**THE JOURNAL OF WORLD WOMEN STUDIES| ISSN 2717-7211**

**Research Article**

**Submission**: 30.08.2026| **Acceptance**: 30.09.2026| **Volume**: 11, **Issue**: 3| **pp**: 424 - 439| **Doi**: http://doi.org/10.5281/zenodo.23560347

# Association Between Loneliness and Nutrition Literacy Among Adults Aged 65–74 Receiving Institutional Care

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**Abstract**

In institutional care, nutrition practices are shaped by mealtime arrangements, while residents' nutrition-related knowledge, attitudes, and behaviors remain relevant. This study examined the association between overall loneliness and nutrition literacy among residents aged 65–74 and whether social and emotional loneliness showed different patterns of association with the five nutrition literacy subscales and the total score. In this cross-sectional study, 142 residents of three private care facilities in Isparta, Türkiye, were recruited by convenience sampling between November and December 2025. The Loneliness Scale for Elderly and the Nutrition Literacy Scale for Early-Stage Older Adults were administered in face-to-face interviews. Associations were examined using Spearman correlations with Benjamini–Hochberg correction and hierarchical multiple linear regression adjusted for sociodemographic covariates; social and emotional loneliness were entered jointly in exploratory models. Total loneliness was negatively associated with total nutrition literacy ($r_s = -0.335$), including after adjustment, although the additional variance explained was small ($\beta = -0.187$; $\Delta R^2 = 0.028$). Social loneliness was negatively correlated with all subscales and the total score and remained negatively associated with nutrition attitude, nutrition behavior, and the total score in adjusted models. Emotional loneliness was negatively correlated only with the knowledge-based subscales, whereas its conditional coefficients were positive in the joint adjusted models. These results were unchanged in sensitivity analyses using bootstrap confidence intervals and heteroscedasticity-consistent standard errors. The findings indicate that loneliness dimensions should be examined separately, as the total score may obscure opposing associations. The cross-sectional design precludes causal inference, and multicenter longitudinal studies are needed.

**Keywords:** Institutional Care, Loneliness, Nutrition Literacy, Older Adults, Social Loneliness

# Kurumsal Bakım Hizmeti Alan Erken Dönem Yaşlılarda (65–74 Yaş) Yalnızlık ile Beslenme Okuryazarlığı Arasındaki İlişki

**Özet**

Kurumsal bakım ortamında beslenme uygulamaları kurumun öğün düzeni tarafından şekillenirken sakinlerin beslenmeyle ilgili bilgi, tutum ve davranışları önemini korumaktadır. Bu çalışmada 65–74 yaşındaki kurum sakinlerinde toplam yalnızlık ile beslenme okuryazarlığı arasındaki ilişki ve sosyal ile duygusal yalnızlığın beslenme okuryazarlığının beş alt boyutu ve toplam puanıyla farklı ilişki örüntüleri gösterip göstermediği incelenmiştir. Kesitsel nitelikteki araştırmaya Kasım–Aralık 2025 döneminde Isparta'daki üç özel bakım kuruluşunda yaşayan ve kolayda örnekleme ile ulaşılan 142 birey katılmıştır. Yaşlılar İçin Yalnızlık Ölçeği ve Erken Dönem Yaşlılarda Beslenme Okuryazarlığı Ölçeği yüz yüze görüşmelerle uygulanmıştır. İlişkiler Benjamini–Hochberg düzeltmeli Spearman korelasyonu ve sosyodemografik değişkenlere göre düzeltilmiş hiyerarşik çoklu doğrusal regresyonla incelenmiş; keşfedici modellerde sosyal ve duygusal yalnızlık birlikte değerlendirilmiştir. Toplam yalnızlık, toplam beslenme okuryazarlığıyla negatif ilişkili bulunmuş ($r_s = -0.335$) ve ilişki düzeltme sonrasında da sürmüş, ancak açıklanan ek varyans sınırlı kalmıştır ($\beta = -0.187$; $\Delta R^2 = 0.028$). Sosyal yalnızlık tüm alt boyutlar ve toplam puanla negatif korelasyon göstermiş; beslenme tutumu, beslenme davranışı ve toplam puanla negatif ilişkisi düzeltilmiş modellerde de sürmüştür. Duygusal yalnızlık yalnızca bilgiye dayalı alt boyutlarla negatif korelasyon gösterirken ortak düzeltilmiş modellerdeki koşullu katsayıları pozitif bulunmuştur. Bu sonuçlar, bootstrap güven aralıkları ve heteroskedasiteye dayanıklı standart hatalarla yapılan duyarlılık analizlerinde değişmemiştir. Bulgular, toplam puanın zıt yönlü ilişkileri gizleyebileceğini ve yalnızlık boyutlarının ayrı ayrı incelenmesi gerektiğini göstermektedir. Kesitsel tasarım nedensel çıkarıma izin vermemekte olup çok merkezli boylamsal çalışmalara ihtiyaç vardır.

**Anahtar Kelimeler:** Beslenme Okuryazarlığı, Kurumsal Bakım, Sosyal Yalnızlık, Yaşlı Bireyler, Yalnızlık

## INTRODUCTION

Daily routines in institutional care, including meals, develop within the facility's care arrangements and residents' relationships with one another. Nutrition contributes to the maintenance of muscle mass and function in older age and has implications for frailty and functional capacity (Volkert et al., 2024). Meals also form part of residents' social lives. Drawing on interviews with care home residents, Watkins et al. (2017) described how mealtime experiences involved interpersonal bonds, familiar routines, and efforts to accommodate differing preferences when resources were limited. Their findings also emphasized residents' preferences and autonomy. Morrison-Koechl et al. (2021) reported lower energy intake among long-term care residents with less social engagement; however, accounting for eating difficulties removed the statistical significance of this relationship. In a different care context, interviews with attendees of adult day centers suggested that eating together could encourage participation and strengthen feelings of connection and community (Avraham et al., 2025). These centers offer daytime services rather than residential care, which limits direct comparison with care homes. Taken together, these studies suggest that nutrition research in institutional care should consider both residents' social relationships and how they experience them.

Evaluating social relationships requires distinguishing the objective level of interaction from how individuals experience those relationships. Loneliness is a subjective experience of lacking meaningful social connections or a close relationship, whereas social isolation refers to objectively limited interaction with others or the wider community (Hanna et al., 2023). Following Weiss's (1973) distinction, emotional loneliness reflects the absence of a close attachment, while social loneliness reflects an insufficient social network. De Jong Gierveld and Kamphuis (1985) operationalized this distinction in a loneliness scale with separate emotional and social components, and these dimensions are assessed separately in its Turkish version of the Loneliness Scale for Elderly (LSE) (Akgül & Yeşilyaprak, 2015). This distinction is important in institutional care because sharing living spaces may not meet individuals' needs for intimacy and belonging. Berkman et al. (2000) proposed that social networks may influence health through social support, social influence, social engagement and attachment, and access to resources and material goods. This model provides a conceptual basis for examining whether social and emotional loneliness have different associations with nutrition-related knowledge, attitudes, and behaviors.

Nutrition literacy is an important concept in assessing nutrition-related knowledge, attitudes, and behaviors. As a nutrition-specific form of health literacy, its definitions primarily emphasize the ability to obtain and understand nutrition information. Food literacy has a broader scope, encompassing the application of information to food choices and critical consideration of their effects on personal health and society (Krause et al., 2018). The Nutrition Literacy Scale for Early-Stage Older Adults (NLS-E), used in this study, was developed for adults aged 65–74 and comprises five subscales: general nutrition knowledge, food groups, food label reading, nutrition attitude, and nutrition behavior (Karademir, 2023). The study's age range was selected to match the population for which the scale was developed. In institutional care, mealtime arrangements and available options may limit residents' autonomy in food choices (Watkins et al., 2017). Although understanding nutrition information and expressing preferences remain relevant in these settings, the attitudes and behaviors assessed should be interpreted in light of the opportunities available within the facility.

These contextual differences are also important when interpreting studies of loneliness, the social environment, and nutrition. A scoping review linked loneliness or social isolation to lower fruit and vegetable consumption and poorer diet quality, but excluded people living in institutions where meals were provided (Hanna et al., 2023). Caution is therefore needed when applying these findings to care settings where institutional arrangements shape mealtime routines and opportunities for individual choice (Watkins et al., 2017). Among community-dwelling older adults, social isolation and loneliness were independently associated with malnutrition risk (Boulos et al., 2017). Another study involving middle-aged and older adults associated a low-support social environment profile with greater nutritional risk (Ingham et al., 2023). Qualitative findings also link experiences of loneliness to food choices, cooking routines, and the meaning of shared meals (Freire Paz et al., 2025). However, associations are not consistent across nutritional outcomes. A study in England found that social isolation was associated with inadequate intake of several micronutrients assessed two years later, whereas no corresponding association was identified for loneliness (Steptoe et al., 2024). In institutional care, a meta-analysis estimated the mean prevalence of moderate and severe loneliness at 61% and 35%,

respectively, while reporting substantial variation between studies (Gardiner et al., 2020). Although these studies address dietary intake, nutritional risk, and mealtime experiences, they do not directly establish how social and emotional loneliness relate to multidimensional nutrition literacy among adults aged 65–74 receiving institutional care.

Against this background, the primary aim of this study was to examine the association between the total scores of the Loneliness Scale for Elderly and the Nutrition Literacy Scale for Early-Stage Older Adults among adults aged 65–74 receiving institutional care. It was hypothesized that higher loneliness scores would be associated with lower nutrition literacy scores. The secondary aim was to examine whether social and emotional loneliness showed different patterns of association with general nutrition knowledge, food groups, food label reading, nutrition attitude, nutrition behavior, and the total nutrition literacy score. The study focused on nutrition literacy, encompassing nutrition-related knowledge, attitudes, and self-reported behaviors, and did not directly assess dietary intake or nutritional status.

## MATERIAL AND METHOD

### Study Design And Setting

A cross-sectional, descriptive-correlational design was used to investigate residents of three private facilities offering residential care for older adults in Isparta, Türkiye. Fieldwork took place in November and December 2025. The facilities comprised two urban sites in the city center and one rural site. Of the 142 participants, 70 were recruited from the two urban facilities and 72 from the rural facility. The researcher administered the structured questionnaire individually to participants during face-to-face interviews.

### Participants and Sample Size

Recruitment used convenience sampling among residents accessible at the three facilities during fieldwork. Eligibility required an age of 65–74 years, residence in a participating facility, sufficient ability to understand and answer the questionnaire in a face-to-face interview, and voluntary agreement to participate under the approved informed consent procedure. Before administering the questionnaire, the researcher held a brief interview to assess whether each resident could understand and answer the questions. This assessment did not involve a standardized cognitive screening tool. Only residents meeting every eligibility criterion were enrolled. The restriction to ages 65–74 matched the population in which the Nutrition Literacy Scale for Early-Stage Older Adults (NLS-E) had been developed and validated (Karademir, 2023).

Before recruitment began, an a priori calculation in G*Power 3.1.9.4 established the sample size needed for the planned correlation analysis (Faul et al., 2009). A two-tailed bivariate correlation test was specified with an anticipated correlation of $r = 0.30$, $\alpha = 0.05$, and power of 0.95. These settings yielded a minimum sample of 138 participants. Allowing for possible missing data, recruitment aimed to include at least 140 residents; the final sample comprised 142.

### Data Collection Instruments

The questionnaire brought together three instruments: a personal information form, the Loneliness Scale for Elderly (LSE; Akgül & Yeşilyaprak, 2015), and the Nutrition Literacy Scale for Early-Stage Older Adults (NLS-E; Karademir, 2023).

### Personal Information Form

Participants reported their age, occupation, educational attainment, marital status, perceived income level, sex (female or male), and residential area (rural or urban). Marital status was recorded using four separate response options: married, single (never married), widowed, and divorced. When asking about “Place of Residence (Rural–Urban),” the researcher clarified that the question concerned where participants had lived before entering institutional care. Rural or urban residence was therefore recorded from participants’ own accounts of their pre-admission living area, rather than from the location of their current care facility.

## Loneliness Scale For Elderly

The LSE was originally developed by de Jong Gierveld and Kamphuis (1985); its Turkish version comprises 11 items with the response options "Yes," "More or less," and "No" and assesses social and emotional loneliness. For the positively worded social loneliness items (1, 4, 7, 8, and 11), these responses are scored 0, 1, and 2, respectively. For the negatively worded emotional loneliness items (2, 3, 5, 6, 9, and 10), they are scored 2, 1, and 0, respectively (Akgül & Yeşilyaprak, 2015). Social loneliness scores range from 0 to 10, emotional loneliness scores from 0 to 12, and total loneliness scores from 0 to 22. The total score is obtained by summing the two subscale scores, with higher scores indicating greater loneliness. For descriptive purposes, total scores were classified as no loneliness (0–4), acceptable loneliness (5–14), very lonely (15–18), and very intense loneliness (19–22) (Akgül, 2016, p. 116).

In the Turkish adaptation study, Cronbach's alpha coefficients were 0.79 for emotional loneliness, 0.81 for social loneliness, and 0.85 for the overall scale (Akgül & Yeşilyaprak, 2015). In the present study, the corresponding coefficients were 0.806 ($n$ = 142), 0.844 ($n$ = 141), and 0.848 ($n$ = 141). Social loneliness, emotional loneliness, and total loneliness scores were used in the analyses.

## Nutrition Literacy Scale For Early-Stage Older Adults

The NLS-E (original Turkish name: Erken Dönem Yaşlılarda Beslenme Okuryazarlığı Ölçeği) was developed by Karademir for adults aged 65–74. It comprises 45 items across five subscales: general nutrition knowledge (10 items), food groups (10 items), food label reading (5 items), nutrition attitude (10 items), and nutrition behavior (10 items) (Karademir, 2023).

General nutrition knowledge items have the response options "True," "False," and "Do not know." Correct responses receive 1 point, whereas incorrect and "Do not know" responses receive 0. Food groups and food label reading items are also scored as correct (1) or incorrect (0). Nutrition attitude and nutrition behavior items use five-point Likert-type response options and are scored from 1 to 5 after negatively worded items are reverse-coded. Higher scores indicate more favorable nutrition attitudes and behaviors.

Scores range from 0 to 10 for general nutrition knowledge and food groups, from 0 to 5 for food label reading, and from 10 to 50 for nutrition attitude and nutrition behavior. The total score is obtained by summing the five subscale scores and ranges from 20 to 125, with higher scores indicating higher nutrition literacy. According to the developer's quartile-based classification, general nutrition knowledge and food groups scores are categorized as inadequate (<5) or adequate (≥5), and food label reading scores as inadequate (<2.5) or adequate (≥2.5). Nutrition attitude scores (<36, 36–43, >43), nutrition behavior scores (<26, 26–36, >36), and total scores (<82, 82–99, >99) are categorized as inadequate, partially adequate, and adequate, respectively (Karademir, 2023). These classifications were used for descriptive purposes in the present study.

In the scale-development study, Cronbach's alpha coefficients were 0.738, 0.897, 0.788, 0.770, and 0.819 for general nutrition knowledge, food groups, food label reading, nutrition attitude, and nutrition behavior, respectively, and 0.825 for the overall scale (Karademir, 2023). In the present study, KR-20 coefficients were 0.825 for general nutrition knowledge, 0.741 for food groups, and 0.549 for food label reading. Cronbach's alpha coefficients were 0.868 for nutrition attitude, 0.890 for nutrition behavior, and 0.918 for the overall scale ($n$ = 142 for all reliability analyses).

## Ethics Approval And Informed Consent

The study was conducted in accordance with the Declaration of Helsinki and approved by the Health Sciences Ethics Committee of Süleyman Demirel University (approval date: 3 November 2025; Meeting No. 105; Decision No. 55). The management of each participating facility authorized data collection. Before answering the questionnaire, residents received the ethics committee-approved voluntary participation form. The researcher explained what participation involved, why the research was being conducted, how responses would be kept confidential, and that residents could decline or withdraw without adverse consequences. Under the procedure approved by the ethics committee, informed consent consisted of residents voluntarily agreeing to answer the questionnaire. Data were anonymized and held in confidential storage for scientific use only.

## Statistical Analysis

IBM SPSS Statistics 31.0 (IBM Corp., Armonk, NY, USA) was used for the analyses. Descriptive summaries included means and standard deviations, medians, and minimum and maximum values for continuous variables, and counts with percentages for categorical variables. The Shapiro–Wilk test was used to examine score distributions. Reliability calculations followed the scoring structure of the instruments: Cronbach's alpha was calculated for the LSE total and subscale scores, the NLS-E nutrition attitude and nutrition behavior subscales, and the NLS-E as a whole. For the three NLS-E subscales with binary scoring—general nutrition knowledge, food groups, and food label reading—internal consistency was estimated using KR-20.

A single unanswered item (Item 8 of the LSE) prevented calculation of social and total loneliness scores for one resident. Analyses requiring either score therefore used 141 participants. The emotional loneliness score and every NLS-E score were complete for all 142 residents. No values were substituted for the missing response.

Departures from normality in the score distributions informed the choice of Spearman's rank correlation. Each of the three loneliness scores—social, emotional, and total—was examined against the five NLS-E subscale scores and the total nutrition literacy score. The resulting 18 tests formed a single family to which the Benjamini–Hochberg procedure was applied for false discovery rate control (Benjamini & Hochberg, 1995).

Hierarchical multiple linear regression was used to estimate adjusted associations. In the model for total nutrition literacy, the first block comprised age, sex, educational attainment, marital status, perceived income level, and residential area before institutional admission. Total LSE score was then added in the second block. Three further models examined nutrition attitude, nutrition behavior, and total NLS-E score using the same first-block covariates, followed by both social and emotional loneliness scores in the second block. Including the two dimensions together provided an estimate for each dimension conditional on the other. General nutrition knowledge, food groups, and food label reading were examined through Spearman correlations without adjusted linear models, given their restricted, bounded scoring ranges. Models containing both loneliness dimensions were exploratory; no further adjustment for multiple testing was made for these three models.

Age was included as a continuous covariate. The remaining covariates used two-category coding, with female sex, primary school education or below, unmarried status, low perceived income, and pre-admission rural residence serving as the reference groups. The corresponding comparison groups were male sex, secondary school education or above, married status, moderate or high perceived income, and pre-admission urban residence. Linearity and homoscedasticity were assessed using residual plots, residual normality using Q–Q plots, influential observations using standardized residuals, Cook's distance, and leverage values, and multicollinearity using variance inflation factors together with the Spearman correlation between social and emotional loneliness. Homoscedasticity was additionally tested using the Breusch–Pagan test, and residual normality using the Shapiro–Wilk test. Because several score distributions departed from normality, two sensitivity analyses were conducted for all regression models: 95% bias-corrected and accelerated (BCa) confidence intervals were obtained from 5,000 nonparametric bootstrap resamples, and heteroscedasticity-consistent standard errors (HC3) were estimated (Efron & Tibshirani, 1993; Long & Ervin, 2000). The models were also re-estimated after excluding observations with Cook's distance values greater than 4/n. Regression results were reported as unstandardized coefficients ($B$) with 95% confidence intervals, standardized coefficients (β), $R^2$, adjusted $R^2$, $\Delta R^2$, $F$, and $p$ values. All tests were two-sided. Statistical significance was defined as a Benjamini–Hochberg-adjusted $p < 0.05$ for the correlation analyses and an unadjusted $p < 0.05$ for the other analyses.

# RESULTS

## Participant Characteristics

A total of 142 adults aged 65–74 receiving institutional care participated in the study. Their mean age was 69.12 ± 3.01 years. Of the participants, 52.1% were male, 67.6% were primary school graduates, and 81.7% reported a low perceived income level. Before admission to institutional care, 66.2% had lived in an urban area. Single (never-married) participants constituted the largest marital status category (45.1%). Participants' sociodemographic characteristics are presented in Table 1.

**Table 1.** Sociodemographic characteristics of the participants (*N* = 142)

| Characteristic | Category/statistic | *n* (%) or value |
|---|---|---|
| Age, years | Mean ± SD | 69.12 ± 3.01 |
| | Median | 69 |
| | Minimum–maximum | 65–74 |
| Sex | Female | 68 (47.9) |
| | Male | 74 (52.1) |
| Educational attainment | Not literate | 1 (0.7) |
| | Primary school | 96 (67.6) |
| | Secondary school | 9 (6.3) |
| | High school | 17 (12.0) |
| | Bachelor's degree | 19 (13.4) |
| Reported occupation | Homemaker | 50 (35.2) |
| | Self-employed | 31 (21.8) |
| | Farmer | 11 (7.7) |
| | Other[a] | 50 (35.2) |
| Pre-admission residential area[b] | Rural | 48 (33.8) |
| | Urban | 94 (66.2) |
| Perceived income level | Low | 116 (81.7) |
| | Moderate | 17 (12.0) |
| | High | 9 (6.3) |
| Marital status | Married | 41 (28.9) |
| | Single (never married) | 64 (45.1) |
| | Widowed | 36 (25.4) |
| | Divorced | 1 (0.7) |

*Note.* Categorical variables are presented as *n* (%); age is presented as mean ± SD, median, and minimum–maximum values. Percentages may not total 100 because of rounding. SD = standard deviation.
[a] "Other" includes teachers (*n* = 9), nurses (*n* = 5), and 27 different occupations or employment statuses, each reported by one or two participants.
[b] Pre-admission residential area refers to the rural or urban area in which participants reported living before admission to institutional care; it does not indicate the location of the care facility.

## Descriptive Statistics And Internal Consistency

One participant did not respond to item 8 of the LSE; therefore, social loneliness and total loneliness scores were calculated for 141 participants. Emotional loneliness and all NLS-E scores were available for all 142 participants. The mean total LSE and NLS-E scores were 9.70 ± 5.82 and 84.10 ± 18.49, respectively. Cronbach's alpha coefficients for the LSE subscales and overall scale ranged from 0.806 to 0.848. Internal consistency coefficients for the NLS-E subscales and overall scale ranged from 0.549 to 0.918, with the lowest coefficient observed for food label reading (KR-20 = 0.549) and the highest for the overall scale ($\alpha = 0.918$). Descriptive statistics and internal consistency coefficients are presented in Table 2. Scores for food groups and food label reading clustered near the upper limits of their ranges: 39.4% of participants obtained the maximum food groups score and 62.7% scored 9 or 10, while 51.4% obtained the maximum food label reading score (skewness = −1.95 and −0.82, respectively).

**Table 2.** Descriptive statistics and internal consistency coefficients for the study measures

| Scale/subscale (*n*) | Mean ± SD | Median (minimum–maximum) | Coefficient (no. of items) |
|---|---|---|---|
| LSE—Social loneliness (*n* = 141) | 3.65 ± 3.24 | 3 (0–10) | α = 0.844 (5) |
| LSE—Emotional loneliness (*n* = 142) | 6.00 ± 3.66 | 6 (0–12) | α = 0.806 (6) |
| LSE—Total score (*n* = 141) | 9.70 ± 5.82 | 9 (0–22) | α = 0.848 (11) |
| NLS-E—General nutrition knowledge (*n* = 142) | 5.86 ± 3.02 | 6 (0–10) | KR-20 = 0.825 (10) |
| NLS-E—Food groups (*n* = 142) | 8.60 ± 1.81 | 9 (2–10) | KR-20 = 0.741 (10) |
| NLS-E—Food label reading (*n* = 142) | 4.02 ± 1.18 | 5 (1–5) | KR-20 = 0.549 (5) |
| NLS-E—Nutrition attitude (*n* = 142) | 37.71 ± 7.32 | 38 (18–50) | α = 0.868 (10) |
| NLS-E—Nutrition behavior (*n* = 142) | 27.91 ± 9.79 | 28 (10–50) | α = 0.890 (10) |
| NLS-E—Total score (*n* = 142) | 84.10 ± 18.49 | 85 (39–125) | α = 0.918 (45) |

*Note.* LSE = Loneliness Scale for Elderly; NLS-E = Nutrition Literacy Scale for Early-Stage Older Adults; *n* = number of participants; SD = standard deviation; α = Cronbach's alpha; KR-20 = Kuder–Richardson Formula 20. Minimum–maximum values represent the observed score ranges. Values in parentheses in the final column indicate the number of items included in each internal consistency analysis. Social loneliness and total loneliness scores were calculated for 141 participants because one participant did not respond to item 8 of the LSE.

## Loneliness and Nutrition Literacy Score Classifications

Among the 141 participants with available total LSE scores, the scale-defined acceptable loneliness category was the most common (55.3%), followed by no loneliness (20.6%), very lonely (17.0%), and very intense loneliness (7.1%) (Table 3, Panel A). Based on total NLS-E scores, 41.5% of participants were classified as having inadequate, 34.5% partially adequate, and 23.9% adequate nutrition literacy (Table 3, Panel B). The proportions classified as adequate were 93.0% for food groups, 85.2% for food label reading, and 66.2% for general nutrition knowledge. Partially adequate was the most common category for nutrition attitude (45.1%), whereas the proportions classified as inadequate (41.5%) and partially adequate (40.1%) for nutrition behavior were similar.

**Table 3.** Distribution of participants by loneliness and nutrition literacy score classifications

Panel A. Total loneliness score classifications (*n* = 141)

| Measure | No loneliness, *n* (%) (0–4) | Acceptable loneliness, *n* (%) (5–14) | Very lonely, *n* (%) (15–18) | Very intense loneliness, *n* (%) (19–22) |
|---|---|---|---|---|
| LSE total score | 29 (20.6) | 78 (55.3) | 24 (17.0) | 10 (7.1) |

**Panel B. Nutrition literacy score classifications (*n* = 142)**

| Scale/subscale | Inadequate, *n* (%) [score] | Partially adequate, *n* (%) [score] | Adequate, *n* (%) [score] |
|---|---|---|---|
| General nutrition knowledge | 48 (33.8) [<5] | — | 94 (66.2) [≥5] |
| Food groups | 10 (7.0) [<5] | — | 132 (93.0) [≥5] |
| Food label reading | 21 (14.8) [<2.5] | — | 121 (85.2) [≥2.5] |
| Nutrition attitude | 43 (30.3) [<36] | 64 (45.1) [36–43] | 35 (24.6) [>43] |
| Nutrition behavior | 59 (41.5) [<26] | 57 (40.1) [26–36] | 26 (18.3) [>36] |
| NLS-E total score | 59 (41.5) [<82] | 49 (34.5) [82–99] | 34 (23.9) [>99] |

*Note.* LSE = Loneliness Scale for Elderly; NLS-E = Nutrition Literacy Scale for Early-Stage Older Adults; *n* = number of participants. Classifications follow the score boundaries specified in the respective sources (Akgül, 2016; Karademir, 2023). Score ranges for loneliness categories are shown in parentheses in Panel A, and score boundaries for nutrition literacy categories are shown in square brackets in Panel B. An em dash indicates that a partially adequate category is not defined for the corresponding subscale. Percentages may not total 100 because of rounding. These classifications were used for descriptive purposes.

## Associations Between Loneliness And Nutrition Literacy Scores

Social loneliness was negatively correlated with all five NLS-E subscale scores and the total score ($r_s = -0.523$ to $-0.318$; all $p < 0.001$; $n = 141$). The largest correlation in absolute magnitude was observed for food label reading ($r_s = -0.523$). Emotional loneliness was negatively correlated with

general nutrition knowledge, food groups, and food label reading scores ($r_s$ = −0.393 to −0.293; all $p$ < 0.001; $n$ = 142). No statistically significant associations were identified between emotional loneliness and nutrition attitude, nutrition behavior, or the NLS-E total score (all $p \geq 0.05$).

The LSE total score was negatively correlated with all five NLS-E subscale scores and the total score ($r_s$ = −0.551 to −0.230; all $p \leq 0.006$; $n$ = 141). The largest correlation in absolute magnitude was again observed for food label reading ($r_s$ = −0.551). Following Benjamini–Hochberg false discovery rate correction, all 15 correlations that were significant in the unadjusted analyses remained statistically significant (all adjusted $p \leq 0.0074$; Table 4).

**Table 4.** Spearman correlations between loneliness and nutrition literacy scores

| NLS-E measure | Social loneliness, $r_s$ ($p$) ($n$ = 141) | Emotional loneliness, $r_s$ ($p$) ($n$ = 142) | LSE total score, $r_s$ ($p$) ($n$ = 141) |
|---|---|---|---|
| General nutrition knowledge | −0.481 (<0.001) | −0.338 (<0.001) | −0.489 (<0.001) |
| Food groups | −0.318 (<0.001) | −0.293 (<0.001) | −0.346 (<0.001) |
| Food label reading | −0.523 (<0.001) | −0.393 (<0.001) | −0.551 (<0.001) |
| Nutrition attitude | −0.447 (<0.001) | 0.016 (0.846) | −0.246 (0.003) |
| Nutrition behavior | −0.333 (<0.001) | −0.045 (0.598) | −0.230 (0.006) |
| NLS-E total score | −0.465 (<0.001) | −0.106 (0.209) | −0.335 (<0.001) |

*Note.* LSE = Loneliness Scale for Elderly; NLS-E = Nutrition Literacy Scale for Early-Stage Older Adults; $n$ = number of participants; $r_s$ = Spearman rank correlation coefficient. Unadjusted two-sided $p$ values are shown in parentheses. The Benjamini–Hochberg false discovery rate procedure was applied to the 18 correlations as a single family of tests. All 15 correlations that were significant in the unadjusted analyses remained statistically significant after correction (all adjusted $p \leq$ 0.0074).

## Hierarchical Regression Models of Loneliness and Nutrition Literacy

In the total-score model, the LSE total score was negatively associated with the NLS-E total score after adjustment for age, sex, educational attainment, marital status, perceived income level, and pre-admission residential area ($B$ = −0.595, 95% CI [−1.088, −0.102], β = −0.187, $p$ = 0.018). Adding the LSE total score in Block 2 increased the explained variance by 2.8 percentage points ($\Delta R^2$ = 0.028, $p$ = 0.018). The final model was statistically significant and explained 33.5% of the variance in the NLS-E total score ($R^2$ = 0.335, adjusted $R^2$ = 0.300, $F$(7, 133) = 9.558, $p$ < 0.001; Table 5, Panel A).

In the exploratory dimension-level models, social and emotional loneliness were entered jointly in Block 2. Social loneliness was negatively associated with nutrition attitude, nutrition behavior, and the NLS-E total score (β = −0.590 to −0.404; all $p$ < 0.001). Adding the two loneliness dimensions increased the explained variance by 25.3, 13.3, and 20.1 percentage points for nutrition attitude, nutrition behavior, and the NLS-E total score, respectively ($\Delta R^2$ = 0.253, 0.133, and 0.201, respectively; all $p$ < 0.001).

After adjustment for social loneliness and the sociodemographic covariates, emotional loneliness was positively associated with nutrition attitude, nutrition behavior, and the NLS-E total score (β = 0.277–0.355; all $p$ < 0.001). These coefficients represent conditional associations estimated with social and emotional loneliness entered jointly and should not be interpreted as unadjusted associations.

The final models explained 42.7% of the variance in nutrition attitude ($R^2$ = 0.427, adjusted $R^2$ = 0.392), 36.0% of the variance in nutrition behavior ($R^2$ = 0.360, adjusted $R^2$ = 0.322), and 50.7% of the variance in the NLS-E total score ($R^2$ = 0.507, adjusted $R^2$ = 0.477). All three models were statistically significant ($F$(8, 132) = 12.291, 9.297, and 16.960, respectively; all $p$ < 0.001). Among the sociodemographic covariates, pre-admission urban residence was positively associated with all three outcomes, whereas moderate or high perceived income was positively associated only with the NLS-E total score. None of the other sociodemographic coefficients was statistically significant in these three final models (Table 5, Panel B).

Social and emotional loneliness were moderately correlated ($r_s$ = 0.427; $p$ < 0.001; $n$ = 141). Variance inflation factors ranged from 1.04 to 1.98 in the total-score model (LSE total score: 1.23) and from 1.05 to 2.00 in the dimension-level models (social loneliness: 1.46; emotional loneliness: 1.38), indicating no problematic multicollinearity. Although several observed score distributions departed from normality, the residuals of all four final models were approximately normally distributed (Shapiro–

Wilk $p$ = 0.369–0.637; skewness = 0.05–0.35; excess kurtosis = −0.36 to 0.67), and the Breusch–Pagan test did not indicate heteroscedasticity ($p$ = 0.089–0.694). No Cook's distance value exceeded 0.09, and the maximum centered leverage value was 0.128. One standardized residual exceeded ±3 (nutrition behavior model; 3.61); excluding this observation did not materially change the loneliness coefficients (social loneliness: $B$ = −1.216; emotional loneliness: $B$ = 0.920; both $p$ < 0.001).

In the sensitivity analyses, all loneliness coefficients retained their direction and statistical significance. In the total-score model, the BCa bootstrap 95% CI for the LSE total score was [−1.064, −0.183], and the HC3-based $p$ value was 0.010. In the dimension-level models, the BCa 95% CIs for social loneliness were [−1.686, −0.946], [−1.725, −0.780], and [−3.940, −2.279], and those for emotional loneliness were [0.411, 0.968], [0.440, 1.232], and [0.678, 2.062] for nutrition attitude, nutrition behavior, and the NLS-E total score, respectively (all HC3-based $p$ < 0.001). Pre-admission urban residence also remained statistically significant in all models. Excluding observations with Cook's distance > 4/n did not alter the direction or significance of the loneliness coefficients (e.g., LSE total score: $B$ = −0.524; $p$ = 0.028).

**Table 5.** Hierarchical multiple linear regression models of the associations between loneliness and nutrition literacy scores ($n$ = 141)

Panel A. Total-score model

| **Outcome/model** | **Variable** | **Regression coefficients** | | | |
|---|---|---|---|---|---|
| | | ***B*** | **95% CI** | **β** | ***p*** |
| NLS-E total score | Age, years | −0.242 | [−1.115, 0.632] | −0.039 | 0.585 |
| | Sex: male | −1.748 | [−7.041, 3.544] | −0.047 | 0.515 |
| | Education: secondary school or above | −1.093 | [−8.900, 6.714] | −0.028 | 0.782 |
| | Marital status: married | −2.521 | [−8.850, 3.807] | −0.062 | 0.432 |
| | Perceived income: moderate or high | 7.030 | [−1.988, 16.047] | 0.147 | 0.125 |
| | Pre-admission residential area: urban | 16.513 | [10.053, 22.972] | 0.423 | **<0.001** |
| | LSE total score | −0.595 | [−1.088, −0.102] | −0.187 | **0.018** |
| *Model summary* | $R^2$ = 0.335; adjusted $R^2$ = 0.300; $\Delta R^2$ = 0.028 ($p$ = 0.018); $F$(7, 133) = 9.558; $p$ < 0.001. | | | | |

Panel B. Models incorporating loneliness dimensions

| **Outcome/model** | **Variable** | **Regression coefficients** | | | |
|---|---|---|---|---|---|
| | | ***B*** | **95% CI** | **β** | ***p*** |
| **Nutrition attitude** | Social loneliness | −1.341 | [−1.698, −0.983] | −0.590 | **<0.001** |
| | Emotional loneliness | 0.717 | [0.407, 1.026] | 0.355 | **<0.001** |
| | Age, years | −0.236 | [−0.560, 0.088] | −0.097 | 0.152 |
| | Sex: male | −0.186 | [−2.143, 1.770] | −0.013 | 0.851 |
| | Education: secondary school or above | −0.608 | [−3.504, 2.287] | −0.039 | 0.679 |
| | Marital status: married | 0.325 | [−2.086, 2.736] | 0.020 | 0.790 |
| | Perceived income: moderate or high | 2.779 | [−0.577, 6.135] | 0.147 | 0.104 |
| | Pre-admission residential area: urban | 3.519 | [1.112, 5.925] | 0.228 | **0.004** |
| *Model summary* | $R^2$ = 0.427; adjusted $R^2$ = 0.392; $\Delta R^2$ = 0.253 ($p$ < 0.001); $F$(8, 132) = 12.291; $p$ < 0.001. | | | | |
| **Nutrition behavior** | Social loneliness | −1.225 | [−1.729, −0.720] | −0.404 | **<0.001** |
| | Emotional loneliness | 0.846 | [0.409, 1.282] | 0.313 | **<0.001** |
| | Age, years | −0.378 | [−0.835, 0.079] | −0.116 | 0.104 |
| | Sex: male | −0.191 | [−2.953, 2.570] | −0.010 | 0.891 |
| | Education: secondary school or above | −2.764 | [−6.850, 1.321] | −0.132 | 0.183 |
| | Marital status: married | 2.486 | [−0.916, 5.888] | 0.115 | 0.151 |

| | | | | | |
|---|---|---|---|---|---|
| | Perceived income: moderate or high | 4.126 | [−0.610, 8.861] | 0.164 | 0.087 |
| | Pre-admission residential area: urban | 7.765 | [4.369, 11.160] | 0.376 | **<0.001** |
| *Model summary* | $R^2$ = 0.360; adjusted $R^2$ = 0.322; $\Delta R^2$ = 0.133 ($p$ < 0.001); $F$(8, 132) = 9.297; $p$ < 0.001. | | | | |
| **NLS-E total score** | Social loneliness | −3.068 | [−3.906, −2.231] | −0.535 | **<0.001** |
| | Emotional loneliness | 1.416 | [0.691, 2.140] | 0.277 | **<0.001** |
| | Age, years | −0.483 | [−1.241, 0.275] | −0.079 | 0.210 |
| | Sex: male | −0.795 | [−5.377, 3.787] | −0.021 | 0.732 |
| | Education: secondary school or above | −3.375 | [−10.155, 3.404] | −0.085 | 0.327 |
| | Marital status: married | 2.290 | [−3.356, 7.936] | 0.056 | 0.424 |
| | Perceived income: moderate or high | 10.486 | [2.628, 18.344] | 0.220 | **0.009** |
| | Pre-admission residential area: urban | 13.875 | [8.240, 19.510] | 0.356 | **<0.001** |
| *Model summary* | $R^2$ = 0.507; adjusted $R^2$ = 0.477; $\Delta R^2$ = 0.201 ($p$ < 0.001); $F$(8, 132) = 16.960; $p$ < 0.001. | | | | |

*Note.* LSE = Loneliness Scale for Elderly; NLS-E = Nutrition Literacy Scale for Early-Stage Older Adults; CI = confidence interval; $B$ = unstandardized coefficient; β = standardized coefficient. Final-model coefficients are shown; intercepts are omitted. Reference categories are female, primary school education or below, unmarried, low perceived income, and rural residence. Residential area refers to pre-admission residence. $\Delta R^2$ indicates the additional variance explained by adding loneliness variables in Block 2; its accompanying $p$ value refers to the F-change test. Bold $p$ values indicate statistical significance ($p$ < 0.05). Panel B models are exploratory; $p$ values were not adjusted for multiple testing. Spearman correlation between social and emotional loneliness: $r_s$ = 0.427 ($p$ < 0.001). Variance inflation factors were 1.04–1.98 in Panel A (LSE total score = 1.23) and 1.05–2.00 in Panel B (social loneliness = 1.46; emotional loneliness = 1.38). BCa bootstrap confidence intervals (5,000 resamples) and HC3 robust standard errors yielded the same conclusions for all loneliness coefficients.

## DISCUSSION

This study examined the associations between loneliness and multidimensional nutrition literacy among adults aged 65–74 receiving institutional care. Approximately one-quarter of participants with available total loneliness scores were classified as very lonely or experiencing very intense loneliness, while 41.5% of the sample was classified as having inadequate total nutrition literacy. The inverse association between total loneliness and total nutrition literacy remained statistically significant after adjustment for sociodemographic covariates. However, the magnitude of the adjusted association and the additional variance explained by loneliness were modest (β = −0.187; $\Delta R^2$ = 0.028). Social loneliness was negatively associated with all nutrition literacy subscales and the total score, and its associations with nutrition attitude, nutrition behavior, and the total score persisted in the adjusted models. Emotional loneliness showed a different pattern. Significant negative associations in the bivariate analyses were confined to the three knowledge-related subscales, whereas exploratory models controlling jointly for social loneliness and sociodemographic covariates yielded positive conditional coefficients for nutrition attitude, nutrition behavior, and the total score. These findings support the primary hypothesis that greater total loneliness would be associated with lower total nutrition literacy. The different patterns observed in addressing the secondary aim also suggest the importance of examining social and emotional loneliness separately in relation to nutrition literacy.

The inverse association between total loneliness and total nutrition literacy is broadly consistent with literature linking loneliness and the social environment to nutrition-related outcomes. A scoping review reported that most quantitative studies identified associations of loneliness or social isolation with unfavorable dietary patterns, including lower fruit and vegetable consumption and poorer diet quality (Hanna et al., 2023). Among community-dwelling older adults in Lebanon, social isolation and subjective loneliness were independently associated with malnutrition risk (Boulos et al., 2017). In a Canadian study of middle-aged and older adults, a low-support social environment profile was associated with greater nutritional risk and lower consumption of some food groups (Ingham et al., 2023). Frequent feelings of loneliness were associated with malnutrition or malnutrition risk among adults aged 75 and older in Finland, while subjective loneliness was associated with poor nutritional status in a community-based study in Poland (Eskelinen et al., 2016; Krzymińska-Siemaszko et al.,

2021). In Türkiye, Büyükyörük et al. (2025), using the Turkish version of the same loneliness scale employed in the present study, reported an inverse correlation between total loneliness and Mini Nutritional Assessment–Short Form (MNA-SF) scores. These findings support examining associations between loneliness and different aspects of nutrition, but they do not directly correspond to our findings on nutrition literacy. Differences in the outcomes assessed, age groups, and living environments limit comparisons. The present study contributes to this literature by jointly assessing nutrition-related knowledge, attitudes, and self-reported behaviors among adults aged 65–74 receiving institutional care.

The findings for social loneliness suggest that social relationships may be relevant to different components of nutrition literacy. Its inverse association with nutrition attitude partly parallels the findings of Arslan et al. (2025) among nursing home residents. In that study, social loneliness was associated with higher Eating Attitudes Test (EAT-40) scores, whereas no significant association was identified for emotional loneliness. Higher EAT-40 scores indicate more disturbed eating attitudes, while higher NLS-E nutrition attitude scores indicate more favorable attitudes. The bivariate findings for social loneliness therefore suggest a conceptually similar pattern, although the instruments do not measure the same construct. Community-based research also indicates associations of social support and information sources with nutrition literacy. Higher perceived social support was associated with greater nutrition literacy after adjustment for other variables among rural older adults in China (Liu et al., 2025). In Japan, informational support and obtaining nutrition information from friends were associated with adequate nutrition literacy among men, while obtaining information from healthcare professionals was associated with adequate nutrition literacy among women (Aihara & Minai, 2011). Lobo et al. (2021) also reported a modest positive association between nutrition literacy and Mediterranean diet adherence among community-dwelling older adults. These community-based studies did not directly assess social loneliness and therefore provide an indirect context for our findings. In the present study, the largest bivariate correlation for social loneliness in absolute magnitude was observed for food label reading. Because this subscale assesses the comparison and interpretation of provided label information (Karademir, 2023), the finding may relate to skills in understanding and evaluating nutrition information rather than actual food-purchasing behavior in institutional care. However, this finding should be interpreted together with the score distributions. Food groups and food label reading scores clustered near the upper limits of their ranges, and more than half of the participants obtained the maximum label reading score. Such ceiling effects restrict score variance and the ability to discriminate among higher-performing participants; in a short five-item binary subscale, restricted variance can also lower KR-20 values and may partly explain the limited internal consistency of the label reading subscale (KR-20 = 0.549). The strongest correlation was thus observed for the subscale with the least precise measurement, was not examined in adjusted models, and may be driven largely by differences among the minority of participants scoring below the ceiling; its magnitude should therefore be interpreted cautiously. In addition, the negative bivariate associations of emotional loneliness were confined to the knowledge-based subscales (general nutrition knowledge, food groups, and food label reading), which require recall, classification, and interpretation of information. Because cognitive function was not assessed with a standardized instrument and is related to both loneliness and performance on knowledge-based tasks, these associations may partly reflect unmeasured differences in cognitive function.

In contrast to the pattern observed for social loneliness, the positive coefficients for emotional loneliness in the adjusted models require a different interpretation. These coefficients for nutrition attitude, nutrition behavior, and total nutrition literacy were obtained in models that included social loneliness and sociodemographic covariates jointly. Such conditional associations should not be interpreted as evidence that emotional loneliness improves nutrition literacy or has a protective role. Changes in coefficient magnitude or direction after other predictors are included suggest a suppression-like pattern as one possible explanation (MacKinnon et al., 2000). However, the bivariate associations were assessed using Spearman correlations, whereas the adjusted associations were estimated using linear regression, and suppression was not formally tested. The present analyses therefore do not establish such an effect. The positive coefficients are, however, unlikely to be an artifact of multicollinearity, because social and emotional loneliness were only moderately correlated ($r_s$ = 0.427), all variance inflation factors were below 2.1, and the estimates were stable in bootstrap and heteroscedasticity-consistent analyses. Previous research also suggests that loneliness dimensions may have different associations with nutritional outcomes. Romero-Ortuno et al. (2011) found significant differences in emotional loneliness between groups with normal and impaired nutritional status, but no

differences in social loneliness. In the study by Tkatch et al. (2022), emotional loneliness was associated with greater nutrition risk after adjustment for other variables among non-Māori participants. By contrast, social loneliness showed a more consistent pattern in the present study and in the bivariate analyses of Arslan et al. (2025). Steptoe et al. (2024) also found associations between social isolation and inadequate intake of several micronutrients, but no significant associations for subjective loneliness. These differences suggest that social and emotional loneliness, social isolation, and social support should not be used interchangeably, and that their associations with nutrition may vary according to the population, outcome, and analytical approach.

These dimension-specific patterns also help explain the limited contribution of the total loneliness score. Adding the total LSE score to the adjusted model increased the explained variance in total nutrition literacy by only 2.8 percentage points, whereas entering social and emotional loneliness jointly increased it by 20.1 percentage points. Because the total score sums two moderately correlated dimensions whose conditional associations with nutrition literacy were in opposite directions, it may partly conceal these opposing associations and thereby understate the relevance of loneliness to nutrition literacy. Relying solely on the total score may thus obscure theoretically meaningful differences, supporting the separate assessment of social and emotional loneliness as originally conceptualized (de Jong Gierveld & Kamphuis, 1985; Weiss, 1973).

Pre-admission residential area was also associated with nutrition literacy. Participants who reported previously living in an urban area had higher nutrition attitude, nutrition behavior, and total NLS-E scores after adjustment for the sociodemographic covariates and loneliness dimensions included in the models. These associations, however, do not establish a direct effect of urban residence. Because the rural facility accounted for approximately half of the sample (72 participants, compared with 70 from the two urban facilities), pre-admission residential area may partly overlap with facility membership. This overlap is necessarily incomplete: because only 48 participants reported pre-admission rural residence, at least 24 residents of the rural facility had previously lived in urban areas. Nevertheless, residents who previously lived in rural areas may have been more likely to live in the rural facility, and the urban–rural association may therefore partly reflect between-facility differences in resident characteristics, care routines, meal provision, or social activities rather than participants' previous place of residence alone. Because facility identifiers were not available in the analytical dataset, these two sources of variation could not be separated. Although educational attainment was controlled for, unmeasured differences in access to educational opportunities, healthcare, and nutrition information throughout life may have contributed to this pattern. Aihara and Minai (2011) linked nutrition literacy to informational support and sources of nutrition information; Liu et al. (2025) identified associations with perceived social support and educational attainment; and Lobo et al. (2021) reported associations with educational attainment and the use of mass media as a source of nutrition information. These findings provide indirect support for the relevance of access to resources but do not directly explain differences between urban and rural residence. Self-reported residential area and the predominance of participants reporting low income further limit interpretation in the present study. Pre-admission urban residence may therefore represent a marker of unmeasured contextual resources, although this explanation requires investigation in studies that directly assess those resources.

Alongside contextual resources, psychosocial processes and institutional practices may help explain the observed associations. A systematic review of eating behaviors in later life identified health-related attitudes, food decision-making, perceived control, mood, enjoyment of food, and social support among the relevant factors (Walker-Clarke et al., 2022). This framework is consistent with Berkman et al.'s (2000) model, which proposes that social networks may influence health through social support, social influence, social engagement and attachment, and access to resources. In a qualitative study in China, healthcare professionals and family members were identified as trusted sources of nutrition information, whereas difficulties understanding labels, conflicting online information, and limited access to affordable healthy foods were reported as barriers (Li & Wang, 2025). Other qualitative studies have highlighted the relevance of eating alone, food access, and maintaining independence to older adults' food practices, and linked loneliness and the loss of shared meals to simpler meal preparation and reduced meal variety (Freire Paz et al., 2025; Whitelock & Ensaff, 2018). However, these findings concerning individual shopping and cooking practices cannot be directly transferred to settings where meals are provided by the institution. In care homes, mealtime experiences are shaped by relationships among residents, familiar routines, and opportunities to express personal preferences (Watkins et al.,

2017). In long-term care homes, low social engagement was associated with more task-focused mealtime care practices and lower energy intake, although the association with energy intake was no longer statistically significant after adjustment for eating difficulties (Morrison-Koechl et al., 2021). Qualitative findings from adult day centers, which do not provide residential care, suggested that shared meals may support social connections and a sense of community and emphasized the importance of participation in food-related decisions (Avraham et al., 2025). This literature suggests that mealtimes are relevant not only to nutrition but also to social interaction and the expression of individual preferences. Nevertheless, these processes were not measured in the present study and should be regarded as possible pathways underlying the associations between loneliness and nutrition literacy.

This relational perspective also receives indirect support from studies of community-dwelling populations. Eating alone has been associated in some studies with poorer diet quality and lower food diversity, although findings have been inconsistent (Wyman et al., 2026), and certain marital transitions have been linked to changes in fruit and vegetable intake (Mehranfar et al., 2025). Intervention studies combining nutritional support with shared eating or meal services have reported improvements in loneliness (Pinheiro et al., 2020; Wright et al., 2015); however, methodological limitations restrict their interpretation, and neither study assessed nutrition literacy or involved institutional care residents. These findings therefore provide a rationale for testing, rather than evidence for, nutrition literacy initiatives that incorporate social participation in institutional care.

Given the limitations of this evidence, future research should examine social and emotional loneliness both separately and jointly and assess social support, mealtime companionship, nutrition information sources, participation in social activities within facilities, and residents' autonomy in food-related decisions. Multicenter longitudinal studies involving a sufficient number of facilities and accounting for the clustering of residents within facilities could clarify the temporal ordering of changes in loneliness and nutrition literacy and the consistency of these associations across institutional settings. Controlled intervention studies could evaluate the effects of approaches combining nutrition literacy support with opportunities for social participation on both nutrition literacy and loneliness.

## Strengths and Limitations

The principal strength of this study is the joint examination of multidimensional nutrition literacy and social and emotional loneliness among institutional care residents in the age group for which the NLS-E was developed. Assessing the five nutrition literacy subscales and the total score allowed different patterns of association with the loneliness dimensions to be examined. Entering social and emotional loneliness jointly in the regression models enabled the conditional association of each dimension to be estimated while controlling for the other, while the Benjamini–Hochberg correction applied to the 18 correlations aimed to control the false discovery rate within this family of tests. Additional strengths include determining the sample size before data collection for the planned correlation analysis, using internal consistency coefficients appropriate to the item scoring structures, explicitly reporting the missing response and resulting analysis sample sizes, and applying the same sociodemographic covariates across adjusted models.

Several limitations should nevertheless be considered. The cross-sectional design precludes establishing the temporal ordering of the associations or causality. Self-reported data may have been affected by response and social desirability biases. Participants' ability to understand and answer the questionnaire was evaluated through a brief interview rather than a standardized cognitive screening instrument. Nutritional status, diet quality, dietary intake, cognitive function, depressive symptoms, chronic conditions, duration of institutional residence, social support, and mealtime companionship were not systematically assessed; residual confounding by unmeasured variables therefore cannot be excluded. In addition, one nutrition attitude item explicitly addresses the perceived adverse effect of loneliness on nutrition. This content overlap may have contributed to the associations of loneliness with nutrition attitude and the total NLS-E score, which includes this subscale, although its contribution was not evaluated in the present analyses. Because the NLS-E assesses nutrition-related knowledge, attitudes, and self-reported behaviors, its scores should not be interpreted as direct indicators of malnutrition, inadequate dietary intake, or poor diet quality.

Further limitations concern sampling and analysis. Convenience sampling from three private care facilities in a single province restricts the generalizability of the findings. The absence of eligible-resident counts and facility-specific participation rates limits the assessment of selection and

nonresponse bias. Although the number of participants recruited from each facility is reported, facility identifiers were not recorded at the individual level in the analytical dataset, preventing adjustment for within-facility clustering and facility-level differences and the separation of facility effects from pre-admission residential area. Potential dependence between observations from residents of the same facility may have affected standard errors and assessments of statistical significance. Institutional routines may also constrain residents' control over behaviors assessed by some NLS-E items; behavior scores may therefore reflect opportunities provided by the facility alongside individual competencies. Pre-admission residential area was based on self-report without independent verification. The sample size was determined for the planned correlation analysis rather than the regression models, and no additional multiplicity adjustment was applied to the exploratory dimension-level regression models. Finally, the food label reading subscale showed limited internal consistency (KR-20 = 0.549), and scores on both the food groups and food label reading subscales clustered near the maximum; associations involving these subscales should therefore be interpreted with measurement uncertainty and restricted score variance in mind. In light of these limitations, the findings should be regarded as cross-sectional associations requiring confirmation in other samples and institutional settings.

## CONCLUSION

In this sample of institutional care residents aged 65–74 years, higher total loneliness scores were associated with lower total nutrition literacy scores. This association remained statistically significant after adjustment for sociodemographic covariates, although its magnitude was modest. Social loneliness was negatively correlated with all nutrition literacy subscales and the total score, and its inverse associations with nutrition attitude, nutrition behavior, and the total score were also observed in the exploratory adjusted models. Emotional loneliness showed a pattern that varied by outcome and analytical approach. Its positive conditional coefficients in the adjusted models should not be interpreted as evidence of a protective or beneficial effect. These findings highlight the importance of examining social and emotional loneliness separately and jointly, because the total score may obscure opposing associations of the two dimensions, when investigating loneliness and nutrition literacy in institutional care. Multicenter longitudinal studies are needed to examine the temporal ordering and consistency of these associations across institutional settings, while controlled intervention studies should evaluate the effects of nutrition literacy initiatives incorporating social participation on both loneliness and nutrition literacy.

### Author Contributions

All stages of the research were undertaken by the sole author, including developing the study concept and methodology, collecting and curating the data, conducting the statistical analyses, preparing visual materials, and administering the project. The author drafted and revised the manuscript and approved its final version.


### Funding and Acknowledgments

No external funding supported this research. The author is grateful to the older adults who volunteered to participate and to the facility administrators who enabled data collection. Academic guidance and mentorship provided by Prof. Dr. İsmail Tufan are also gratefully acknowledged.


### Ethics Approval

Ethical approval was granted by the Health Sciences Ethics Committee of Süleyman Demirel University on 3 November 2025 (Meeting No. 105; Decision No. 55), and the research followed the principles of the Declaration of Helsinki.

### Informed Consent

The consent process followed the procedure authorized by the ethics committee. Before completing the questionnaire, each participant received the approved voluntary participation form and an explanation of the research procedures, confidentiality arrangements, and freedom to decline participation or withdraw without adverse consequences. Participants gave informed consent by voluntarily agreeing to complete the questionnaire.

## Data Availability

Ethical obligations and participant privacy prevent public release of the dataset. The corresponding author may consider requests for de-identified data, provided that the necessary ethical and institutional permissions are obtained.

## Conflict of Interest

The author declares no conflicts of interest.

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