

Understanding Loneliness as a Multidimensional Burden Through Demographic Patterns, Health Pathways, and Measurement Consistency

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Abstract—It is a well-known fact that loneliness has become a significant public health and social problem in European societies. Following this observation, this study aims to examine patterns of loneliness and its relation with mental health, self-rated health, and overall well-being. The analysis is conducted with data from the EU Loneliness Survey which includes individuals aged between 16 and 100 across all EU states and it includes demographic characteristics, depressive symptoms, subjective happiness, and lifestyle behaviors such as smoking, exercise, and fruit consumption. Based on the study, it investigates how loneliness depends on age and gender, how it relates to health behaviors and well-being. Using descriptive and correlation based analyses, this paper will discuss to what extent loneliness as a multidimensional issue for public health and social policy.

Key Terms — loneliness, mental health, well-being, health behavior, EU Loneliness Survey, social isolation

I. INTRODUCTION

Loneliness started to be a part of a major social and public health concern all over the world. Instead of only being an individual and emotional experience, it is highly related to mental health problems, poorer self-rated health, and reduced overall well-being. In this study, we aim to highlight loneliness as an important public health and social concern that requires systematic analysis.

To achieve this, we use data from the EU Loneliness Survey, which includes respondents aged between 16 to 100 across all EU states. Our main goal is to show how loneliness differs across demographic groups and how it is associated with health and well-being outcomes. Particularly, we focus on age and gender differences, since the literature suggests that loneliness is not experienced equally across the population.

Moreover, this study illustrates the relationship between loneliness and depressive symptoms as well as subjective happiness, because loneliness is often linked to emotional distress and low life satisfaction. We also consider lifestyle behaviors such as smoking, exercise, and fruit consumption, and show whether unhealthy habits are related to poor self-rated health and higher loneliness levels or not.

Finally, this study addresses the measurement of loneliness by combining two indicators, the UCLA loneliness scale and a direct self-reported loneliness question. By comparing these measures, we examine whether individuals' subjective perceptions of loneliness are consistent with a standardized assessment. In addition, the study introduces a composite measure, the Loneliness Burden Scale (LBS), which offers loneliness not only as an emotional experience

but also as a broader view linked to health conditions and demographic vulnerability. This integrated approach provides a clear framework for understanding loneliness patterns across countries and may offer a supportive way for future research and policy discussions aimed at reducing loneliness and improving public well-being.

The dominant literature suggests that loneliness is a construct and experience with multiple dimensions, which vary across age, gender, health, lifestyle, and culture. Studies on social withdrawal syndromes such as hikikomori in Japanese societies show a strong link between social isolation and symptoms of depression, poor health, and reduced subjective well-being. Concurrently, in the realm of psychology, there are two distinct definitions of loneliness, namely subjectively experienced loneliness and inferential loneliness, which tend to underestimate loneliness despite the manifestations of social isolation.

Upon this foundation, and using the structure of the EU Loneliness Survey, the following hypotheses are proposed to explore demographic disparities, healthcare-related correlates, lifestyle factors, and the validity of measurement of loneliness in European societies.

II. HYPOTHESES

On the basis of previous research and using the multidimensional approach offered by the EU Loneliness Survey, the following hypotheses are proposed:

H1: Increasing age is associated with a higher loneliness burden, as measured by the Loneliness Burden Scale (LBS), and with a greater prevalence of depressive symptoms.

H2: Loneliness differs systematically across gender groups; more precisely, male respondents report a higher average loneliness score than female respondents for all age cuts.

H3: Unhealthy lifestyle behaviors such as smoking, lack of physical activity, and low fruit consumption are found to increase loneliness because of their relationship with self-rated health.

H4: The correlation between self-reported loneliness and the UCLA loneliness scale score is positively related, although the strength of the relationship depends on the affective experiences of the respondents, including depressive experiences and subjective happiness.

H5: The greater the levels of loneliness, the more negative the relationship with subjective happiness, such that people with high levels of loneliness score low on happiness.

III. METHODOLOGY

The current study relies on the EU Loneliness Survey (EU27, 2022), which was conducted by the Joint Research Centre of the European Commission. The study participants were between 16-100 years of age, with the survey being done anonymously from online panels representing all EU member states. The survey was voluntary, with the data being anonymous, thus available for analysis in accordance with EU data protection policies.

Loneliness is measured with two indicators: the three-item UCLA loneliness scale and a question directly assessing loneliness. Other variables are depression symptoms, subjective happiness, health, lifestyle factors (smoking, exercise, fruit-eating), and sociodemographics like age, gender, education level, origin country, migration background, and childhood circumstances. The survey documentation also mentions an integrated behavioral experiment which facilitates the interpretation of the data collected.

Data cleaning concerned the recording of specific missing data values (997-999) to NA and the selection of the sample based on actual age. The analysis is based on descriptive statistics and visualization to investigate age and gender differences, associations with health and lifestyles, the extent to which loneliness indicators measure consistently, and the properties of the Loneliness Burden Scale (LBS) concept.

Furthermore, correlation analyses were conducted to examine the strength and direction of associations between loneliness, depressive symptoms, and subjective happiness. Given the cross-sectional nature of the survey and the absence of causal identifiers, the analysis focuses on descriptive and correlation-based methods.

IV. DESCRIPTIVE STATISTICS

Statistic	Age	Loneliness (Direct)	Health	Depression
N	25,634	24,601	25,298	25,262
Minimum	16	1.00	1.00	1.00
Q1	32	3.00	2.00	3.00
Mean	44.39	3.84	2.51	4.18
Median	44	4.00	2.00	4.00
Q3	55	5.00	3.00	6.00
Maximum	91	5.00	5.00	6.00
Standard Deviation	15.20	1.12	0.96	1.48

Fig. 1. Descriptive Statistics for Continuous Variables

The descriptive statistics of the continuous variables used in the analysis are summarized in Table 1. The data represent individuals aged 16-91 years with a mean of 44.39. The scores of direct loneliness, self-rated health status, depression, as well as the mean scores of the LBS components show a moderate central tendency with enough variation in the data. The data did not show any substantial deviations in terms of the descriptive statistics of skewness and kurtosis. These are the primary components of the Loneliness Burden Scale.

V. CONSTRUCTION OF THE LONELINESS BURDEN SCALE (LBS)

In this study, we constructed a Loneliness Burden Scale (LBS) using data from the EU27 Loneliness Survey. The aim of this scale is to conceptualize loneliness not only as an emotional state but as a multidimensional burden shaped by health conditions and demographic vulnerability. The LBS consists of three core components: the Loneliness Score (LS), the Health Risk Score (HRS), and the Demographic Vulnerability Weight (DVW).

All components used in the construction of the scale were normalized to a 0–1 range prior to aggregation in order to ensure comparability across variables measured on different scales.

Loneliness Score (LS)

The Loneliness Score (LS) captures emotional and social aspects of loneliness and was constructed using three indicators: the UCLA loneliness items, the DJG loneliness scale, and a direct self-reported loneliness question. The normalized components were combined using a weighted average:

$$LS = 0.4 \times UCLA_{norm} + 0.3 \times DJG_{norm} + 0.3 \times Direct_{norm}$$

A slightly higher weight was assigned to the UCLA scale because it captures indirect emotional and social aspects of loneliness.

Health Risk Score (HRS)

The Health Risk Score (HRS) reflects the health-related dimension of loneliness and was calculated using self-reported depressive feelings and general health status:

$$HRS = 0.6 \times DepressiveFeelings_{norm} + 0.4 \times HealthStatus_{norm}$$

Depressive feelings were given greater weight due to their strong association with loneliness.

Demographic Vulnerability Weight (DVW)

Structural vulnerability was captured through the Demographic Vulnerability Weight (DVW), which is based on age group, gender, and education level. Each category was assigned a predefined risk weight reflecting known differences in loneliness vulnerability:

Age group weights were defined to increase with age: 16–30 = 0.20, 31–45 = 0.30, 46–60 = 0.40, 61–75 = 0.50, 75+ = 0.60.

Gender weights were assigned as follows: Male = 0.30, Female = 0.40, Other = 0.35.

Education weights reflect decreasing vulnerability with higher education: Lowest education = 0.60, followed by 0.50, 0.40, 0.30, and highest education = 0.20.

The overall demographic vulnerability was calculated as the simple average of these three weights:

$$DVW = \frac{age_w + gender_w + education_w}{3}$$

These weights do not represent probabilities, but relative levels of demographic vulnerability.

Loneliness Burden Scale (LBS)

The final Loneliness Burden Scale (LBS) integrates loneliness intensity with health risk and demographic vulnerability:

$$LBS = LS \times (0.6 \times HRS + 0.4 \times DVW)$$

This formulation reflects the idea that loneliness becomes more burdensome when it co-occurs with poor health and structural disadvantage.

Scaling and Interpretation

To improve interpretability, the LBS was normalized and rescaled to a 0–100 range:

$$LBS_{scaled} = 100 \times Normalized(LBS)$$

Higher values indicate a heavier loneliness burden. Overall, this approach allows loneliness to be analyzed as a cumulative burden shaped by emotional, health-related, and demographic factors, and provides a quantitative basis for identifying population groups that experience disproportionate levels of loneliness. The weights were defined based on established findings in the loneliness and public health literature and are intended to reflect relative vulnerability rather than causal impact.

VI. HYPOTHESES DEVELOPMENT

H1. Age, Loneliness Burden, and Depressive Symptoms

The results show a clear age-related pattern in the burden of loneliness and symptoms of depression. Figure 2 and the Loneliness Burden Scale (LBS) map both show that as people get older, they tend to feel more lonely. Young adults (16–30 years old) already feel very lonely and depressed, but this feeling is getting worse, especially for people aged 61 to 75 and 75 and older. This trend shows that

people are not only feeling more lonely, but they are also showing more signs of depression as they get older.

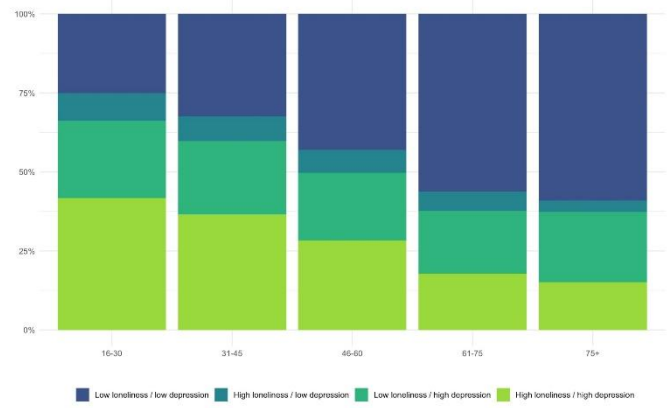


Fig. 2. Distribution of Respondents Across Combined Loneliness and Depression Profiles by Age Group.

The findings indicate that age-related loneliness is not solely attributable to emotional distress. It is a burden that builds up over time. This burden is caused by health problems, fewer friends, and demographic risks. The LBS framework illustrates this multidimensional structure by integrating loneliness, health risks, and demographic factors in a comprehensive manner. Even though raw loneliness scores don't always show this vulnerability, the results show that older adults are more lonely than other groups. These results generally back up the H1 hypothesis. They confirm that older people are more likely to feel lonely and have more common symptoms of depression.

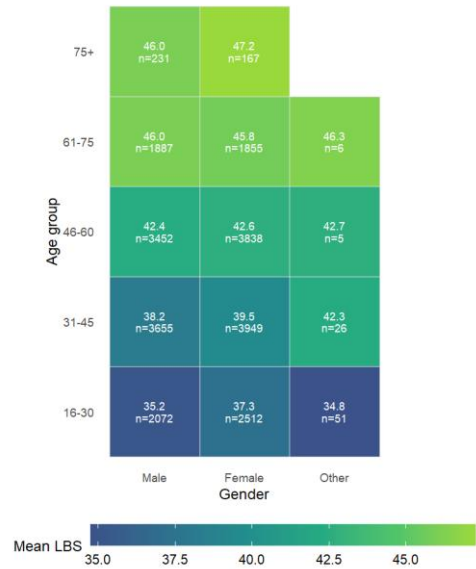


Fig. 3. Loneliness Burden Scale (LBS) scores across age groups and gender categories.

H2. Gender Differences in Loneliness Across Age Groups

Figure 4 and the Age × Gender LBS map demonstrate the consistent emergence of gender-based differences in loneliness across age groups. In all age groups, male participants generally scored higher on loneliness than female participants, defying some conventional expectations. Rather than being an age-specific anomaly, this pattern persists from early adulthood into old age, suggesting a systematic gender difference.

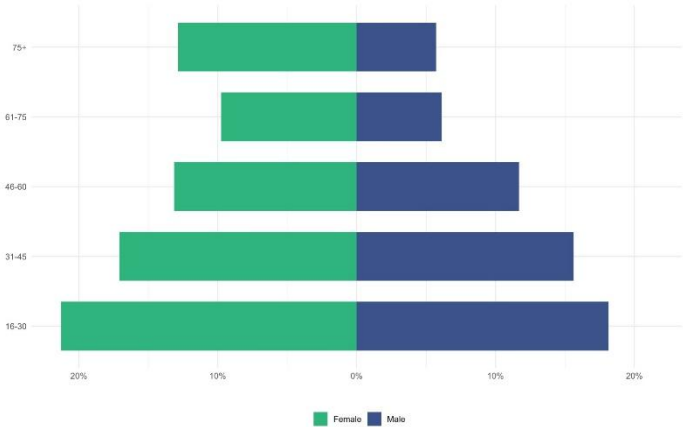


Fig. 4. Percentage of high UCLA loneliness for each age group by gender.

This finding could be explained by the fact that men are more socially isolated, especially as they age, because they have smaller social networks and are less expressive of their emotions. Men seem to be more likely to experience loneliness when social ties deteriorate, such as during retirement or the death of a spouse, whereas women typically report higher levels of emotional distress. When health and demographic factors are taken into consideration, the LBS results also demonstrate that men's high levels of loneliness translate into a higher burden of loneliness. When combined, these results strongly support hypothesis H2, which states that loneliness varies systematically by gender, with men generally experiencing higher levels of loneliness across all age groups.

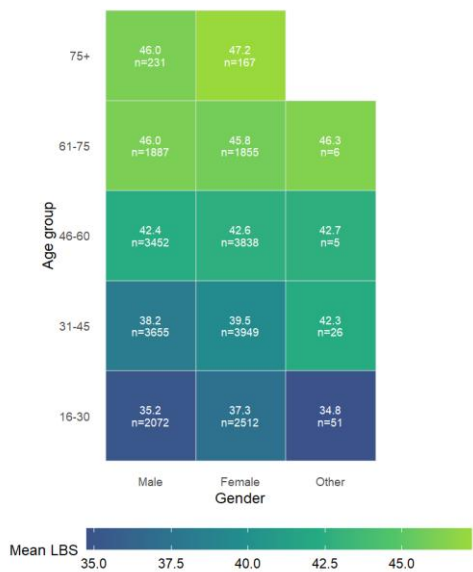


Fig. 3. Loneliness Burden Scale (LBS) scores across age groups and gender categories.

H3. Lifestyle, Health, and Loneliness: A Health-Mediated

The findings indicate a graded relationship between lifestyle behavior, perceived health, and loneliness. As evident from Figure 5, for all ages, people who experience poor health report systematically higher loneliness on the UCLA loneliness scale compared to people who report good and excellent health. This suggests that health is a very important indicator of loneliness across all ages.

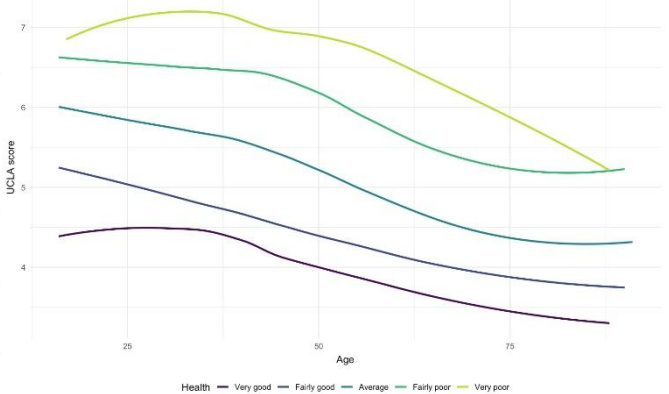


Fig. 5. Relationship between age and UCLA loneliness scores grouped according to self-rated health.

For the purpose of illustrating the behavioral aspect of the association in the above quote, Figure 6 is stratified in terms of respondents' smoking behavior, physical activity levels, and fruit consumption. The categories in which individuals with moderate to high lifestyle risk are overrepresented include higher levels of loneliness, and lower levels of loneliness can be found in healthy lifestyle profiles.



Fig. 6. Composition of lifestyle risk for respondents with high levels of loneliness, by exercise, fruit, and smoking.

Taken altogether, these results indicate that unhealthy lifestyle behavior is not directly related to loneliness but that unhealthy behaviors primarily through self-reported health. Unhealthy behaviors are related to poorer health perceptions, and lower health perceptions are associated with higher levels of loneliness. Results from correlation analysis also support these findings and show a negative correlation between lifestyle risk and self-reported health, as well as a positive correlation with UCLA loneliness.

These findings are consistent with relational and public health models of loneliness, which emphasize the importance of high-quality social relationships for both psychological and physical well-being. Chronic loneliness has been associated with psychological fragility and health risks comparable to

known behavioral risks. On this model, poor health behavior and loneliness could mutually maintain each other through lower health perception and reduced social interaction.

Overall, the results support H3, demonstrating unhealthy lifestyle behaviors are associated with increased feelings of loneliness, primarily because they impact self-rated health. It is reinforcing the concept of a multidimensional burden underpinning feelings of loneliness, as shaped by several scholars.

H4. Direct and Inferred Loneliness: The Role of Affective States

The findings indicate a positive but imperfect relationship between direct self-reported loneliness and UCLA loneliness scale scores. As illustrated in Figure 7, a subset of respondents presents inconsistent profile scores, that is, high on the UCLA loneliness scale but low on self-reported loneliness and vice versa.

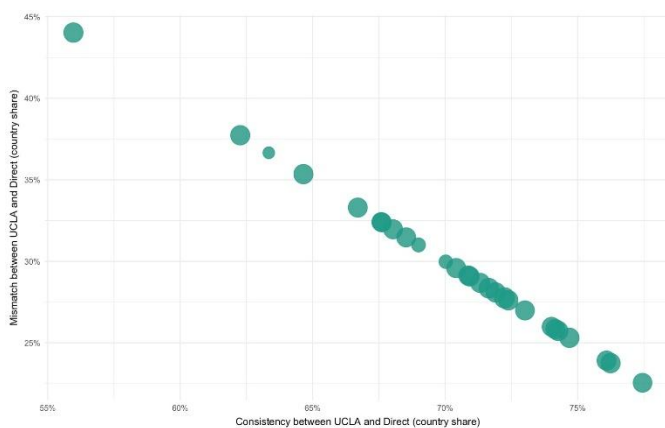


Fig. 7. Country-level concordance and discordance between UCLA loneliness scores and direct reports of loneliness.

These findings mean that the two methods of measurement relate to, but are not the same, aspects of loneliness. The explicit measures of loneliness rely upon conscious awareness and identification, while the UCLA measures the implicit affective and social manifestations of loneliness. Also, Figure 8 above shows that affects, specifically depressive experiences and subjective feelings of unhappiness, mediate this relationship in such a way that those who experience unstable affects tend to rate higher in UCLA measures of loneliness even without explicit identification as lonely.

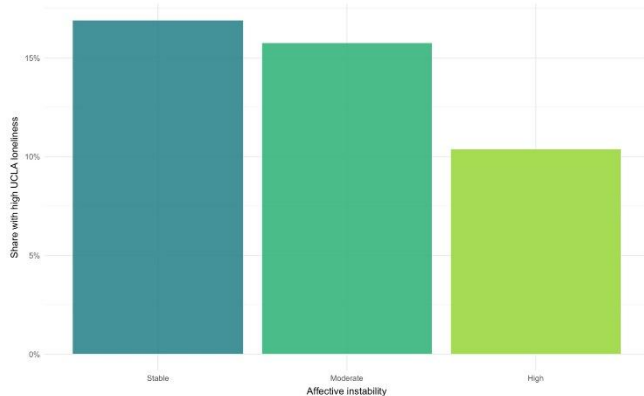


Fig. 8. Relation between affective instability and prevalence of high UCLA loneliness.

From a social psychology perspective, social exclusion and rejection experiences might be a reason behind such a discrepancy. People who experience social marginalization or consider themselves different might be suffering from social isolation without necessarily identifying this experience as loneliness. These factors can explain why indirect indicators of latent loneliness might be more sensitive, especially when dealing with a social withdrawal or exclusion normalization setting.

These findings in general support the hypothesis H4 in the sense that the association between direct loneliness scores and scores of inferred loneliness is qualified by experiences of affective states as well as social context.

H5. Loneliness and Subjective Happiness

The analysis reveals a strong and consistent negative relationship between loneliness and subjective well-being, as shown in Figure 9. Individuals with higher levels of loneliness are significantly less likely to report high levels of happiness. However, the vast majority of those with low levels of loneliness tend to fall into the high happiness category. This inverse relationship is true across all age groups and shows that loneliness weakens well-being throughout life. In particular, the results show that loneliness is not only related to unhappiness, but is also one of its strongest predictors. Even individuals who report relatively stable emotional states show a decrease in happiness when their loneliness levels increase. This pattern highlights loneliness as a central component of subjective well-being rather than a peripheral emotional state. In conclusion, the findings strongly support hypothesis H5, confirming that higher loneliness is closely linked to lower subjective well-being and strengthening the concept that loneliness is a critical predictor of overall life satisfaction.

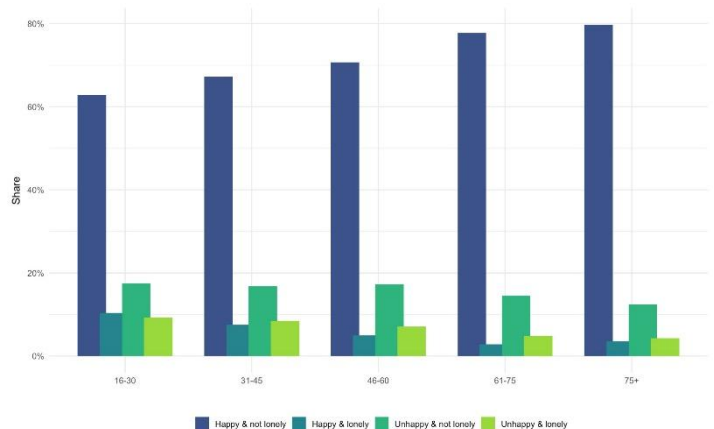


Fig. 9. Joint distribution of loneliness and subjective happiness categories by age group.

VII. CONCLUSION

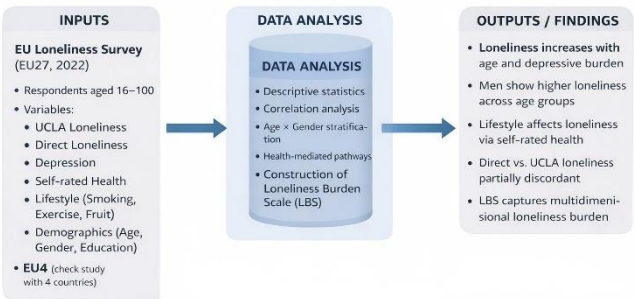
This research examines the dimension of loneliness as a public health concern by using the data from the EU Loneliness Survey. The findings of the research show the systematical variation of the phenomenon of loneliness with the dimensions of age and sex and the systematical association with depression and subjective well-being indicators. This testifies that the vulnerability caused by loneliness is a structured phenomenon.

Apart from differences in demographics, results indicate that health and lifestyle factors emerge as crucial in the context of loneliness. Poor self-rated health is consistently associated with higher levels of loneliness, while unhealthy lifestyle practices such as lack of physical activity, smoking, and inadequate consumption of fruits are indirectly associated with loneliness based on their influence on self-rated health perceptions. Lastly, although self-reported loneliness and the UCLA loneliness score tend to positively correlate, differences between the two are adequately accounted for by affective experiences, such that loneliness could potentially exist without the individual necessarily knowing it.

The key importance of this research work is the inclusion of the Loneliness Burden Scale (LBS) as a conceptualization of loneliness as a burden, which is a reflection of individual emotional experiences, health sensitivities, and demographic factors. Beyond individual items or emotions, it is believed that LBS has a broader conceptual framework that enables understanding about loneliness at a population level. From a public health perspective, it could reflect that an effective way to address loneliness is to consider a combination of social, mental, and health aspects as treatment, as it is a stand-alone phenomenon.

VIII. GRAPHICAL ABSTRACTS

DATASET: Overview of the EU Loneliness Survey–based analytical framework, illustrating the integration of demographic, health, lifestyle, and affective indicators through descriptive and correlation analyses to construct and interpret the multidimensional Loneliness Burden Scale (LBS).



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