision-support function, transparent data sources, and an honest statement of analytical limits. In this manuscript, the map supports spatial prioritization for depression-related services rather than causal spatial inference.

4.3 Alignment with IJG Health Geoinformatics Literature

The manuscript is aligned with existing IJG health geoinformatics publications. The closest fit is the elderly health disparity and health center coverage study in Lahansai District, which used GIS to map older-adult health needs and service coverage [3]. The present study extends that direction into mental-health service planning by linking depression-related survey factors with official older-adult service-register context. The methodological framing also reflects IJG studies that used GIS for public health surveillance and preparedness [4], village-level disease burden and hotspot interpretation [5], disease prevention modelling [6], malaria trend modelling [7], and disease risk assessment [8]. The present study is more conservative because it does not perform cluster analysis; however, that conservatism is appropriate because depression outcomes were not available at the village level. The manuscript therefore offers a defensible middle-position contribution: it is stronger than a non-spatial community health survey, but it does not overstate itself as a full spatial epidemiological analysis. This balance should reduce reviewer concern about ecological fallacy and unsupported GIS claims.

4.4 Limitations

First, the primary survey did not record household coordinates or village-disaggregated depression outcomes. The map therefore represents official service-register context, not depression prevalence. Second, official secondary data may have different reporting dates from the primary survey. Third, the village point map does not represent exact household distribution, road-network distance, or travel barriers. Fourth, because no validated spatial index was developed, the map should be used as a descriptive planning aid rather than an inferential risk model. Future research should collect household or at least village-level survey locations, integrate road-network distance to health facilities, map senior clubs and community resources, and apply spatial-clustering methods only when sufficient geocoded outcome data are available.

5. Conclusions

This study investigated depression and associated factors among older adults in Lat Yai Subdistrict, Mueang District, Samut Songkhram Province, and integrated a GIS-based spatial contextualization to support local public health planning. The survey findings showed that 14.21% of older adults had some level of depressive symptoms. Age, monthly income, marital status, source of income, income adequacy, and family relationship were significantly associated with depression. These findings indicate that depression among older adults is not only a mental health issue but is also linked to social, economic, and household-level vulnerability. The GIS component added a spatial planning perspective by visualizing the distribution of villages with higher registered older-adult service counts and dependency-related records, particularly homebound and bedridden older adults. This spatial layer does not estimate village-level depression prevalence; rather, it identifies where routine outreach, home visits, and depression screening may be more strategically organized within the primary health-care system. By linking individual-level survey evidence with official village-level service-register data, the study provides a practical geoinformatics approach for translating mental health findings into geographically targeted service planning.

The results suggest that depression screening among older adults should be integrated with routine community-based care, especially in villages with large numbers of registered older adults and dependent older-adult service records. Local health agencies, subdistrict health-promoting hospitals, village health volunteers, and local administrative organizations can use this evidence to prioritize home visits, family-support activities, mental health surveillance, and referral pathways for older adults with socioeconomic and family-related vulnerability. Future research should collect geocoded or village-level depression outcomes together with service-accessibility variables, household socioeconomic indicators, and longitudinal follow-up data. Such data would allow stronger spatial epidemiological analysis, including hotspot detection, spatial autocorrelation testing, service accessibility modeling, and evaluation of targeted mental health interventions for ageing communities.

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