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Health literacy among university students and their families in the Republic of San Marino: association with socioeconomic and health status determinants

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Abstract
Over the last decade Health Literacy (HL) has become a vibrant area of research. Low HL has been associated with poorer health status, greater inequalities and higher health system costs. This study examined functional, interactive and critical HL among university students and their families within the context of the Republic of San Marino. This study aimed to: (1) adapt the HL-EU-Q47 instrument; (2) estimate the prevalence of inadequate or problematic HL and analyze its associations with socioeconomic and health status variables; and (3) identify HL-related risk factors using a logistic regression model and odds ratios. HL was measured through a questionnaire with 47 items that fall into four information management dimensions, namely: obtain information, understand, evaluate, and apply it. It was also linked to each of the three health domains, namely: health care, disease prevention and health promotion. The items of the survey measuring HL skills were formulated as direct questions, using a Likert scale. The instrument was administered by the Paper Assisted Personal Interview (PAPI) method. The first results considered the percentages of inadequate or problematic HL, according to different categories of sociodemographic and health status variables. Significant differences were also found in the means of Standardized Literacy Index (SLI). These results confirmed the presence of a social gradient influencing HL levels, highlighting how sociodemographic and health status variables shape HL outcomes. Inadequate or problematic HL was significantly associated with factors including advanced age, low income, limited educational attainment, poor self-perceived health, and limitations in activities of daily living. These findings are consistent with previous literature, confirming a significant relationship between limited HL and factors such as older age, low education, lower income, low perceived health status and activity limitations, among others. These results are also consistent with those of HLS-EU Survey.

Keywords Health literacy · Health risks · HLS-EU-Q47 · Social gradient · Republic of San Marino · University students and their families

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1 Introduction

In the midst of unprecedented global challenges, the pivotal role of Health Literacy (HL) has come to the forefront, shaping the narrative of healthcare crises. HL as defined by Sørensen et al. (2012), refers to individual knowledge, motivation, and competencies to access, understand, evaluate, and apply health information in order to make informed judgments and decisions in everyday life concerning health care, disease prevention, and health promotion aimed at maintaining or improving quality of life (Kickbusch & Maag 2008; Squiers 2012; Kickbusch et al. 2013; Apfel and Tsouros 2013). Broder et al. (2017) conducted a systematic review of the definitions and conceptual models of HL in children and university students. They concluded that, in literature, HL is usually described as a set of dimensions. These can be interpreted as a cluster of related abilities, skills, commitment, and knowledge facilitating the competent handling of health information and the making of effective health-promoting decisions. The definition of HL in the context of young people closely resembles the general definition of HL.

HL is associated with cognitive and social skills that are essential for motivating individuals to access, understand, and use information in ways that promote and maintain good health (Nutbeam 1998). It is increasingly recognized as pivotal by both the United Nations (UN) and the World Health Organization (WHO). Together, they highlight the importance of HL in achieving the Sustainable Development Goals on health and promoting community well-being.

The European HL Project (HLS-EU) emphasizes HL as a determinant of health, integrating public health perspectives and individual approaches (Pelikan and Ganahl 2017). These global perspectives are based on the dimensions of HL described by Nutbeam (2000) and Nutbeam and Lloyd (2021): functional, interactive, and critical.

- The functional dimension pertains to basic skills in reading, writing, and numeracy necessary to function effectively in a health care context
- Interactive HL refers to more advanced cognitive literacy skills that, along with social skills, can be used to actively participate in everyday situations, extract information and derive meaning from different forms of communication, and apply this to changing circumstances.
- Critical HL comprises the most advanced skills, allowing individuals to critically analyze information and use it to exert greater control over significant events and situations.

Over the past decade, understanding among practitioners and researchers has improved regarding the impact of the context in which people are required to use their capabilities, HL skills, and abilities (Bello et al. 2024). Even a person with a high level of observable HL skills may experience significant challenges in applying those skills in an unfamiliar environment (such as a hospital) or when interacting with someone (such as a doctor) whom they find intimidating (Berry et al. 2017).

Parker et al. (2003) and Parker and Ratzan (2010) have proposed a HL framework that explicitly considers the extent to which HL is mediated by the situational demands and complexities placed on people. This framework shows that HL involves a dual nature of communication: it requires an alignment between the capacity and skills possessed by users and the complexity of the information and demands of health care systems (where commu-

nication should be effective, empathetic, honest, and transparent). Only when this balance is achieved can we confidently say there is a health-literate population.

Building on the definitions of HL proposed initially by Parker and Ratzan and later developed by Sørensen, this study highlights the convergence of their frameworks, emphasizing the need to identify ethical principles as fundamental inspirations for public health actions. Indeed, in the conceptual model developed by Sørensen, the model elucidates the pathways linking HL to health behaviors and outcomes.

The model identified the determinants and factors influencing HL levels (antecedents) and their subsequent health outcomes (consequences). Indeed, Sørensen incorporates Nutbeam's theory and its dimensions, which are represented by four key public health processes: access, understanding, appraisal, and application of health-related information. These processes are involved in three public health domains: health care (HC), disease prevention (DP), and health promotion (HP). Thus, through this approach, the concept of HL has found its place in public health, allowing it to move beyond a narrow vision centered solely on need. Indeed, early studies focused on functional HL and its repercussions on treatment adherence (Berkman et al. 2011).

Today, a growing number of studies (Sudore and Schillinger 2009; Bennett et al. 2009; Batterham et al. 2016; Tamayo-Fonseca et al. 2023; Papalois and Papalois 2024) allow for description and better understanding of the links between HL. These links involve social determinants, health behaviors, and health status. They converge to indicate links between limited HL and poor health, unfavorable social positioning, and lower use of preventive care. Furthermore, less favorable health behaviors are observed. Recent European surveys on HL show that the level of HL varies across the population and highlight the links between higher HL and better health outcomes, and reduced economic burdens (Kinoshita et al. 2024; Bøggild et al. 2021). HL outperforms many socioeconomic factors as predictors of health status and is recognized as a key determinant within health systems. Findings from systematic reviews (Liu et al. 2024) show that low HL is associated with a range of negative health outcomes, including:

- Poor health status.
- Health-compromising behaviors.
- High health costs.
- Lower use of preventive services.
- Greater access to emergency services.
- Improper use of hospital services.
- Lower understanding of health information.
- Lower competence in taking medications as prescribed.
- Lower adherence to prescribed treatments and care.
- Worse therapeutic outcomes.
- Greater risk of treatment-related complications.
- Higher rates of avoidable hospital readmissions.
- Less understanding of diseases in patients with chronic conditions.

In Italy (Ongis and Barcella 2024) and in the Republic of San Marino, the HL of university students is essential as they transition into independent living, face new health challenges, and take on greater personal responsibility for maintaining their health (Hartman and Swartz

2006; Vozikis et al. 2014; Sendatzki et al. 2024; Rosário et al. 2024a, b). Although the growing interest in health has led to an increase in studies and research on the topic, limited research is available to assess HL levels among university students and their families (Ickes & Cottrell 2010; Uysal et al. 2020; Juvinyà-Canal et al 2020; Almeida et al. 2024). Since few studies have been conducted on students' HL and its consequences (Wang et al., 2014; Zhang et al. 2016), this research aimed to determine the HL and its related factors among students and their families in the Republic of San Marino. The choice to investigate HL levels among university students and their relatives is based on the fact that HL is significantly associated with parents' education levels and the family's economic status (Dehghankar et al. 2019; Duplaga and Grysztar 2021).

Furthermore, setting this study in the context of the Republic of San Marino was justified for the following considerations:

- It belongs to the WHO's Small Countries Initiative (SCI) network (Anckar 2020). One of the emerging themes in this organization is the monitoring and measurement of HL, with particular reference to young people and their families (Muscat and Camilleri 2018).
- During a meeting held on 5th December 2024 and organized by UNAR (Ufficio Nazionale Antidiscriminazioni Razziali), the Ministry of Health of the Republic of San Marino, has pointed out the concept of HL in its broader theorization on the youth population and their families, trying to highlight some specificities that justify this study.
- Furthermore, the attention on this territory is derived from the fact that the Sammarinese population has reached very high levels of life expectancy at birth (overall: 85.08; 83.17 years for men and 86.96 years for women), placing the Republic among the countries with one of the highest life expectancies in the world. Consequently, a low HL in this context may be a possible variable that can imply this outcome (Authority per l'autorizzazione, l'accreditamento e la qualità dei servizi sanitari, socio-sanitari e socio-educativi, 2022).
- For these considerations, identifying the factors associated with a low HL among Sammarinese people is crucial. Moreover, in the hypothesis that low HL will be present, this will underscore its significance as a crucial public health issue. Therefore, the measurement of HL captures its social value, which guarantees the overall health of this population, reducing structural inequalities and the lack of access to healthcare resources.
- Undoubtedly, another important concern for Sammarinese policymakers is the measurement of university students' health literacy, because the young people are the future leaders in the Small Countries. Ensuring their health and wellbeing now and in the future, is one of the strongest mechanism available to safeguard the collective future of the Republic of San Marino and to secure a more just society and healthier and more productive Republic, following the Government guidelines.
- To the best of our knowledge, the current level of HL among university students in San Marino is unknown, making it difficult to design effective health interventions.
- University students are considered ideal targets for initiating health promotion programs where HL is one of the main aspects. Their uniqueness lies mainly in the availability of human and physical resources to foster the adoption of healthy lifestyle changes. University students are in a critical growth stage for health interventions to create healthy lifestyles. Since human health ensures community health, it is important to determine

any effects and changes to promote the health of younger generations.

The main aims of this research were as follows: (1) to measure, identify and analyze the levels of HL and the factors that influence it in this population, using a quantitative method through a questionnaire, titled of HLS-EU-Q47 (Health Literacy Survey—European Union Questionnaire—47), developed by M-POHL (Measuring Population and Organizational Health Literacy). (2) To investigate the relationship of HL with sociodemographic variables and state of health in the population of students and their families, attending degree courses at the University of the Republic. We believe that this study will support future research and youth and family health promotion programs by enabling data-driven decisions based on academic fields and the factors that positively or negatively influence HL. (3) Through the logistic regression, to analyze relationship between HL and several independent variables among university students and their family in this territory. The independent variables included were age, level of education, employment status, income, self-perceived health and activity limitations.

2 Material and methods

Following Parker & Ratzan's theory (Parker & Ratzan 2010), Nutbeam classification (Nutbeam 2017) and Sørensen framework (Sørensenet al. 2015), HL was classified into three categories: i.e., interactive, functional, and critical. This allowed the construction of a 4×3 matrix with four aspects of dealing with health-related information (accessibility, understanding, evaluation, and application) and three domains of health-related tasks (healthcare, disease prevention, and health promotion) (See Table 1).

Following the matrix and the guidelines of M-POHL Consortium, a questionnaire was developed, adopting the criteria which should be used to assess any measurement instru-

Table 1 Adapted version from the Sørensen model and comparison with Nutbeam's typologies. HLS-EU health literacy matrix

Health literacy (47 items)	Accessibility to information (12 items)	Understanding the information (12 items)	Evaluation on information (12 items)	Application/Use of Information (11 items)	Indexes obtainable per row
Health care (16 items)	1. Ability to access medical or clinical information **(3 items)**	2. Ability to understand and evaluate medical information and derive meaning from it **(5 items)**	3. Ability to interpret and evaluate the doctor's information **(4 items)**	4. Ability to make informed decisions about medical problems **(4 items)**	**HLS-EU Sub-index Health Care (HC-HL)**
Disease prevention (15 items)	5. Ability to access information on health risk factors **(4 items)**	6. Ability to understand information related to risk factors **(3 items)**	7. Ability to evaluate and interpret information on risk factors **(5 items)**	8. Ability to judge the relevance of information on risk factors **(3 items)**	**HLS-EU Sub-index Disease Prevention (DP-HL)**
Health promotion (16 items)	9. Ability to keep up to date on health problems **(5 items)**	10. Ability to understand health-related information and derive meaning from it **(4 items)**	11. Ability to evaluate and interpret information relating to health issues **(3 items)**	12. Ability to form an informed opinion on health problems **(4 items)**	**HLS-EU Sub-index Health Promotion (HP-HL)**
Sub-index by dimension of HL	**HLS-EU Sub-index Obtain Information (OI-HL)** (Interactive HL)	**HLS-EU Sub-index Understand Information (UI-HL)** (Functional HL)	**HLS-EU Sub-index Process Information (PI-HL)** (Critical HL)	**HLS-EU Sub-index Apply Information (AI-HL)** (Critical HL)	**Index of general Health Literacy (Gen-HL)** (HLS-EU-Q47)

Number of items in the HLS-EU-Q47 for each cell was added into the original table of Sørensen et al (2012) for this publication

ment, considering also its psychometric proprieties in terms of validity and reliability. For these considerations this instrument can be immediately utilized in any European Country.

In this study, the Italian version of HLS-EU-Q47 was used to measure HL (Palumbo et al. 2016; Dietscher and Pelikan 2019). It is composed of 47 items, that are related to the difficulty/ease of access (12 items), comprehension (12 items), evaluation (12 items), and application of information (11 items) in the domains of healthcare (16 items), disease prevention (15 items), and health promotion (16 items).

The first section of the questionnaire comprised the presentation of the study's participation conditions and the request for informed, voluntary, and clear consent along with confirmation of age being over 14 years. The second section consisted of the HLS-EU-Q47 scale, and it is formed by 47 questions. Another two sections related to sociodemographic characteristics (16 items) and state of health and lifestyles information (19 items) are present. The overall number of items was 82 and the estimated response time was 30 min.

The 47 survey items assessing self-reported HL skills were formulated as direct questions. It asked about the functional, communicative and critical level of HL in the Italian language. Participants were asked to rate their ability to deal with health-related issues on a 4-point Likert rating scale where 1 indicated 'very difficult', 2 'fairly difficult', 3 'fairly easy' and 4 'very easy'. In the event of the respondent not being able to select, or wishing not to select any of these options, the interviewer marked the particular item "difficult to say/not applicable". The score based on the responses to the 47 items was calculated according to the methodology of the HLS-EU project team.

The items of the survey assessing self-perceived HL were aggregated in a general HL index, which provided a synthetic measure of HL levels. Respecting the guidelines of the M-POHL (Pelikan et al. 2014; Sørensen et al. 2013a, b; Sørensen et al. 2015; Maie et al. 2021)), the index was standardized (SLI) on a scale from a minimum of 0 (lowest level of HL) to a maximum of 50 (best level of HL), using the formula:

$$\mathrm{SLI} = [(\mathrm{Mean}_{\mathrm{HL\ index}} - 1) \times (50/3)]$$

In this formula the mean represents the average response in each index. This standardization facilitated comparability across different studies and populations by rescaling raw scores into a unified metric. The choice of this standardization method was driven by its widespread use in European HL research and its ability to categorize HL levels (Inadequate, Problematic, Sufficient, Excellent) in a consistent and internationally recognized manner.

In line with European studies, three different thresholds were established to allocate the respondents into four groups, which reflected their HL abilities:

- Group 1 ("Inadequate HL") included people who scored between 0 and 25.00.
- Group 2 ("Problematic HL") included people who scored between 25.01 and 33.00
- Group 3 ("Sufficient HL") included people who scored between 33.01 and 42.00.
- Group 4 ("Excellent HL") included people who scored between 42.01 and 50.00.

Both Group 1 and Group 2 were assumed to include the respondents who lived with limited HL skills (combining inadequate and problematic HL levels). A pretest was conducted with 48 representative individuals from the target population, and no corrections to the questions or formatting were required. This classification system facilitates the identification of indi-

viduals or populations that may benefit from targeted HL interventions (Manochaiwuthikul et al. 2025).

Sampling was conducted through a convenience method, leveraging university mailing lists and institutional collaborations to disseminate the questionnaire. Participation was voluntary, anonymous, and preceded by informed consent. Although randomization procedures were not implemented, efforts were made to capture a broad demographic representation of the population under study, particularly in terms of age, gender, and socioeconomic background.

The study population was composed of all students enrolled in undergraduate and master's degree programs and their families. Students from all academic years were considered. A total of 2000 students were enrolled for the 2023–2024 academic year, resulting in a population of almost 8000 persons.

A minimum sample size of 319 was determined using Open EPI online program, with a 95% confidence level, a population proportion of 31.6%, an estimated population size of 8000, and a margin of error of 5%. To reduce the margin of error to 4%, a sample of 488 respondents was determined, increased by 25% to account for potential non-responses (610). The sample comprised 662 units, exceeding the required size to achieve a 4% margin of error. Based on the calculations outlined, the sample was considered representative. The interviewees were selected according to the quota method respecting the structure of the Sammarinese population in terms of gender, age and faculty (Touzani et al. 2024a, b).

The study was conducted during the period March to June 2023 and covered 662 students and their relatives. The instrument HL-EU-Q47 was used and administered using the Paper Assisted Personal Interview (PAPI) method. Following the necessary authorizations, an email invitation to participate in the study was disseminated to all undergraduate and master's degree students (Pelikan et al. 2022).

Outcome variables were calculated utilizing the SLI categorized into two levels: 'Inadequate or Problematic HL' and 'Sufficient or Excellent HL'. The percentages of 'Inadequate or Problematic HL' were calculated first, together with the general standardized HL index, both globally and according to the study variable categories, with a 95% confidence interval (CI 95).

The chi-square test was used to analyze the association between 'Inadequate or Problematic HL' and demographic, socioeconomic and status variables. Independent t-test and one-way ANOVA were employed to compare the mean scores of the HL scale among independent groups. In this study we were interested in assessing the predictors of the prevalence of limited literacy. For this reason, multiple logistic regression models were used, to provide the much-needed reliability of empirical study results (Hosmer et al. 2013). Over the last two decades the logistic regression model has become, in many fields, the standard method of analysis in this situation. Indeed, it is the best model when some of the variables are qualitative rather than quantitative or when the required assumptions for multiple regression analysis (e.g., linearity, independence, etc.) are not met (Fang 2013; Cerioli and Lauirni 2019). In this study, the dichotomous dependent variable was derived from the SLI, which was first converted into a categorical variable with four levels. The 'inadequate' and 'problematic' levels were then collapsed into a 'limited HL' category, while the 'sufficient' and 'excellent' levels were merged into a 'non-limited HL' category, following the thresholds proposed by the M-POHL. This transformation allowed the use of multiple logistic regression models to explore associations between HL and the independent variables of interest.

Furthermore, this model was chosen because it provides interpretable estimates through adjusted odds ratios (O.R.). O.R., with 95% confidence intervals, and p-values were reported to show the association between the dichotomous HL variable (inadequate or problematic HL) and the independent variables (Duplaga and Grysztar 2021; Tamayo-Fonseca et al. 2023; Rosário et al. 2024a, b; Manochaiwuthikul et al. 2025).

The first category for each sociodemographic variable (i.e. Age 14–24 years, No Studies, etc.) is used as the reference value (Ref.; O.R. = 1) for the figures assigned to the subsequent categories within each of the sociodemographic variables (Table 7).

Alternative approaches, such as linear regression or ordinal logistic models, were considered less appropriate given the goal of identifying clear risk profiles based on HL adequacy levels. Moreover, dichotomization facilitates comparability with previous studies adopting similar classifications in this particular topic of research (Pelikan et al. 2014; Sørensen et al. 2015; Tamayo-Fonseca et al. 2023).

For all estimates and models, IBM SPSS 26 software was employed.

3 Results

Among the 82 questionnaire items, 3 had a missing response rate ≥ 10% (including "don't know/no answer"), all in the HL section. Missing data were relatively high in the HL section (from 0% to 13.29%). For the sociodemographic and lifestyle section and for the health status section, missing data reached a lower percentage, 5.74% and 6.04%, respectively. Missing values in the HL section were ignored in the calculation of the SLI index, while, if a value was missing in the other two sections, the statistical unit was not considered pairwise in the bivariate and multivariate analysis.

The first phase of analysis (Table 2) summarizes the sociodemographic characteristics of the 662 participants: 50.9% of the participants identified as male, 49.5% were employed, 28.4% had completed secondary school, 32.9% aged between 40 and 64 years and 26.0% indicated a monthly income of more than 2.950€.

Table 3 and Fig. 1 display the distribution of HL levels by percentages across general HL and domains. It was observed that 20% of the population had an inadequate level for general HL, while 1.21% had an excellent level. Processing information related to health promotion appears to be more challenging for the students and their families with 26.06% of inadequate HL, compared to 24.55% for disease prevention and 17.58% for health care. In terms of the healthcare domains, limited HL was observed to have a higher percentage in health promotion (62.73%), while adequate HL was observed to have a higher percentage in health care (47.27%).

The mean SLI (Table 4) was 30.4 ± 7.0, in a range from 0 to 50. The domains of HL pertaining to healthcare, disease prevention, and health promotion were observed to be 31.1 ± 7.3, 30.1 ± 8.1, and 29.4 ± 8.3, respectively. Furthermore, Table 4 presents the distributions of the means and standard deviations of the SLI according to the management of information of HL: finding, understanding, evaluating, and applying. The highest value of the SLI was observed in the applying information in healthcare (37.9 ± 8.3) and understanding of disease prevention (34.4 ± 9.5). The lowest scores were observed in finding information at the level of health promotion (26.0 ± 10.7) and evaluating information in healthcare (24.9 ± 10.6).

Tables 5 and 6 show that 59.70% of participants showed inadequate or problematic HL, particularly among people > 85 years (90.91%); people with a low level of education (87.50% no studies, 90.24% primary education); retired people (75.93%); low-income people (94.74%); people with a perceived poor health status (65.00%); and people with chronic disease (65.08%) or with activity limitations (71.88% severe, 64.37% not severe). Significant differences were also found in the means of SLI.

When adjusting a multivariate model using logistic regression (Table 7) with HL ('Inadequate or Problematic HL' versus 'Sufficient or Excellent HL') as a response, and socioeconomic and health status as explanatory variables, all presented a significant association except 'sex' and 'chronic disease'.

Following these analyses, it was confirmed that any individual belonging to the following groups—age group 65–84 years; retired employment status; income between €800 and €1350 per month; poor self-perceived health; and non-severe limitation of activities—would be highly likely to present 'Inadequate or Problematic HL'. The estimated probability using the model was 91.47%.

By comparison, an individual belonging to one or more of the following groups—university-educated young person; age group 25–39 years; employed; monthly income between €2950–3600; declaring a good self-perceived state of health; and no activity limitations—would have a low probability of presenting 'Inadequate or Problematic HL'. The estimated probability using the model was 44%.

4 Discussion

The findings of this study offer critical insights into HL levels among university students and their families in the Republic of San Marino. A total of 662 participants were included in the research, representing a diverse sample in terms of age, gender, education level, income and employment status. Overall, 59.7% of participants were classified as having 'Inadequate or Problematic HL', which is consistent with similar studies conducted across Europe, such as the HLS-EU (Sørensen et al. 2013a, b).

The results showed a clear age difference in HL levels, with older adults having significantly lower HL than younger participants. Indeed, Table 6 showed that participants aged 85 years and more had the highest percentage of 'Inadequate or Problematic HL', at 90.91% (95% CI 78.90–100%). This finding is consistent with existing literature (Schaeffer et al. 2017), which suggested that older adults are particularly vulnerable to low HL due to factors such as cognitive decline, less exposure to health education during formative years, and limited access to digital health information (Pleasant 2014; Rudd 2015). Additionally, older individuals may struggle with the increasing complexity of healthcare systems, where digital platforms and health self-management tools are becoming more prevalent, increasing their difficulties in accessing and understanding health information (Ghahfarokhi 2025). This highlights an age-related divide, with younger participants, particularly those aged 25–39 years, demonstrating much lower rates of inadequate HL, with only 35.29% (95% CI 23.94–46.65%) falling into the 'Inadequate or Problematic HL' category. This suggested that younger people, especially students, may benefit from better access to digital tools and newer health education programs, which often include elements of digital literacy and interactive learning (Mackert et al. 2014). Younger participants' relative familiarity with online

health resources may also contribute to their higher levels of interactive HL, enabling them to engage more effectively with both digital health platforms and health providers.

The general level of HL among university students appears to remain insufficient and needs to be improved. Indeed, among younger participants, over a third still reported difficulties with HL. This finding highlights the continued need for health education campaigns aimed at improving HL among younger populations, particularly in relation to critical HL, viz. the ability to critically evaluate and act on health information in the context of broader social and economic determinants (Kühn et al. 2022). In general, it is recommended that universities pay more attention to the promotion of HL when planning future courses for students.

Participants aged 40–64 years exhibited relatively high rates of 'Inadequate or Problematic HL', with 55.05% (95% CI 48.44–61.65%), highlighting the persistence of HL challenges within the middle-aged population. This middle group often has to balance work, family responsibilities, and managing chronic health conditions, which can compound the difficulties of navigating health information and making informed decisions. Stresses associated with midlife, including caring for both children and aging parents, may also increase the cognitive load required to process health information, leading to higher rates of 'Inadequate or Problematic HL' (Zarcadoolas et al. 2006).

Odds ratios further confirmed these age-related differences. Participants aged 65–84 years were 191% more likely to have 'Inadequate or Problematic HL' than those aged 14–24 years (OR = 2.913, 95% CI 1.054–8.045, $p = 0.039$). For participants aged 85 years and older, the odds increased dramatically, with a 1056% higher likelihood of having 'Inadequate or Problematic HL' than the reference group (OR = 11.567, 95% CI 1.868–71.639, $p = 0.009$). These results indicate that individuals aged 85 years and older were 11.56 times more likely to experience 'Inadequate or Problematic HL' than those aged 14–24 years.

In terms of gender differences, the study found that women were slightly more likely to have 'Inadequate or Problematic HL' than men, with 62.96% of women falling into this category compared to 56.55% of men (Table 6) but with no significant differences.

However, although the gender difference was not statistically significant, it reflects broader trends observed in other studies of HL and gender (Garcia et al. 2013). Despite often being the primary caregivers for health care and management in families, women may face additional challenges in managing health information due to overload and complexity of health systems (DeWalt et al. 2004; Abdelwadoud et al. 2024).

Educational level emerged as one of the most significant predictors of HL. Participants with no formal education or only primary education showed the highest rates of 'Inadequate or Problematic HL'. Specifically, 87.50% (95% CI 71.29–100%) of those with no formal education and 90.24% (95% CI: 83.82–96.67%) of those with only primary education fell into this category (Table 6). These findings are consistent with international literature, which links low educational attainment to poor HL skills (Chinn 2011; Rababah et al. 2019; Bhusal et al. 2021). Individuals with limited education may lack the reading, numeracy, and comprehension skills needed to interpret complex health information, such as medical instructions, drug labels, or insurance documents. This can lead to misinterpretations of medical advice, difficulty following treatment regimens, and a reduced ability to engage in preventive health behaviors (Nutbeam 2008, 2017). Additionally, individuals with lower levels of education may be less familiar with thinking and analytical skills, which are essential for

critical HL, i.e., the ability to evaluate the credibility and reliability of health information sources.

In contrast, participants with higher levels of education, such as college graduates or those with a master's degree, demonstrated significantly lower rates of 'Inadequate or Problematic HL'. Only 46.55% of college graduates (95% CI 37.47–55.63%) and 44.71% of those with a master's degree (95% CI 28.00–61.42%) reported 'Inadequate or Problematic HL' (Table 6). These findings suggested that education provides individuals with the critical thinking and communication skills needed to navigate the health care system, process health information, and make informed decisions (Nutbeam et al. 2018).

Odds ratios (Table 7) further support the strong association between education and HL. Participants with only primary education were 27.4% more likely to have 'Inadequate or Problematic HL' (OR = 1.274, 95% CI 0.235–6.905) compared to the reference group. Individuals with secondary education were 50.6% less likely to have 'Inadequate or Problematic HL' (OR = 0.494, 95% CI 0.096–2.544), although this result was not statistically significant. These results reinforce the protective effect of education on HL outcomes.

Employment status played a significant role in determining HL levels. Results indicated that retired individuals were among the most vulnerable, with 75.93% (95% CI 67.86–83.99%) of retirees exhibiting 'Inadequate or Problematic HL' (Table 6). This finding was consistent with previous studies suggesting that retirement can lead to reduced access to health information and support networks, as well as increased risk of social isolation and reduced cognitive stimulation (Kobayashi et al. 2015). Without the habitual engagement with information and communication that comes with work, retirees may experience a decline in cognitive function. Thus, their ability to process complex health information may also be reduced. Table 7 showed that retired people were 85.9% less likely to have adequate HL compared to employed people (OR = 0.141, 95% CI 0.041–0.489, $p = 0.002$), suggesting that they are approximately seven times more likely to experience 'Inadequate or Problematic HL' than those who are still in employment. Unemployed individuals also showed increased odds (OR = 0.150, 95% CI 0.014–1.672), although this result was not statistically significant.

By contrast, students and employed participants demonstrated lower rates of 'Inadequate or Problematic HL', with 50% of students and 57.32% of employed individuals falling into this category. These groups benefit from more frequent exposure to health information through workplace health programs, university curricula, or access to digital tools that improve their ability to find, evaluate, and apply health information. In addition, the unemployed group showed a 50% rate of 'Inadequate or Problematic HL', although the small sample size (n = 8) makes it difficult to draw definitive conclusions. However, unemployment is often associated with economic stress, social isolation, and reduced access to care, all of which can negatively affect HL (Schillinger et al. 2002). Further research is needed to explore the specific difficulties faced by the unemployed in accessing and understanding health information.

As expected, income was another strong predictor of HL. Participants with monthly incomes below €1,350 were significantly more likely to have 'Inadequate or Problematic HL', with 94.74% (95% CI: 87.64%—100%) of this group reporting difficulties with HL (Table 6). This finding reflects broader trends in health inequalities, where low-income individuals often face barriers in accessing health services, understanding complex medical information, and adhering to prescribed treatments (Paasche-Orlow et al. 2005). Individu-

als in lower income brackets may also experience digital exclusion, with limited access to the internet or technological tools needed to find and use health information. Additionally, financial hardship may reduce the ability to afford preventive care, such as regular checkups or health screenings. This, in turn, limits exposure to health education opportunities. The stress of managing financial hardship can affect cognitive function, making it more difficult to process and retain health information (Kutner et al. 2006). Odds ratios (Table 7) highlight the critical role of income in shaping HL outcomes. The odds ratio analysis further emphasized the economic disparities in HL. Participants earning less than €1,350 per month were significantly more likely to exhibit inadequate or problematic HL compared to higher-income individuals (OR = 0.053, 95% CI 0.007–0.392, $p = 0.004$), underscoring the critical role of socioeconomic status in shaping health outcomes.

It follows that participants with higher incomes (above €3,600 per month) demonstrated significantly better HL, with only 51.22% (95% CI 40.40–62.04%) reporting 'Inadequate or Problematic HL'. This income gradient highlights the interaction between economic conditions and health outcomes, suggesting that policies aimed at reducing economic barriers—such as providing subsidized health services or increasing access to digital health tools—could contribute to improving HL across socioeconomic levels.

The analyses revealed a significant correlation between self-perceived health status and HL levels among participants. Individuals who rated their health HL "good" showed a lower percentage of 'Inadequate or Problematic HL' (56.67%) compared to those who reported "bad" health, for whom the percentage rose to 65.00%. This suggests that those with poor self-perceived health may struggle more difficulties in accessing, understanding, and applying health information, due to the high volume of complex medical information they must manage. Odds ratios analysis supports this finding, showing that participants with negative self-perceived health were more than three times more likely to have 'Inadequate or Problematic HL' compared to those with positive self-perceived health (OR = 3.228, 95% CI 1.560–6.681, $p = 0.002$). These findings highlight the need for targeted interventions to improve HL among individuals who perceive their health as poor, as they are at significantly higher risk of poor HL.

The presence of chronic diseases emerged as a key factor associated with differences in HL levels. Participants with one or more chronic diseases were more likely to have 'Inadequate or Problematic HL' (65.08%) compared to those without chronic diseases (56.22%). Individuals with chronic conditions may face additional challenges in managing complex treatment regimens, understanding medication instructions, and navigating healthcare systems. Odds ratios analysis indicates that people with chronic conditions are 65% more likely to have 'Inadequate or Problematic HL' compared to those without chronic conditions (OR = 1.650, 95% CI 1.122–2.398, $p < 0.05$), highlighting the need to simplify health information and provide additional support to improve understanding and adherence among patients with chronic conditions.

Activity limitations were associated with proportionally lower HL levels. Specifically, 71.88% of individuals with severe limitations reported 'Inadequate or Problematic HL', compared to 64.37% of those with mild limitations and 56.12% of those without limitations. This gradient suggested that activity limitations may constitute barriers to HL, thereby hindering individuals' ability to access health services or participate fully in health-promoting behaviors. Odds ratios analysis further supports this trend, showing that individuals with severe limitations are six times more likely to have 'Inadequate or Problematic HL' than

those without limitations (OR = 6.100, 95% CI 1.666–22.328, $p = 0.006$). Those with mild limitations are approximately two and a half times more likely to have 'Inadequate or Problematic HL' (OR = 2.466, 95% CI 1.042–5.836, $p = 0.040$). These findings suggested a critical need for health information and resources to be adapted to different physical abilities, to ensure that people with activity limitations have equal access to health information. These results are in line with those present in the literature and confirmed the presence of a social gradient in the HL arena (Touzani et al. 2024a, b).

Finally, it follows that an individual aged 65 to 84 years, retired, with a monthly income between €800 and €1,350, who perceives his or her health HL poor and with non-severe limitations, has a 91.5% probability of having 'Inadequate or Problematic HL'. This probability is derived from the combined influence of being retired (OR = 0.141), aged between 65 and 84 years (OR = 2.913), having an income between €800 and €1,350 (OR = 0.053), perceiving poor self-reported health (OR = 3.228), and having non-severe limitations (OR = 2.466).

On the other hand, a second type of individual analyzed—aged between 25 and 39 years, employed, with a monthly income between €2,950 and €3,600, with self-perceived good health and without activity limitations—has only a 44% probability of having 'Inadequate or Problematic HL'. This is supported by the odds ratios for being employed (OR = 1), being aged between 25 and 39 (OR = 0.410), having an income between €2,950 and €3600 (OR = 0.031), and having self-perceived good health (OR = 1).

5 Strengths and weaknesses of the study

The study makes a significant contribution to the conceptualization of HL in university students and their families, especially in the Small States, such as Republic of San Marino.

The HLS-EU-Q47 questionnaire supports distinct functions for policy, practice and research very well. By measuring 47 key items it enables the identification of the HL capabilities of specific populations and subpopulations. It therefore acts as a solid diagnostic basis for enabling health policy to target tailored interventions for improving specific aspects of HL for these populations.

The use of HLS-EU-Q47 as a tool to measure the HL of the different student groups and their families, was found to be both feasible and practicable, in addition to its validity and reliability. The score for each individual scale also provided a detailed and action-orientated picture of the HL strengths and limitations among sociodemographic variables of the different student groups and their families. Furthermore, it considers the 3 main aspects of HL: functional, interactive and critical.

The findings of this study set out the HL profile of students at varying stages of their degree courses and their families at the University of the Republic of San Marino and thus may have limited generalizability to a broader population. Nonetheless, the research constitutes a significant contribution to the literature by elucidating the relationship between university students and their HL (Elsborg et al. 2017). It is believed that the methodology could be readily transferred to other Small States around the world, and therefore it is desirable that the results obtained in this study would be brought to the attention of their local health authorities, facing similar public health challenges, highlighting the need for specific strategies to address HL disparities effectively.

Inevitably, there are a number of limitations in the research. One is that it is possible that only the more enthusiastic and interested students and their families completed the survey. (Van den Broucke and Renwart 2014).

Nonetheless, we acknowledge that a complementary analysis using multiple linear regression, rather than logistic regression, would be appropriate in the context of further research specifically focused on the analysis of continuous outcome variable. This modelling approach would enable the estimation of the direct impact of several independent factors on the average level of the outcome, thereby allowing for a more straightforward and quantitatively interpretable analysis of the regression coefficients. Moreover, it could potentially provide additional insights into the characteristics that influence HL, enhancing the interpretability of the results. This approach could be incorporated into future studies—particularly when the dependent variable is the HL score—in order to assess the robustness of the findings from alternative statistical perspectives.

Furthermore, it is important to note that the widely used original definition of HL, based on an individual's ability to process and use information for health gains, needs to be updated in light of recent empirical studies. Arguably the current iteration of the definition of HL, proposed in the most recent literature (Liu et al. 2020), makes the most sense: "*HL is 'the ability of an individual to obtain and translate knowledge and information in order to maintain and improve health in a way that is appropriate to the individual and system contexts"*. This highlights the diversity of needs from different individuals and the importance of interactions between individual consumers, healthcare providers and healthcare systems for maintaining health. This whole-system view can help people to better understand the role of HL and what needs to be done to improve it. However, Liu's definition represents only a first step, because there is a need for a unanimous consensus for the definition and conceptualization of HL, and its measurement, which will require further studies and embrace additional techniques, such as the Delphi method.

Overall, these strengths and limitations outline both the robustness and areas for improvement of this study's design, offering guidance for future research.

6 Conclusions

Parker & Ratzan, have proposed an HL framework that makes explicit the extent to which HL is mediated by the situational demands and complexities that are placed on people.

The importance of HL within public health has led to the development of comprehensive assessment tools developed by M-POHL. Among this, the Health Literacy Survey Questionnaire (HLS-EU-Q47), enabling cross-country comparisons, following Sorensen's framework and Nutbeam classification. As global public health increasingly focuses on HL in Small Countries, assessing it among university students has become important, given their role as emerging professionals and influencers within society. In the Republic of San Marino too, university students, undergoing substantial life transitions, are a key demographic for targeted HL enhancement due to their need for informed decision-making that can influence long-term health outcomes.

Percentages of 'Inadequate or Problematic HL' differed according to characteristics of the population groups. A specific population group with 'Inadequate or Problematic HL' level was identified. This profile should be regarded as a target group for HL improvement

measures, including the implementation of specific policies and programs. The ultimate objective would thus be to reduce health disparities and to help to improve health status (Sentell and Halpin 2006; Paasche-Orlow and Wolf 2010). The results are in line with the literature, showing a significant relationship between HL and key determinants such as, older age, low educational levels, lower income, low perceived health status and activity limitations, among others. The findings are consistent with those of HLS-EU Survey and other studies conducted in other countries (Uysal et al. 2020; Dauletkaliyeva et al 2025).

Future studies should adopt longitudinal designs to monitor changes in HL over time and evaluate the impact of various intervention strategies. Such evidence is crucial for refining HL interventions and ensuring they are tailored to the diverse needs of university students and their families. By integrating HL as a priority within educational and public health policies, students can be equipped with the competencies needed to enhance health outcomes and contribute to building a healthier society in the Republic of San Marino.

Appendix

See Fig. 1

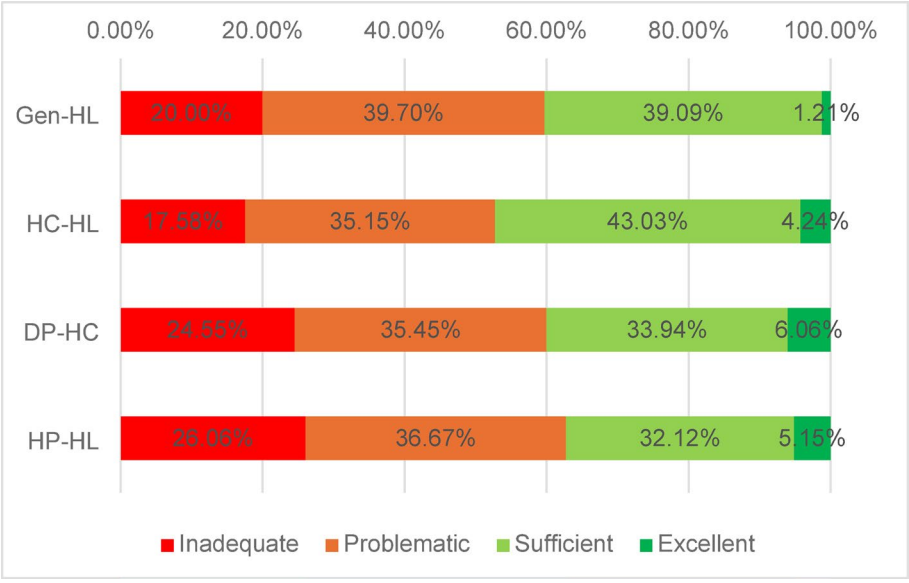

Fig. 1 Distribution of HL levels across general HL (Gen-HL) and domains

See Tables 2, 3, 4, 5, 6 and 7

Table 2 Sociodemographic sample description

Sample size: 662	Employment status
Gender	Working: 328 (49.5%)
Male: 337 (50.9%)	Unemployed: 8 (1.2%)
Female: 325 (49.1%)	Retired: 108 (16.3%)
	Studying: 156 (23.6%)
	Other: 16 (2.4%)
Age groups (years)	Income
14–24: 208 (31.4%)	€800–€1.350: 38 (5.7%)
25–39: 68 (10.3%)	€1.350–€1.850: 48 (7.3%)
40–64: 218 (32.9%)	€1.850–€ 2.400: 74 (11.2%)
65–84: 106 (16.0%)	€2.400–€ 2.950: 54 (8.2%)
85+: 22 (3.3%)	€2.950–€ 3.600: 90 (13.6%)
	>€3.600:82 (12.4%)
Education	
No studies: 16 (2.4%)	
Primary: 82 (12.4%)	
Secondary:188 (28.4%)	
High School Diploma: 184 (27.8%)	
Bachelor's Degree: 116 (17.5%)	
Master's Degree:34 (5.1%)	

Table 3 Distribution of HL levels across general HL (Gen-HL) and domains

	Inadequate (%)	Problematic (%)	Sufficient (%)	Excellent (%)
Gen-HL	20.00	39.70	39.09	1.21
HC-HL	17.58	35.15	43.03	4.24
DP-HL	24.55	35.45	33.94	6.06
HP-HL	26.06	36.67	32.12	5.15

Table 4 Distribution of the means and standard deviations of the SLI according to the competences of HL: access, understand, apprise and apply (on a scale 0–50)

HL dimensions	HL competencies and SLI				
	Find/access	Understand	Evaluate	Apply	All
Healthcare	29.6 ± 10.1	32.5 ± 10.1	**24.9 ± 10.6**	*37.9 ± 8.3*	*31.1 ± 7.3*
Disease prevention	31.1 ± 11.3	*34.4 ± 9.5*	28.7 ± 10.4	26.5 ± 10.9	30.1 ± 8.1
Health promotion	**26.0 ± 10.7**	30.9 ± 10.4	33.7 ± 10.7	29.3 ± 11.6	29.4 ± 8.3
All	29.2 ± 9.0	32.4 ± 7.8	28.0 ± 8.3	31.3 ± 7.3	30.4 ± 7.0

Values in bold represent the lowest scores observed, whereas values in italics represent the highest scores

Table 5 Levels of HL

Level of HL	General HL (%)
Inadequate or problematic HL	59.70
Sufficient or excellent HL	40.30

Table 6 Percentages of 'Inadequate or Problematic HL' and mean values of the standardized literacy index (95% CI), according to categories of the explanatory sociodemographic and health status variables

Variable	Subjects	Inadequate or Problematic HL			Standardized literacy index		
	n	%	95% CI		Mean values	95% CI	
			Lower limit	Upper limit		Lower limit	Upper limit
Total sample	662	59.70%	55.96%	63.44%	30.39	29.86	30.93
Sociodemographic variables							
Age (Years)**							
14–24	208	52.88%	46.10%	59.67%	32.20	31.47	32.93
25–39	68	35.29%	23.94%	46.65%	33.26	31.71	34.82
40–64	218	55.05%	48.44%	61.65%	31.86	31.12	32.59
65–84	106	79.25%	71.52%	86.97%	26.48	25.12	27.84
85 and more	22	90.91%	78.90%	100%[a]	19.30	16.50	22.10
Sex							
Male	337	56.55%	51.26%	61.84%	30.87	30.13	31.60
Female	325	62.96%	57.71%	68.21%	29.91	29.13	30.68
Level of education**							
No studies	16	87.50%	71.29%	100%[a]	22.07	17.46	26.68
Primary	82	90.24%	83.82%	96.67%	23.51	21.67	25.35
Secondary	188	61.70%	54.75%	68.65%	30.46	29.68	31.25
High School	184	48.91%	41.69%	56.14%	32.27	31.46	33.08
Bachelor's degree	116	46.55%	37.47%	55.63%	32.73	31.53	33.92
Master's degree	34	64.71%	48.64%	80.77%	31.72	29.96	33.47
Employment status**							
Working	328	57.32%	51.96%	62.67%	31.28	30.59	31.97
Unemployed	8	50.00%	15.35%	84.65%	30.63	26.79	34.47
Retired	108	75.93%	67.86%	83.99%	24.89	23.20	26.58
Studying	156	50.00%	42.15%	57.85%	33.43	23.20	26.58
Other	16	62.50%	38.78%	86.22%	30.29	26.98	33.60
Income**							
€800–€1.350	38	94.74%	87.64%	100%[a]	23.13	20.77	25.50
€1.350–€1.850	48	66.67%	53.33%	80.00%	30.23	28.45	32.02
€1.850–€ 2.400	74	62.16%	51.11%	73.21%	28.88	27.25	30.50
€2.400–€ 2.950	54	74.07%	62.39%	85.76%	29.81	28.32	31.30
€2.950–€ 3.600	90	60.00%	49.88%	70.12%	31.29	29.56	33.01
>€3.600	82	51.22%	40.40%	62.04%	32.95	32.00	33.90
Health status variables							
Self-perceived health**							
Good	420	56.67%	51.93%	61.41%	31.88	31.32	32.44
Bad	240	65.00%	58.97%	71.03%	27.79	26.77	28.81
Chronic disease**							
No	370	56.22%	51.16%	61.27%	28.69	27.71	29.67
Yes	252	65.08%	59.19%	70.97%	31.54	30.93	32.16
Activity limitation**							
Severely limited	64	71.88%	60.86%	82.89%	25.32	23.07	27.56
Limited but not severely	174	64.37%	57.25%	71.48%	29.20	28.10	30.30
Not at all limited	392	56.12%	51.21%	61.03%	31.66	31.06	32.26

**Statistically significant variables, $p<0.05$, based on the differences in percentages and mean values of SLI according to categories, established by the chi square test, the Student's t-test and ANOVA

The upper limit of the calculated confidence interval exceeded 100% due to the approximation method used; it was therefore reported as 100% for consistency with the natural range of percentages

Table 7 Adjusted odds ratios and 95% CI association between HL ('Inadequate or Problematic HL' vs. 'Sufficient or Excellent HL') and sociodemographic and health variables

Variable	Adjusted OR	95% CI		*p*
		Lower limit	Upper limit	
Sociodemographic variables				
Age (Years)*				<0.001*
14–24	Ref			
25–39	0.410	0.203	0.828	0.013*
40–64	0.733	0.378	1.421	0.358
65–84	2.913	1.054	8.045	0.039*
85 and more	11.567	1.868	71.639	0.009*
Sex				0.582
Male	Ref			
Female	0.848	0.473	1.523	0.582
Level of education*				0.002*
No studies	Ref			
Primary	1.274	0.235	6.905	0.779
Secondary	0.494	0.096	2.544	0.399
High school	0.251	0.048	1.311	0.101
Bachelor's Degree	0.281	0.053	1.488	0.135
Master's Degree	0.479	0.079	2.900	0.423
Employment status*				0.002*
Working	Ref			
Unemployed	0.150	0.014	1.672	0.123
Retired	0.141	0.041	0.489	0.002*
Studying	0.153	0.153	0.529	0.003*
Other	0.951	0.297	3.047	0.933
Income*				<0.001*
Da €800 a €1.350	Ref			
Da €1.350 a €1.850	0.053	0.007	0.392	0.004*
Da € 1.850 a € 2.400	0.080	0.011	0.573	0.012*
Da € 2.400 a € 2.950	0.287	0.037	2.205	0.230
Da € 2.950 a € 3.600	0.053	0.008	0.359	0.003*
€3.600 and more	0.031	0.004	0.227	0.001*
Health status variables				
Self-perceived health*				0.002*
Good	Ref			
Bad	3.228	1.560	6.681	0.002*
Chronic disease				0.166
No	Ref			
Yes	0.595	0.286	1.241	0.166
Activity limitation*				0.014*
Not at all limited	Ref			
Limited but not severely	2.466	1.042	5.836	0.040*
Severely limited	6.100	1.666	22.328	0.006*

*Significant differences (Ref.: O.R. = 1)

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Declarations

Informed consent Interviewees were invited to read the informed consent before completing the questionnaire.

References

Abdelwadoud, M., Huang, J., Villalonga-Olives, E., dosReis, S., Jansky, L., Mullins, C.D., Kusinitz, M., Ovelmen, H., Ju, J.: Women's health information-seeking experiences and preferences for health communications on FDA-regulated products: a qualitative study in urban area. Int. J. Environ. Res. Public Health **21**(3), 321 (2024)

Almeida, S., Pinto, E., Correia, M., Veiga, N., Almeida, A.: Evaluating e-health literacy, knowledge, attitude, and health online information in Portuguese university students: a cross-sectional study. Int. J. Environ. Res. Public Health **21**(3), 271 (2024)

Anckar, D.: Small states: politics and policies. In: Handbook on the politics of small states, pp. 38–54. Edward Elgar Publishing (2020)

Apfel, F., Tsouros, A. D. Health literacy: the solid facts. Copenhagen: World Health Organization, **15**(1), 3–26 (2013)

Authority per l'autorizzazione, l'accreditamento e la qualità dei servizi sanitari, socio-sanitari e socio-educativi (2022). Profilo di salute della Repubblica di San Marino, anno 2022

Batterham, R.W., Hawkins, M., Collins, P.A., Buchbinder, R., Osborne, R.H.: Health literacy: applying current concepts to improve health services and reduce health inequalities. Public Health **132**, 3–12 (2016). https://doi.org/10.1016/j.puhe.2016.01.001

Bello, C.B., Akinwale, O.D., Elemile, M.G.: Understanding the concept of health literacy: a strategy to improve nursing practice. J. Integr. Nurs. **6**(4), 241–249 (2024)

Bennett, I.M., Chen, J., Soroui, J.S., White, S.: The contribution of health literacy to disparities in self-rated health status and preventive health behaviors in older adults. Ann. Fam. Med. **7**(3), 204–211 (2009)

Berkman, N.D., Sheridan, S.L., Donahue, K.E., Halpern, D.J., Crotty, K.: Low health literacy and health outcomes: an updated systematic review. Ann. Intern. Med. **155**(2), 97–107 (2011). https://doi.org/10.7326/0003-4819-155-2-201107190-00005

Berry, L.L., Danaher, T.S., Beckham, D., Awdish, R.L., Mate, K.S.: When patients and their families feel like hostages to health care. In: Mayo Clinic Proceedings, vol. 92, pp. 1373–1381. Elsevier (2017)

Bhusal, S., Paudel, R., Gaihre, M., Paudel, K., Adhikari, T.B., Pradhan, P.M.S.: Health literacy and associated factors among undergraduates: a university-based cross-sectional study in Nepal. PLoS Glob. Public Health **1**(11), e0000016 (2021)

Bøggild, H.: HLS19 Consortium of the WHO Action Network M-POHL. International report on the methodology, results, and recommendations of the European health literacy population survey 2019–2021 (HLS19) of M-POHL (2021)

Bröder, J., Okan, O., Bauer, U., Bruland, D., Schlupp, S., Bollweg, T.M., et al.: Health literacy in childhood and youth: a systematic review of definitions and models. BMC Public Health **17**, 1–25 (2017)

Cerioli, A., Laurini, F.: Il modello di regressione logistica per le applicazioni aziendali. Uni.Nova Editore (2019)
Chinn, D.: Critical health literacy: a review and critical analysis. Soc Sci Med **73**(1), 60–67 (2011). https://doi.org/10.1016/j.socscimed.2011.04.004
Dauletkaliyeva, Z., Bolatova, Z., Yerdessov, N., Nukeshtayeva, K., Zhamantayev, O., Takuadina, A., Kayupova, G.: Health literacy and influencing factors in university students across diverse educational fields in Kazakhstan. Sci. Rep. **15**(1), 3197 (2025)
DeWalt, D.A., Berkman, N.D., Sheridan, S., Lohr, K.N., Pignone, M.P.: Literacy and health outcomes: a systematic review of the literature. J. Gen. Intern. Med. **19**(12), 1228–1239 (2004). https://doi.org/10.1111/j.1525-1497.2004.40153.x
Dehghankar, L., Panahi, R., Kekefallah, L., Hosseini, N., & Hasannia, E. (2019). The study of health literacy and its related factors among female students at high schools in Qazvin. J. Health Lit. **4**(2), 18–26. https://doi.org/10.22038/jhl.2019.40390.1055
Dietscher, C., Pelikan, J.: The action network for measuring population and organizational health literacy (M-POHL) and its health literacy survey 2019 (HLS19). Eur. J. Public Health **29**(Supplement_4), ckz185-556 (2019)
Duplaga, M., Grysztar, M.: Socio-economic determinants of health literacy in high school students: a cross-sectional study. Int. J. Environ. Res. Public Health **18**(22), 12231 (2021)
Elsborg, L., Krossdal, F., Kayser, L.: Health literacy among Danish university students enrolled in health-related study programmes. Scand. J. Public Health **45**(8), 831–838 (2017)
Fang, J.: Why logistic regression analyses are more reliable than multiple regression analyses. J. Bus. Econ. **4**(7), 620–633 (2013)
Ghahfarokhi, Z.S.: Challenges in health and technological literacy of older adults: a qualitative study in Isfahan. BMC Geriatr. **25**(1), 247 (2025)
Garcia, C.H., Espinoza, S.E., Lichtenstein, M.J., Hazuda, H.P., Jenkins, S.: Health literacy associations between Hispanic elderly patients and their caregivers. J. Health Commun. **18**(Suppl 1), 256–272 (2013). https://doi.org/10.1080/10810730.2013.825668
Hartmann, D., Swartz, T.T.: The new adulthood? The transition to adulthood from the perspective of transitioning young adults. Adv. Life Course Res. **11**, 253–286 (2006)
Hosmer, D.W., Jr., Lemeshow, S., Sturdivant, R.X.: Applied logistic regression. Wiley (2013)
Ickes, M.J., Cottrell, R.: Health literacy in college students. J. Am. Coll. Health **58**(5), 491–498 (2010)
Juvinyà-Canal, D., Suñer-Soler, R., Boixadós Porquet, A., Vernay, M., Blanchard, H., Bertran-Noguer, C.: Health literacy among health and social care university students. Int. J. Environ. Res. Public Health **17**(7), 2273 (2020)
Kickbusch, I., Maag, D.: Health literacy. In: Heggenhougen, K., Quah, S. (eds.) International Encyclopedia of Public Health, vol. 3, pp. 204–211. Academic Press (2008)
Kickbusch, I., Pelikan, J.M., Apfel, F., Tsouros, A.D.: Health literacy: the solid facts. World Health Organization Regional Office for Europe (2013)
Kinoshita, S., Hirooka, N., Kusano, T., Saito, K., Aoyagi, R.: Does health literacy influence health-related lifestyle behaviors among specialists of health management? A cross-sectional study. BMC Prim. Care **25**(1), 29 (2024)
Kobayashi, L.C., Smith, S.G., O'Conor, R.: The role of cognitive function in the association between health literacy and mortality in older adults. J. Gen. Intern. Med. **30**(3), 338–344 (2015). https://doi.org/10.1007/s11606-014-3106-7
Kühn, L., Bachert, P., Hildebrand, C., Kunkel, J., Reitermayer, J., Wäsche, H., Woll, A.: Health literacy among university students: a systematic review of cross-sectional studies. Front. Public Health **9**, 680999 (2022)
Kutner, M., Greenberg, E., Jin, Y., & Paulsen, C.: The health literacy of America's adults: results from the 2003 National Assessment of Adult Literacy (NCES 2006-483). U.S. Department of Education (2006)
Liu, C., Wang, D., Liu, C., Jiang, J., Wang, X., Chen, H., Ju, X., Zhang, X.: What is the meaning of health literacy? A systematic review and qualitative synthesis. Fam. Med. Community Health (2020). https://doi.org/10.1136/fmch-2020-000351
Liu, G., Qi, F., Gao, Q., Huo, L., Jia, X., Wang, R., Wu, Y., Li, S.: The relationship between health literacy and problematic internet use in Chinese college students: the mediating effect of subject well-being and moderating effect of social support. J. Affect. Disord. **362**, 877–884 (2024)
Maie, A., Kanekuni, S., Yonekura, Y., Nakayama, K., Sakai, R.: Evaluating short versions of the European Health Literacy Survey Questionnaire (HLS-EU-Q47) for health checkups. Health Eval. Promot. **48**(4), 351–358 (2021)
Mackert, M., Champlin, S.E., Holton, A., Muñoz, I.I., Damasio, M.J.: Ehealth and health literacy: a research methodology review. J. Comput.-Mediat. Commun. **19**(3), 516–528 (2014). https://doi.org/10.1111/jcc4.12044

Manochaiwuthikul, T., Chaichutchouwakul, A., Yunan, N., Winothai, N., Kanta, P., Sapbamrer, R.: Health literacy disparities in Thai university students: exploring differences between health science and non-health science disciplines. BMC Public Health **25**, 557 (2025)
Muscat, N. A., Camilleri, C.: Challenges and opportunities for the health sector in small states. In: Handbook of Small States, pp. 445–474 (2018).
Nutbeam, D.: Evaluating health promotion—progress, problems and solutions. Health Promot. Int. **13**(1), 27–44 (1998)
Nutbeam, D.: Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. Health Promot. Int. **15**(3), 259–267 (2000). https://doi.org/10.1093/heapro/15.3.259
Nutbeam, D.: The evolving concept of health literacy. Soc Sci Med **67**(12), 2072–2078 (2008). https://doi.org/10.1016/j.socscimed.2008.09.050
Nutbeam, D.: Health literacy as a population strategy for health promotion. Jpn. J. Health Educ. Promot. **25**(3), 210–222 (2017)
Nutbeam, D., McGill, B., Premkumar, P.: Improving health literacy in community populations: a review of progress. Health Promot. Int. **33**(5), 901–911 (2018). https://doi.org/10.1093/heapro/dax015
Nutbeam, D., Lloyd, J.E.: Understanding and responding to health literacy as a social determinant of health. Annu. Rev. Public Health **42**(2021), 159–173 (2021)
Ongis, L., & Barcella, G. The level of Health Literacy among high school students of Bergamo: an observational study.
Paasche-Orlow, M.K., Parker, R.M., Gazmararian, J.A., Nielsen-Bohlman, L.T., Rudd, R.R.: The prevalence of limited health literacy. J. Gen. Intern. Med. **20**(2), 175–184 (2005). https://doi.org/10.1111/j.1525-1497.2005.40245.x
Paasche-Orlow, M.K., Wolf, M.S.: Promoting health literacy research to reduce health disparities. J. Health Commun. **15**(sup2), 34–41 (2010). https://doi.org/10.1080/10810730.2010.499994
Palumbo, R., Annarumma, C., Adinolfi, P., Musella, M., Piscopo, G.: The Italian Health Literacy Project: insights from the assessment of health literacy skills in Italy. Health Policy **120**(9), 1087–1094 (2016)
Papalois, V., Papalois, K. Eds.: The Role of Health Literacy in Major Healthcare Crises. Igi Global (2024)
Parker, R.M., Ratzan, S.C., Lurie, N.: Health literacy: a policy challenge for advancing high-quality health care. Health Aff. **22**(4), 147–153 (2003). https://doi.org/10.1377/hlthaff.22.4.147
Parker, R.M., Ratzan, S.C.: Health literacy: a second decade of distinction for Americans. J. Health Commun. **15**(S2), 20–33 (2010)
Pelikan, J.M., Röthlin, F., Ganahl, K., Boltzmann, L.: Measuring comprehensive health literacy in general populations: validation of instrument, indices and scales of the HLS-EU study. In Proceedings of the 6th Annual Health Literacy Research Conference, pp. 4–6. Bethesda, Rockville, MD: Hyat Regency (2014)
Pelikan, J.M., Ganahl, K.: Measuring health literacy in general populations: primary findings from the HLS-EU Consortium's health literacy assessment effort. In: Health literacy, pp. 34–59. IOS Press (2017)
Pelikan, J.M., Link, T., Straßmayr, C., Waldherr, K., Alfers, T., Bøggild, H., Griebler, R., Lopatina, M., Mikšová, D., Nielsen, M.G., Peer, S., Vrdelja, M.: Measuring comprehensive, general health literacy in the general adult population: the development and validation of the HLS19-Q12 instrument in seventeen countries. Int. J. Environ. Res. Public Health **19**(21), 14129 (2022)
Pleasant, A.: Advancing health literacy measurement: a pathway to better health and health system performance. J. Health Commun. **19**(12), 1481–1496 (2014). https://doi.org/10.1080/10810730.2014.954083
Rababah, J.A., Al-Hammouri, M.M., Drew, B.L., Aldalaykeh, M.: Health literacy: exploring disparities among college students. BMC Public Health **19**, 1–11 (2019)
Rosário, J., Dias, S.S., Dias, S., Pedro, A.R.: Health literacy and its determinants among higher education students in the Alentejo region of southern Portugal—a cross-sectional survey. PLoS ONE **19**(9), e0309806 (2024a)
Rosário, J., Raposo, B., Santos, E., Dias, S., Pedro, A.R.: Efficacy of health literacy interventions aimed to improve health gains of higher education students—a systematic review. BMC Public Health **24**(1), 882 (2024b)
Rudd, R.E.: The evolving concept of health literacy: new directions for health literacy studies. J. Commun. Healthc. **8**(1), 7–9 (2015). https://doi.org/10.1179/1753806815Z.000000000105
Schaeffer, D., Berens, E.M., Vogt, D.: Health literacy in the German population: results of a representative survey. Dtsch. Arztebl. Int. **114**(4), 53 (2017)
Schillinger, D., Grumbach, K., Piette, J., Wang, F., Osmond, D., Daher, C., Palacios, J., Sullivan, G.D., Bindman, A.B.: Association of health literacy with diabetes outcomes. JAMA **288**(4), 475–482 (2002). https://doi.org/10.1001/jama.288.4.475
Sendatzki, S., Helmchen, R.M., Moor, I., Sudeck, G., Dadaczynski, K., Rathmann, K.: Health literacy of students in Germany-results of the HBSC study 2022. J. Health Monit. **9**(1), 23 (2024)

Sentell, T.L., Halpin, H.A.: Importance of adult literacy in understanding health disparities. J. Gen. Intern. Med. **21**(8), 862–866 (2006). https://doi.org/10.1111/j.1525-1497.2006.00538.x

Sørensen, K., Van den Broucke, S., Fullam, J., Doyle, G., Pelikan, J., Slonska, Z., Brand, H.: Health literacy and public health: a systematic review and integration of definitions and models. BMC Public Health **12**, 80 (2012). https://doi.org/10.1186/1471-2458-12-80

Sørensen, K., Brand, H., Fullam, J.: Health literacy and public health: strengthening the focus through a conceptual framework. Global Health Promot. **20**(2_suppl), 75–83 (2013a). https://doi.org/10.1177/1757975912474645

Sørensen, K., Van den Broucke, S., Pelikan, J.M., Fullam, J., Doyle, G., Slonska, Z., et al.: Measuring health literacy in populations: illuminating the design and development process of the European Health Literacy Survey Questionnaire (HLS-EU-Q). BMC Public Health **13**, 1–10 (2013b)

Sørensen, K., Pelikan, J.M., Röthlin, F., Ganahl, K., Slonska, Z., Doyle, G., Fullam, J., Kondilis, B., Agrafiotis, D., Uiters, E., Falcon, M., Mensing, M., Tchamov, K., van den Broucke, S., Brand, H.: Health literacy in Europe: comparative results of the European health literacy survey (HLS-EU). Eur. J. Public Health **25**(6), 1053–1058 (2015). https://doi.org/10.1093/eurpub/ckv043

Squiers, L., Peinado, S., Berkman, N., Boudewyns, V., McCormack, L.: The health literacy skills framework. J. Health Commun. **17**(sup3), 30–54 (2012)

Sudore, R.L., Schillinger, D.: Interventions to improve care for patients with limited health literacy. J. Clin. Outcomes Manag. **16**(1), 20–29 (2009)

Tamayo-Fonseca, N., Pereyra-Zamora, P., Barona, C., Mas, R., Irles, M.Á., Nolasco, A.: Health literacy: association with socioeconomic determinants and the use of health services in Spain. Front. Public Health **11**, 1226420 (2023)

Touzani, R., Allaire, C., Schultz, E., Ousseine, Y., Dembélé, E., Rigal, L., Vandentorren, S., Guillemin, F., Rouquette, A., Mancini, J.: Littératie en santé: rapport de l'étude Health Literacy Survey France 2020–2021. Saint-Maurice : Santé publique France, 2024, p. 99 (2024)

Touzani, R., Rouquette, A., Schultz, E., Allaire, C., Carrieri, P., Mancini, J., Hardouin, J.B.: Psychometric validation of the French version of two scales measuring general (HLS19-Q12) and navigational (HLS19-NAV) health literacy using the Rasch model. BMC Public Health **24**(1), 3079 (2024b)

United Nations Economic and Social Council (ECOSOC): Health literacy and the millennium development goals: United Nations economic and social council (ECOSOC) regional meeting background paper (abstracted). J. Health Commun. **15**(S2), 211–223 (2010)

Uysal, N., Ceylan, E., Koç, A.: Health literacy level and influencing factors in university students. Health Soc. Care Commun. **28**(2), 505–511 (2020)

Van den Broucke, S., Renwart, A.: Health literacy mediates the relationship between education level and health behaviour: Stephan Van Den Broucke. Eur. J. Public Health **24**(2), cku164-012 (2014)

Vozikis, A., Drivas, K., Milioris, K.: Health literacy among university students in Greece: determinants and association with self-perceived health, health behaviours and health risks. Arch. Public Health **72**, 1–6 (2014)

Wang, W., Hou, Y., Hu, N., Zhang, D., Tao, J., Man, Y., Wang, A., Li, L., Bi, Y.: A cross-sectional study on health-related knowledge and its predictors among Chinese vocational college students. BMJ Open **4**(10), e005182 (2014)

Zhang, Y., Zhang, F., Hu, P., Huang, W., Lu, L., Bai, R., Sharma, M., Zhao, Y.: Exploring health literacy in medical university students of Chongqing, China: a cross-sectional study. PLoS ONE **11**(4), e0152547 (2016)

Zarcadoolas, C., Pleasant, A., Greer, D.S.: Advancing health literacy: a framework for understanding and action. Jossey-Bass (2006)

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