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Health literacy and its determinants among pregnant women in Portugal

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Abstract

Background Health literacy is a key determinant of health outcomes and equity, particularly during pregnancy, a period marked by increased information needs and critical health decisions. Despite its importance, data on health literacy among pregnant women in Portugal remain scarce. This study aimed to assess general health literacy levels and their associations with sociodemographic, health-related, and pregnancy-specific factors in a large sample of pregnant women from the district of Viseu, Portugal.

Methods A cross-sectional study was conducted with 886 pregnant women aged 18 years or older, using the validated HLS_{19}-Q12 instrument to measure general health literacy. Data collection occurred between October 2023 and May 2024 using a multimodal approach (online, interview, and paper-based). Health literacy was categorized into four levels and also dichotomized as limited versus not limited. Descriptive statistics, bivariate analyses, and binary logistic regression were performed to identify determinants of limited health literacy.

Results The mean general health literacy score was 68.3 (SD ± 10.9). A total of 46.7% of participants were classified as having limited health literacy. Among the pregnant women surveyed, 18.8% were born outside Portugal. Of these, 74.7% were classified as having limited health literacy, compared to 40.2% among Portuguese-born participants. Higher prevalence was observed among women aged 18–29, those born outside Portugal, with lower education, in undifferentiated professions, and facing financial hardship. In the final adjusted logistic regression model, which combined variables selected through forward stepwise inclusion with theoretically important covariates entered in a second block, significant predictors of limited health literacy included being born outside Portugal (adjusted OR 2.43; 95% CI: 1.56–3.80), having lower education (up to high school), holding lower-skilled occupations, financial difficulties, and rating current health as equal or worse. Pre-pregnancy Body Mass Index was also negatively associated with health literacy levels, with higher BMI more prevalent among women with limited health literacy. The model showed good discriminatory ability (area under the ROC curve = 0.78).

Conclusions A considerable proportion of pregnant women demonstrated limited health literacy, particularly among socioeconomically vulnerable and migrant groups. These findings underscore the urgency of adopting antenatal care approaches that are responsive to health literacy needs. Incorporating brief assessments during early prenatal visits, using plain language and visual communication tools, and offering targeted support to high-risk groups may enhance informed decision-making, promote equity, and improve maternal and neonatal outcomes.

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Keywords Health literacy, Health inequities, Pregnant women, Maternal health, Prenatal care, Social determinants of health, Public health

Background

Health literacy, defined as the ability to access, understand, appraise, and apply health-related information, is a critical determinant of health outcomes and equity [1]. It is particularly crucial during pregnancy, a period marked by heightened health demands and complex decision-making, impacting both maternal and child health outcomes. Pregnant women must navigate diverse sources of health information and collaborate effectively with healthcare providers, making health literacy an indispensable competency [2].

Research highlights significant associations between low health literacy and adverse pregnancy outcomes, including gestational diabetes, low birth weight, and increased maternal stress [3]. Furthermore, inadequate health literacy is linked to delays in accessing prenatal care, limited adoption of health-promoting behaviors, and lower engagement with antenatal education [4]. These challenges underscore the importance of addressing health literacy disparities, especially in vulnerable populations such as immigrants, socioeconomically disadvantaged groups, and women with limited educational backgrounds [5]. Migrant women, in particular, may face compounded vulnerabilities related to cultural, social, and structural barriers that limit access to adequate reproductive and maternal healthcare services, as highlighted in recent umbrella reviews focused on equity in sexual and reproductive health outcomes [6]. Studies have also shown that low health literacy affects healthcare utilization and adherence to medical recommendations, potentially exacerbating inequalities in maternal and neonatal health outcomes [7].

The percentages of health literacy (HL) levels among pregnant women vary significantly across cultural, socioeconomic, and geographical contexts, as well as depending on the measurement tools used. International studies provide valuable insights into these variations. Globally, between 15% and 50% of pregnant women are classified as having inadequate or limited HL, with significant differences observed across countries and populations [3, 5]. Approximately 33% demonstrate sufficient HL, while only 10–20% achieve excellent HL levels [4]. For example, in the United States, 38% of pregnant women were found to have low HL, which was associated with poorer comprehension of prenatal tests and medical guidelines [8]. Similarly, in Turkey, 33.9% of pregnant women had sufficient HL, while the remaining 66.1% were classified as having limited HL, encompassing both inadequate and problematic levels [5]. In Europe, a study from Denmark highlighted that immigrant pregnant women have lower HL levels compared to native-born women [4]. In Iran, 42.8% of pregnant women were found to have adequate HL, whereas 15.5% had inadequate HL [9].

The investigations specifically focused on health literacy during pregnancy remains limited, despite the significance of this population as a key target for public health interventions. Nonetheless, some initiatives have begun to explore the topic indirectly or within localized contexts, such as studies examining health behaviors during pregnancy. However, studies in Portugal with representative data, or large samples, on health literacy levels among pregnant women, as well as associated factors like sociodemographic determinants and cultural barriers, remain unavailable. For example, in a study of 404 Portuguese pregnant women, the authors found that 50.5% had limited health literacy [10]. In contrast, another study in Portugal, reported that only 25.8% of a sample of 264 pregnant women demonstrated limited health literacy [11]. These variations underscore the impact of differing methodologies, contexts, and population characteristics on the outcomes of health literacy assessments. As emphasized by Zibellini et al., the design of interventions to improve health literacy must account not only for the accessibility of information but also for the cultural and socioeconomic barriers that impede effective healthcare utilization [7].

Pregnancy represents a pivotal period in the life cycle, where individual, familial, and transgenerational factors converge from somatic, psychological, and cultural perspectives. It should be viewed not only as a phase leading to specific outcomes but also as a strategic window for interventions that promote lasting changes in habits and behaviors. These changes can benefit the woman, her child, and the entire family unit across the life span. Examples include adopting healthier eating habits, increasing physical activity, and cessation of smoking and psychoactive substance use. Furthermore, pregnancy offers a critical opportunity to identify and address conditions that may pose risks for future health complications, such as gestational diabetes and pre-eclampsia. Evidence now demonstrates that the presence of these conditions during pregnancy significantly elevates the long-term risk of developing chronic diseases, including diabetes and cardiovascular disorders, in women [12]. The concept of pregnancy as a “teachable moment” for improving health literacy (HL) is well-supported in the literature, emphasizing that women are often highly motivated to adopt health-promoting behaviors during this time. This period is seen as an opportunity to influence behaviors such as nutrition, physical activity, and healthcare engagement,

benefiting both maternal and child health [7, 8, 13, 14]. Additionally, the regular interaction with healthcare systems during pregnancy enhances the potential for targeted interventions aimed at fostering long-term health literacy and behavioral changes [2, 3].

HL encompasses the individual's capacity to access, understand, appraise, and apply health-related information in order to make appropriate health decisions. In the context of pregnancy, this competency is especially critical. It influences a woman's ability to interpret prenatal guidance, adhere to clinical recommendations, recognize warning signs, navigate complex and often fragmented healthcare systems, and engage meaningfully with healthcare professionals. Inadequate health literacy during pregnancy is associated with delayed initiation of antenatal care, poor nutritional and lifestyle choices, lower participation in prenatal education, and increased risk of adverse maternal and neonatal outcomes.

The importance of standardized and theory-based approaches to measuring health literacy has been emphasized by the World Health Organization in its report Health Literacy: The Solid Facts [15]. In line with these recommendations, the European Health Literacy Survey (HLS-EU) developed a comprehensive conceptual framework and a set of validated instruments, HLS-EU-Q47 and its short forms (HLS-EU-Q16, Q12, and Q6), that assess HL across health care, disease prevention, and health promotion domains [16]. Recognizing the need for comparable data across countries, the WHO established the Action Network on Measuring Population and Organizational Health Literacy (M-POHL) in 2018 [17]. The HLS_{19} project, coordinated by M-POHL, built on the HLS-EU framework and included core and optional modules to assess digital, navigational, communicative, and vaccination-related HL dimensions [18]. Prior analyses from the HLS-EU survey also indicated a weak but statistically significant trend of higher HL among women compared to men, although this was not consistent across all participating countries [18].

In Portugal, comprehensive national data on health literacy among pregnant women remain scarce. Migrant women, particularly those with undocumented status or limited Portuguese language proficiency, often face structural, administrative, and linguistic barriers when accessing prenatal care. Although prenatal healthcare is universally available and free of charge within the national health system, these barriers contribute to delayed engagement with services and lower utilization among migrant populations. As a result, these women are less likely to benefit from early antenatal surveillance and preventive care, perpetuating avoidable disparities in maternal and neonatal outcomes. These challenges highlight the need for a more inclusive and equity-oriented approach to maternal health.

This study aims to assess general health literacy among pregnant women in Portugal, focusing on its relationship with sociodemographic, socioeconomic, and healthcare-related factors. By analyzing levels of general health literacy in a large sample from the district of Viseu, this study seeks to identify determinants of limited health literacy, providing insights to support equitable access to prenatal care improving maternal and neonatal outcomes.

Methods

Development

General health literacy was assessed using the HLS_{19}-Q12 instrument, a validated short-form scale derived from the HLS-EU conceptual model [16]. This framework defines HL as the ability to access, understand, appraise, and apply health-related information across three domains: health care, disease prevention, and health promotion [16]. The Portuguese version of the HLS19-Q12 was validated in a representative national sample of individuals aged 16 and older, including 643 women (52%) [19].

The HLS_{19}-Q12 includes 12 items rated on a 4-point Likert scale from "very difficult" to "very easy". A general HL score was calculated by summing the valid responses, converting them to a unified metric ranging from 0 to 100, with higher values indicating better HL [16]. Seven sub-indices were also computed using the same transformation method. Cases with fewer than 80% valid responses were excluded from score calculations. The overall health literacy score and the seven sub-indices were categorized into four levels: "inadequate" (0–50, inclusive), "problematic" (50–66.67, inclusive), "sufficient" (66.67–83.33, inclusive), and "excellent" (above 83.33). While two categorization methods exist, this study adopted the one most widely used across HLS_{19} applications [16]. Use of the HLS19-Q12 in this study was authorized by the HLS19 Consortium (link: https://m-pohl.net/Design_Methods).

Testing

All participants provided written informed consent before any procedures were conducted, following prior ethical approval by the Institutional Health Ethics Committees of the Tondela Viseu Hospital Center (reference 13/29/09/2023) and the Central Regional Health Administration (process number 124–2023). Additionally, all procedures adhered to the ethical principles outlined in the Declaration of Helsinki [20].

The inclusion criteria required participants to be at least 18 years old, at least 10 weeks pregnant, and able to read and comprehend Portuguese. No exclusion criteria were established. Data collection was carried out between the 15th of October 2023 and the 15th of May 2024.

Pregnant women were recruited using a non-probabilistic, multimodal convenience sampling approach. Recruitment was conducted during routine antenatal care visits in public hospitals, primary healthcare centers, and private clinics. Additionally, QR codes and digital survey links were disseminated through posters and flyers placed in maternity care settings to broaden participation. Although the sample captured approximately 49% of all expected pregnancies in the Viseu district during the data collection period, no stratification or sample weighting procedures were applied. This is acknowledged as a methodological limitation, as it restricts the generalizability of findings beyond the study region or the national population.

All the sociodemographic, lifestyle-related, health status, and pregnancy-specific variables listed below were collected as part of the survey instrument administered to participants. Sociodemographic characteristics, lifestyle-related health behaviors, health-related variables, and gynecological and obstetric histories of the pregnant women participants were collected at the outset of the survey. Collected sociodemographic variables included age, which was categorized into age groups (18–29 years; 30–39 years; ≥ 40 years), nationality (Portugal; another country), formal education (up to 2nd cycle of primary education; 3rd cycle of primary education; high school; university education); marital status (single, married/common-law marriage; divorced/separated/widow; employment status (working professionally; not working professionally); profession/occupation (intellectual and scientific; techniques; undifferentiated); residence typology (own house/apartment; rented house/apartment; social house/apartment); situation in the work (worker on their own; family worker; worker on account of other; domestic, student, unemployed or retired; residence typology (own house/apartment; rented house/apartment; home/apartment of relatives; social house/institution); training in a healthcare profession (yes; no).

We collected data on health behaviors and lifestyles, including smoking status (never smoked; smoked before pregnancy; quit during pregnancy; or occasional smoking), exposure to tobacco smoke (yes or no), and consumption of alcohol or psychoactive substances (never; used before pregnancy; quit during pregnancy; or occasional use). Information on physical activity levels was also gathered, categorized as never, never due to medical restrictions, occasional, light, or heavy. Dietary habits were assessed through fruit and vegetable consumption (never; occasional use that correspond to less than one day per week and 1 day; 2 days and 3 days grouped as light use; 4 days, 5 days, 6 days, 7 days grouped as heavy). Additionally, participants reported their pre-pregnancy Body Mass Index (BMI), classified as underweight, normal weight, overweight, or obese.

Health status variables were also included, such as prior self-perceived health status (categorized as bad or very bad; fair; good or very good) and current self-perceived health status (much worse or worse; equal; better or much better). Self-reported chronic diseases or disabilities were recorded (yes or no), along with the perceived ease of managing these conditions (categorized as easy or very easy; hard or very difficult). Finally, participants were asked whether health problems limited their daily activities (not limited; limited; greatly limited).

Data on gynecological variables included the use of contraceptive methods (yes or no) and cervical cytology status, categorized as never performed, within the last 12 months, more than 1 year but less than 2 years ago, more than 2 years but less than 3 years ago, or not performed in the last 3 years. For obstetric history, variables collected encompassed current gestational age groups (10–13 weeks, 14–27 weeks, or 28–41 weeks), attendance at preconception care consultations (yes or no), whether the pregnancy was planned (yes or no), the number of weeks pregnant at the time the pregnancy was discovered, and whether the pregnancy was classified as high-risk (yes or no). Additional information included the number of children, the location of antenatal care (health center, private clinic, or hospital), intention to breastfeed (yes, not yet decided, no, or cannot breastfeed), and intention to attend a childbirth preparation program (no, already attending, plans to attend, or undecided/cannot attend).

Statistical analysis

Data analysis was carried out using IBM SPSS Statistics®, version 29.0 (IBM Corp, Armonk, NY, USA), with a 5% significance level. Descriptive statistics were used to summarize the sample's sociodemographic profile, lifestyle-related health behaviors, health-related characteristics, and gynecological and obstetric histories. The evaluation also included the computation of mean scores and standard deviations for overall health literacy and its sub-dimensions. Furthermore, the distribution of participants across the four health literacy categories and dichotomized variables was reported as percentages, based on valid responses. The number of respondents included in the scoring and the extent of missing data were also recorded. These categories followed the scoring protocol defined in the HLS19-Q12, as detailed in the development of Methods section. For descriptive statistics on sociodemographic, health behaviors and lifestyles, health status, gynecologic and obstetric history characteristics, all available responses were included. Regarding health literacy outcomes, only participants with at least 80% valid responses to the 12 items of the HLS_{19}-Q12 were included in score calculations, in accordance with the instrument's scoring protocol. For the multivariable logistic regression models, participants with missing

data on any of the included variables were excluded using listwise deletion. No data imputation techniques were applied. In this approach, missing values were not estimated or replaced; participants with incomplete data were excluded from the analyses in which those variables were required.

Bivariate analyses were conducted using Fisher's exact test and chi-square tests to identify associations between health literacy levels and various factors. General health literacy, dichotomized into "limited" and "not limited," served as the dependent variable in a binary logistic regression analysis. Independent variables with a p-value < 0.10 in bivariate analyses were included as predictors of limited health literacy in the logistic regression. The first model applied a forward likelihood ratio (LR) approach, while a second model used an enter method to add variables of interest not selected in the initial analysis. Any variables related to age, gender, education, residence, or financial household status excluded from the first model were reintroduced in a subsequent block. A two-step logistic regression approach was used to ensure that both statistically significant and theoretically important predictors were retained. In Block 1, variables were entered using a forward likelihood ratio (LR) method, allowing the model to identify significant associations based on the data. In Block 2, we reintroduced variables with strong theoretical and contextual relevance, such as age, education level, and household financial situation, even if they had not been selected in the first step. This approach was planned a priori and is supported by established epidemiological modelling strategies that recommend the inclusion of conceptually important covariates to control for confounding, particularly when analyzing social determinants of health. These hierarchical or blockwise methods are well described in the literature [21].

The findings are presented as crude odds ratios (cOR) and adjusted odds ratios (aOR), along with 95% confidence intervals (95% CI). The residual probabilities of the final adjusted logistic regression model were utilized to calculate the area under the curve (AUC) of the Receiver Operating Characteristic (ROC) curve.

Results

Sample and items description

The study included a sample of 886 pregnant women with a mean age of 31.09 years (± 5.60 years). To facilitate participation and ensure convenience for pregnant women, the survey, which included the HLS_{19}-Q12 instrument, was offered in three formats to achieve a homogeneous sample. Participants could respond digitally via a QR code or link distributed during pregnancy appointments (28.8%), through an interview conducted in primary healthcare or hospital settings (45.4%), or by self-completing a paper-based version (25.8%). Among those who received the paper version, the response rate was 76%.

The participants ranged in age from 18 to 51 years. More than half of the sample (53.3%) were aged between 30 and 39 years, 39.7% were between 18 and 29 years, and 7.0% were 40 years or older. Most participants were Portuguese nationals (81.2%), with 18.8% born in other countries. Educational attainment was relatively high, as 42.6% had completed university education, and 40.7% had finished high school. Regarding marital status, 73.4% were married or in a common-law relationship, while 25.2% were single. In terms of employment, 77.8% of the participants were professionally active. Among these, 52.5% were employed in technical occupations, 27.3% held intellectual or scientific roles, and 20.2% worked in undifferentiated professions. Additionally, 69.2% worked for others, 8.1% were self-employed, and 1.2% were family workers. However, 21.4% of participants were not engaged in professional work, including students, domestic, unemployed individuals, or retirees. Regarding housing, 46.4% owned their homes, 32.5% rented, and 20.8% lived with relatives, while 0.3% resided in social housing. Notably, 15.2% of participants reported having training in a healthcare profession, while 84.8% did not. The analysis of financial stress among participants reveals that a majority faced challenges in meeting their expenses. Specifically, 61.7% of participants reported finding it "difficult" or "very difficult" to pay their expenses, indicating a significant level of financial strain. Conversely, 38.3% of participants found paying expenses to be "very easy" or "easy," suggesting a minority experienced financial ease. Further details can be found in Table 1.

Health behaviors and lifestyles and health status were examined to better understand factors influencing maternal health. Regarding smoking behavior, 74.0% of participants reported never smoking, while 13.9% smoked before pregnancy, 4.9% quit during pregnancy, and 7.2% smoked occasionally. Tobacco smoke exposure was reported by 32.3% of participants. Alcohol or psychoactive substance use were reported by 33.2% of pregnant women. Among these, 16.8% consumed substances before pregnancy, 7.6% quit during pregnancy, and 8.8% used them occasionally. Physical activity levels varied, with 34.9% engaging in light activity, 30.2% in heavy activity, and 25.4% reporting no physical activity. Fruit and vegetable consumption were notably high, with 89.4% reporting heavy intake. Pre-pregnancy BMI classifications revealed that 55.9% had a normal BMI, 24.5% were overweight, and 15.0% were classified as obese. Regarding self-perceived health, 69.8% rated their previous health as good or very good, while 29.0% considered it fair, and 1.2% described it as bad or very bad. During pregnancy, 11.2% felt their health had worsened, while

Table 1 Sociodemographic characteristics of the sample ($n = 886$)

Sociodemographic characteristics	*n= 886*
Age (mean ± SD)	31.09 ± 5.60
Age Groups (years)	n (%)
18–29	352 (39.7%)
30–39	472 (53.3%)
≥ 40	62 (7.0%)
Nationality	
Portugal	719 (81.2%)
Another country	167 (18.8%)
Formal education	
2nd cycle of primary education	33 (3.7%)
3rd cycle of primary education	115 (13%)
High school	361 (40.7%)
University education	377 (42.6%)
Marital status	
Single	223 (25.2%)
Married/common-law marriage	650 (73.4%)
Divorced/separated/widow	13 (1.5%)
Employment status	
Working professionally	689 (77.8%)
Not working professionally	197 (22.2%)
Profession/occupation	
Intellectual and scientific	242 (27.3%)
Techniques	465 (52.5%)
Undifferentiated	179 (20.2%)
Residence typology	
Own house/apartment	411 (46.4%)
Rented house/apartment	288 (32.5%)
Relatives house/apartment	184 (20.8%)
Social house/apartment	3 (0.3%)
Situation in the work	
Worker on their own	72 (8.1%)
Family worker	11 (1.2%)
Worker on account of other	613 (69.2%)
Domestic_Student_Unemploymen_retired	190 (21.4%)
Training in a healthcare profession	
No	751 (84.8%)
Yes	135 (15.2%)
Payment of expenses	
Very Easy_easy	339 (38.3%)
Difficult_ Very difficult	547 (61.7%)

[1]SD Standard deviation

81.7% reported no change, and 7.1% indicated improvement. Chronic diseases or disabilities were reported by 19.2% of participants, with 30.6% finding it difficult to manage these conditions. Additionally, 12.8% experienced no activity limitations, 5.5% reported some limitations, and 0.9% faced significant limitations. Detailed results are provided in Table 2.

The study also examined gynecological and obstetric variables to provide insights into participants' health profiles and pregnancy care (Table 3). Regarding the use of

Table 2 Health behaviors and lifestyles and health status variables of the sample ($n = 886$)

Health behaviors and lifestyles	*n* (%)
Smoking behavior	
Never	656 (74.0%)
Before pregnancy	123 (13.9%)
Stopped in pregnancy	43 (4.9%)
Occasionally	64 (7.2%)
Tobacco smoke exposure	
Yes	286 (32.3%)
No	600 (67.7%)
Alcohol or psychoative subs. (PS) consumption	
Never	592 (66.8%)
Before pregnancy	149 (16.8%)
Stopped in pregnancy	67 (7.6%)
Occasionally	78 (8.8%)
Physical activity	
Never	225 (25.4%)
Never: medical restriction	27 (3.0%)
Occasional	57 (6.4%)
Light	309 (34.9%)
Heavy	268 (30.2%)
Fruit and vegetable consumption	
Never	3 (0.3%)
Occasional	5 (0.6%)
Light	86 (9.7%)
Heavy	792 (89.4%)
BMI prior to pregnancy	
Underweight	41 (4.6%)
Normal weight	495 (55.9%)
Overweight	217 (24.5%)
Obesity	133 (15.0%)
Health status	n (%)
Previous Self-perceived health status	
Bad or very bad	11 (1.2%)
Fair	257 (29.0%)
Good or very good	618 (69.8%)
Current Self-perceived health status	
Much worse or worse	99 (11.2%)
Equal	724 (81.7%)
Better or much better	63 (7.1%)
Previous self-reported chronic (SRC) disease/disability	
Yes	170 (19.2%)
No	716 (80.8%)
Dealing with SRC disease/disability ($n = 170$)	
Easy or too easy	118 (69.4%)
Hard or very difficult	52 (30.6%)
Health problems limited the activity ($n = 170$)	
Not limited	113 (12.8%)
Limited	49 (5.5%)
Greatly limited	8 (0.9%)

[1]*SD*Standard deviation

Table 3 Gynecologic and obstetric history variables of the sample ($n = 886$)

Gynecologic history	
Contraceptive method	*n* (%)
Yes	795 (89.7%)
No	91 (10.3%)
Cervix vaginal cytology	
Never	113 (12.8%)
In the last 12 months	324 (36.6%)
> 1 year ago, < 2 years	216 (24.4%)
> 2 years ago, < 3 years	118 (13.3%)
Not in the past 3 years	115 (13.0%)
Obstetric history	
Current gestational age (mean ± SD[1])	29.60 ± 10.61)
Current gestational age groups	n (%)
1 st Trimester (10–13 weeks)	169 (19.1%)
2 st Trimester (14–27 weeks)	112 (12.6%)
3 st Trimester (28–41 weeks)	605 (68.3%)
Preconception care ($n = 590$)	
Yes	338 (57.3%)
No	252 (42.7%)
Planned pregnancy	
Yes	590 (66.6%)
No	296 (33.4%)
Pregnancy surveillance	
1–11 weeks	787 (88.8%)
12–27 weeks	95 (10.7%)
≥ 28 weeks	4 (0.5%)
Pregnancy risk	
No	657 (74.2%)
Yes	229 (25.8%)
Children(s) (mean ± SD[1])	0.57 ± 4.21)
Children(s)	n (%)
No	509 (57.4%)
Yes	377 (42.6%)
Site of the queries	
Health center/Private clinic	384 (43.3%)
Health center	288 (32.5%)
Health center/Hospital	125 (14.1%)
Health center/Hospital/Private clinic	89 (10.0%)
Breastfeeding	
Yes	820 (92.6%)
Has not yet decided	51 (5.8%)
No	11 (1.2%)
Cannot breastfeed	4 (0.5%)
Childbirth preparation program	
No	349 (39.4%)
Already attends	284 (32.1%)
Intends to attend	156 (17.6%)
Has not yet decided/Cannot attend	97 (10.9%)

[1]*SD* Standard deviation

contraceptive methods, 89.7% of participants reported using contraception, while 10.3% did not. Cervical cytology results showed that 12.8% had never undergone the procedure. Among those who had, 36.6% underwent it within the last 12 months, 24.4% between one and two years ago, 13.3% between two and three years ago, and 13.0% more than three years ago. The mean gestational age was 29.60 weeks (± 10.61). Most participants were in their third trimester (28–41 weeks; 68.3%), followed by the first trimester (10–13 weeks; 19.1%) and the second trimester (14–27 weeks; 12.6%). Preconception care was reported by 57.3% of participants, while 42.7% did not attend such consultations. Planned pregnancies accounted for 66.6% of cases, while 33.4% of pregnancies were unplanned. In terms of pregnancy surveillance, the majority (88.8%) initiated care between 1 and 11 weeks of gestation, 10.7% began care between 12 and 27 weeks, and 0.5% started care at 28 weeks or later. Pregnancy risk were identified in 25.8% of participants, while 74.2% report a low risk pregnancy. Regarding parity, 57.4% of participants were experiencing their first pregnancy, while 42.6% had one or more children, with a mean of 0.57 children (± 4.21). Antenatal care sites varied, with 43.3% receiving care at both health centers and private clinics, 32.5% exclusively at health centers, 14.1% at health centers and hospitals, and 10.0% across health centers, hospitals, and private clinics. When asked about breastfeeding intentions, 92.6% of participants intended to breastfeed, 5.8% were undecided, 1.2% did not intend to breastfeed, and 0.5% reported being unable to breastfeed. Regarding childbirth preparation programs, 39.4% of participants did not attend, 32.1% were already attending, 17.6% intended to attend, and 10.9% had not yet decided or could not attend, probably because they are at risk of premature birth.

Distribution of limited health literacy across sample subgroups

The distribution of limited health literacy across sample subgroups were calculated using data from participants, ranging from 856 for the "Access" dimension of health information processing to 885 for "Health Promotion," a domain of health literacy. Specifically, the general health literacy score was based on 875 participants, while the domain scores included 875 for "Healthcare" and 879 for "Disease Prevention." For the dimensions of health information processing, the number of participants was 880 for "Understand," 883 for "Appraise," and 885 for "Apply." The variation in sample size reflects the number of pregnant women who provided at least 80% of valid responses required for the calculation of each specific score.

A mean general health literacy score of 68.31 (± 10.92) was observed, which was lower than the mean scores for each of the six sub-indexes. These ranged from 68.32

(± 16.77) in the "Access" dimension of health information processing to 72.50 (± 11.30) in the "Apply" domain of health information processing. An exception was noted in the "Disease Prevention" domain, which exhibited a slightly lower mean score of 67.48 (± 12.83).

The distribution of general health literacy (HL) among pregnant women, as presented in Fig. 1, shows a substantial proportion of participants with intermediate levels of HL. Specifically, 4.2% were classified as having inadequate HL and 42.5% as problematic, indicating that nearly half of the sample experienced difficulties in accessing, understanding, or using health information. An equal proportion of participants (42.5%) demonstrated sufficient HL, suggesting functional skills to manage health-related tasks and decision-making during pregnancy. Only 10.7% of participants were classified in the excellent category, reflecting a relatively small subgroup with the highest levels of autonomy and confidence in dealing with health information.

The analysis of health literacy across the three health information domains (Healthcare, Disease Prevention, and Health Promotion) reveals domain-specific patterns in the distribution of HL levels among pregnant women. In the Healthcare domain, 6.2% of participants were classified as having inadequate HL and 24.8% as problematic, while 55.1% reported sufficient HL and 13.9% excellent. These findings suggest that most women felt confident navigating the healthcare system and interacting with medical professionals, possibly due to their regular contact with antenatal care services. In the Disease Prevention domain, HL levels shifted slightly, with 7.1% of participants classified as inadequate and 33.1% as problematic. Meanwhile, 47.1% reported sufficient HL and 12.7% excellent. This domain presented the highest proportion of participants in the problematic category, indicating potential difficulties in understanding or applying preventive information, such as vaccinations, screenings, or behavioral risk avoidance strategies. The most favorable distribution was observed in the Health Promotion domain, where only 3.2% of participants had inadequate HL and 15.7% problematic, while 66.1% were classified as sufficient and 15.0% as excellent. These results suggest that participants were more confident in engaging with information aimed at maintaining or improving general well-being, such as nutrition, physical activity, or stress management during pregnancy. Overall, the data indicate that while healthcare navigation appears to be relatively well-managed, there are important gaps in understanding and acting upon preventive strategies. Strengthening communication related to disease prevention may help reduce risk behaviors and improve maternal and fetal health outcomes (Fig. 2).

Health literacy performance in each of the four dimensions of information processing (access, understand,

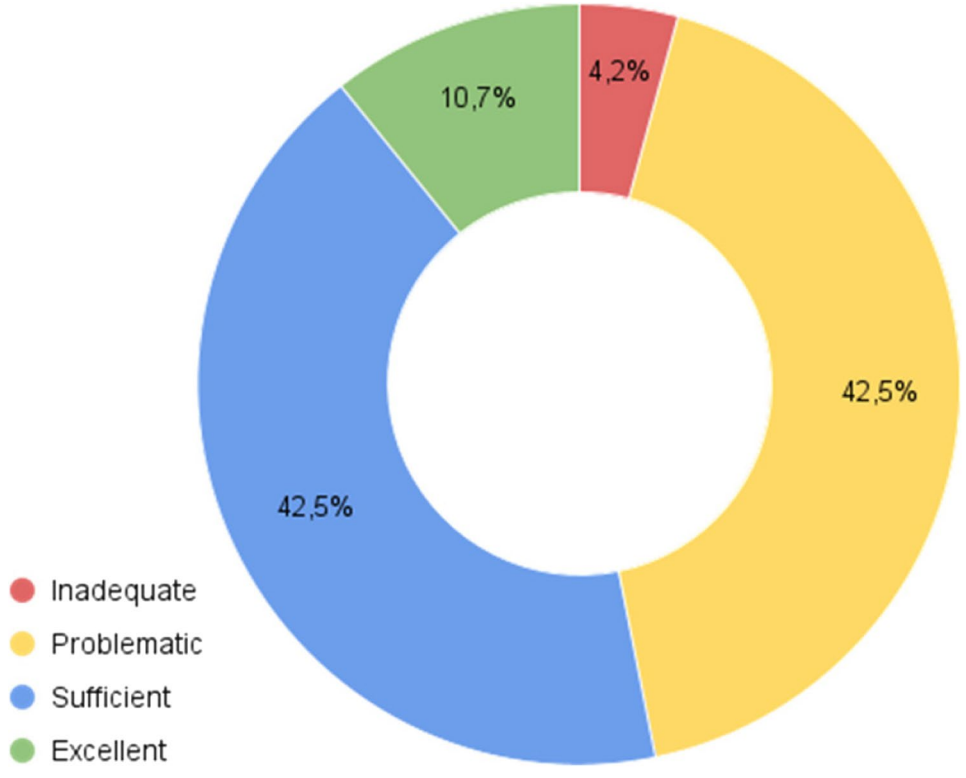

Fig. 1 Levels (%) of general health literacy

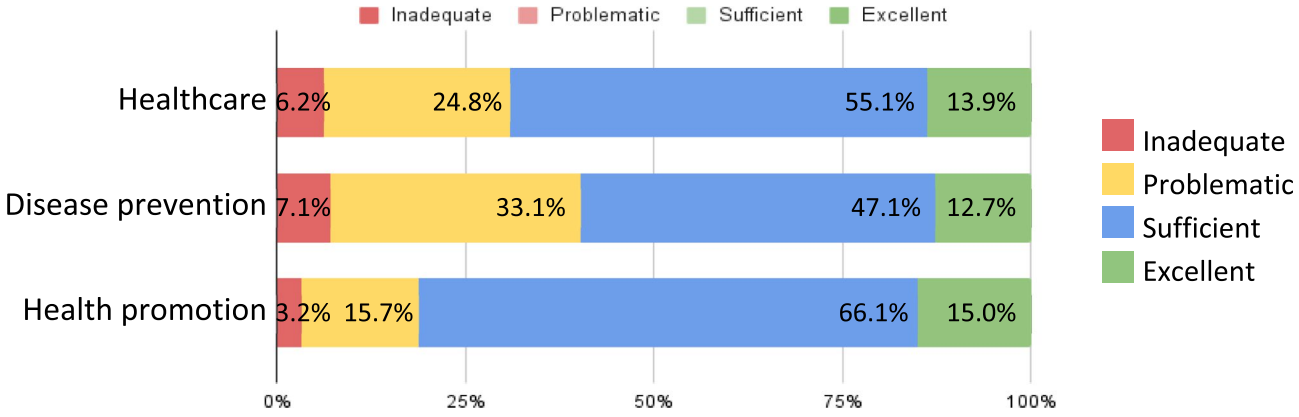

Fig. 2 Health Literacy domains (%)

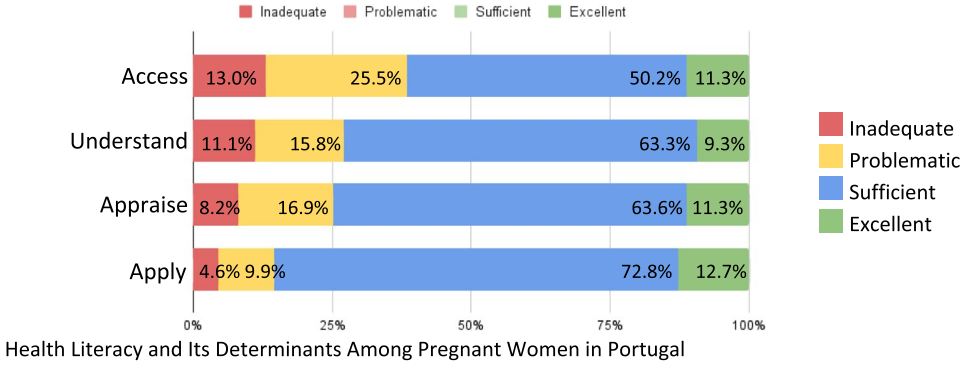

Fig. 3 Dimensions of health information processing (%)

appraise, and apply) demonstrates distinct patterns. The access dimension presented the highest proportion of participants with inadequate HL (13.0%) and also the highest problematic HL level (25.5%), indicating that locating and obtaining health-related information may be the most challenging task for many pregnant women. In contrast, the apply dimension showed the lowest percentage of inadequate HL (4.6%) and problematic HL (9.9%), while presenting the highest proportion of sufficient HL (72.8%) and a relatively elevated excellent level (12.7%). This suggests that once information is understood, most participants felt capable of integrating it into their health decisions. For the understand dimension, 11.1% of participants were classified as inadequate, 15.8% as problematic, 63.3% as sufficient, and 9.3% as excellent. Regarding the appraise dimension, 8.2% were inadequate, 16.9% problematic, 63.6% sufficient, and 11.3% excellent. These results suggest that while comprehension and judgement of health information are generally adequate, they remain more complex than direct application. Overall, the data indicate that challenges are most prominent in the early stages of processing health information, particularly in access and appraisal, whereas applying information is reported more confidently. This may reflect the structured support provided in antenatal care but also highlights potential weaknesses in information navigation and evaluation skills during pregnancy (Fig. 3).

Prevalence of limited health literacy across participant subgroups Table 4 presents the descriptive findings based on a recoded variable in which the "Inadequate" and "Problematic" categories of general health literacy were combined into a new construct termed "Limited Health Literacy." Among pregnant women with at least 80% valid responses to the 12 items of the HLS_{19}-Q12 instrument ($n = 875$), 46.7% were classified as having limited health literacy. To enhance clarity and focus, only variables that showed statistically significant associations with limited health literacy ($p < 0.05$) are included in the table. The full version of this analysis, including non-significant comparisons, is available in Supplementary Material (Additional File 1).

Limited health literacy was more pronounced among specific subgroups, reflecting significant disparities across sociodemographic, behavioral, and health-related variables. Younger pregnant women, particularly those aged 18 to 29 years, had the highest prevalence of limited health literacy at 56.2%. Women born outside of Portugal exhibited a markedly higher prevalence (74.7%) compared to Portuguese nationals. Education level also

Table 4 General health literacy score means and limited health literacy by sociodemographic, health behaviors and lifestyles, health status, gynecologic and obstetric history characteristics

	General HL Mean (± SD)		**Limited HL *n* (%)**	***p*-Value [1]**
Total (*n* = 875)	68.31 (± 10.92)		409 (46.7%)	
Sociodemographic characteristics				
Age Groups (years)				
18–29	66.36 (± 10.42)		196 (56,2%)	< 0.001
30–39	69.50 (± 11.02)		189 (40,7%)	
≥ 40	70.37 (± 11.24)		24 (38,7%)	
Nationality				
Portugal	69.31 (± 11.27)		285 (40.2%)	< 0.001
Another country	64.03 (± 7.94)		124 (74.7%)	
Formal education				
2nd cycle of primary education	58.21 (± 7.22)		30 (90.9%)	< 0.001
3rd cycle of primary education	63.98 (± 9.17)		80 69.6%)	
High school	66.47 (± 9.06)		189 (53,1%)	
University education	72.31 (± 11.74)		110 (29,6%)	
Profession/occupation				
Intellectual and scientific	73.67 (± 11.71)		62 (25.8%)	< 0.001
Techniques	68.03 (± 10.26)		204 (44.5%)	
Undifferentiated	61.77 (± 7.00)		143 (80.8%)	
Employment status				
Working professionally	69.87 (± 11.00)		262 (38,4%)	< 0.001
Not working professionaly	62.78 (± 8.58)		147 (76,2%)	
Payment of expenses				
Very Easy_easy	73.30 (± 10.98)		76 (22.9%)	< 0.001
Difficult_ Very difficult	65.26 (± 9.68)		333 (61.3%)	
Health behaviors and lifestyles				
Smoking behavior				
Never	68.47 (± 10.94)		284 (44.0%)	< 0.001
Before pregnancy	69.67 (± 11.50)		53 (43.4%)	
Stopped in pregnancy	66.58 (± 10.95)		26 (60.5%)	
Occasionally	72.22 (± 7.69)		46 (71.9%)	
Alcohol or PS consumption				
Never	68.20 (± 10.35)		260 (44.4%)	0.016
Before pregnancy	68.90 (± 11.93)		74 (50.3%)	
Stopped in pregnancy	71.49 (± 12.42)		27 (41.5%)	
Occasionally	65.31 (± 11.05)		48 (62.3%)	
Physical activity				
Never	64.89 (± 9.78)		141 (63.2%)	< 0.001
Never: medical restriction	71.83 (± 7.36)		6 (22.0%)	
Occasional	67.93 (± 14.53)		23 (42.6%)	
Light	69.25 (± 10.97)		134 (43.8%)	
Heavy	69.82 (± 10.61)		105 (39.6)	
Health status				
Previous Self-perceived health status				
Bad or very bad	61.00 (±37.23)	9 (81.8%)	<0.001	
Fair	64.87 (±9.27)	162 (63.8%)		
Good or very good	69.87 (±11.22)	238 (39.0%)		
Current Self-perceived health status				
Much worse ou worse	66.82 (±11.18)	58 (58.6%)	0.003	
Equal	68.08 (±10.41)	332 (46.4%)		
Better or much better	73.42 (±14.49)	19 (31.1%)		
Gynecologic History				
Contraceptive method				

Table 4 (continued)

	General HL Mean (± SD)		Limited HL *n* (%)	*p*-Value [1]
Yes	68.67 (±11.13)	350 (44.6%)	<0.001	
No	65.11 (±8.20)	59 (65.6%)		
Cervic vaginal cytology				
Never	62.38 (±8.40)	82 (73.2%)	<0.001	
In the last 12 months	70.33 (±11.24)	119 (37.5%)		
>1 year ago, < 2 years	69.44 (±10.56)	90 (41.9%)		
>2 years ago, < 3 years	69.05 (±11.03)	54 (46.6%)		
Not in the past 3 years	65.62 (±10.25)	64 (55.7%)		
Obstetric history				
Planned Pregnancy				
Yes	70.33 (±11.21)	212 (36.5%)	<0.001	
No	64.32 (±9.06)	197 (67.0%)		
Pregnancy surveillance				
1-11 weeks	68.96 (±11.05)	336 (43.3%)	<0.001	
12-27 weeks	63.37 (±8.21)	69 (72.6%)		
≥ 28 weeks	58.55 (±4.49)	4 (100%)		
Site of the queries				
Health center	64.47 (±8.63)	182 (63.6%)	<0.001	
Health center (HC) / Hospital	66.59 (±11.03)	74 (59.7%)		
HC / Hospital/ Private clinic	69.10 (±10.61)	33 (37.5%)		
Health center/ Private clinic	71.60 (±11.45)	20 (31.8%)		
Breastfeeding				
Yes	68.74 (±10.86)	360 (44.5%)	<0.001	
No	59.80 (±7.72)	8 (72.7%)		
Cannot breastfeed	62.50 (±9.45)	2 (50.0%)		
Has not yet decided	63.71 (±10.64)	39 (76.5%)		
Childbirth preparation program				
Already attends	70.90 (±11.60)	97 (34.5%)	<0.001	
No	64.99 (±8.34)	212 (60.9%)		
Has not yet decided / Cannot attend	65.42 (±10.37)	53 (56.4%)		
Intends to attend	72.90 (±12.21)	47 (30.9%)		

[1]Fisher's exact or chi-square tests used to evaluate associations between limited health literacy and sociodemographic, health behaviors and lifestyles, health status, gynecologic and obstetric history variables

*HL*Health literacy,*SD*Standard deviation

strongly correlated with health literacy, as 90.9% of those with only primary education (2nd cycle) showed limited health literacy. Similarly, marital status revealed disparities, with divorced, separated, or widowed women reporting the highest prevalence at 92.3%. Occupational status highlighted further inequalities, with 80.8% of undifferentiated workers and 76.2% of those not professionally active demonstrating limited health literacy. Regarding housing conditions, 57.6% of women living in homes owned by relatives had limited health literacy, compared to lower rates among those renting or owning their homes. The absence of healthcare training played a critical role, as 51.3% of those without such training exhibited limited health literacy. Financial strain was a key determinant, with 61.3% of women who found it difficult to meet expenses reporting limited health literacy.

Behavioral and lifestyle factors also played a role. Women who smoked occasionally had the highest prevalence of limited health literacy (71.9%), followed by those who quit smoking during pregnancy (60.5%). Exposure to tobacco smoke was associated with higher rates of limited health literacy (58.5%) compared to those not exposed. Occasional alcohol or psychoactive substance users had a prevalence of 62.3%. Among physical activity levels, the highest prevalence was observed in women who reported never engaging in physical activity (63.2%). Regarding dietary habits, limited health literacy was most common among those with occasional (75.0%) or light fruit and vegetable consumption (77.6%). Obesity prior to pregnancy was associated with 60.6% limited health literacy, followed by overweight women (46.7%).

Self-perceived health status also revealed disparities. Women who rated their previous health as "bad or very

Table 5 Final multivariable logistic regression model for predictors of limited health literacy

	Adjusted OR, 2nd bloc (95% CI) [1]
Country of birth	
Portugal	1
Other country	2.43 (1.56–3.80)
Educational level	
University education	1
High school	0.20 (0.05–0.77)
3rd cycle	0.23 (0.06–0.86)
Up to 2nd cycle	0.30 (0.08–1.15)
Profession/occupation	
Intellectual and scientific	1
Techniques	0.36 (0.19–0.70)
Undifferentiated	0.42 (0.25–0.68)
Payment of expenses at the end of the month	
Very easy/Easy	1
Very difficult/Difficult	2.87 (1.99–4.14)
Planned pregnancy	
Yes	1
No	1.37 (0.94-2.00)
Surveillance pregnancy	
1–11 weeks	1
≥ 12 weeks	0.95 (0.53–1.72)
Previous Self-perceived health	
Good/Very good	1
Fair	0.26 (0.04–1.47)
Bad/Very bad	0.39 (0.07–2.20)
Current Selperceived health	
Better/Much Better	1
Equal	0.25 (0.11–0.54)
Worse/much worse	0.65 (0.40–1.05)
BMI prior to pregnancy	
Underweight	1
Normal weight	0.36 (0.15–0.84)
Overweight	0.74 (0.47–1.18)
Obesity	0.67 (0.41–1.12)

*OR*Odds ratio,*CI*Confidence interval

[1]Binary logistic regression model (1st block: forward, LR method; 2nd bloc: enter method) adjusted for country of birth, educational level, profession/occupation, payment of expenses, planned pregnancy, surveillance pregnancy, previous self-perceived health, current self-perceived health, and BMI

bad" had the highest prevalence of limited health literacy (81.8%), while those who rated their current health as "much worse or worse" had a prevalence of 58.6%. In terms of gynecological history, 73.2% of women who had never undergone cervical cytology exhibited limited health literacy, as did 65.6% of those who did not use contraceptive methods.

Pregnancy-related variables further emphasized disparities. Women in their third trimester (28–41 weeks) exhibited the highest prevalence of limited health literacy (47.4%) compared to those in the first (45.7%) and second trimesters (44.5%). Among women with unplanned pregnancies, 67.0% demonstrated limited health literacy, significantly higher than the 36.5% observed among those with planned pregnancies. Delayed initiation of pregnancy surveillance was strongly associated with limited health literacy, with 72.6% of those starting at 12–27 weeks affected and 100% of those starting surveillance at 28 weeks or later. Women without children had a lower prevalence of limited health literacy (44.0%) compared to those with children (50.4%). Healthcare engagement and intentions regarding breastfeeding and childbirth preparation programs further highlighted disparities. Women attending queries only at health centers had the highest prevalence of limited health literacy (63.6%) compared to 37.5% among those attending multiple types of healthcare facilities. Those undecided about breastfeeding (76.5%) or who did not intend to breastfeed (72.7%) exhibited higher rates of limited health literacy compared to women who intended to breastfeed (44.5%). Among those not attending childbirth preparation programs, 60.9% had limited health literacy, while only 30.9% of those intending to attend such programs were affected.

Determinants of limited health literacy

Variables showing statistical differences in limited health literacy across categories met the selection threshold for inclusion in the regression analysis ($p < 0.10$). Table 5 presents the final adjusted odds ratios (ORs) for limited health literacy, highlighting associations with key sociodemographic, economic, health status, and pregnancy-related factors. Full regression outputs, including crude and intermediate estimates, are available in Supplementary Material (Additional File 2).

OR, odds ratio; CI, confidence interval. [1]Binary logistic regression model (1st block: forward, LR method; 2nd bloc: enter method) adjusted for country of birth, educational level, profession/occupation, payment of expenses, planned pregnancy, surveillance pregnancy, previous self-perceived health, current self-perceived health, and BMI. Full model specifications, including crude and intermediate estimates, are available in Supplementary Material (Additional File 2).

In the first regression model (univariate, not adjusted), several variables show a significant relationship with limited health literacy. Regarding age groups, younger individuals demonstrate lower odds of limited literacy compared to those aged 40 and above. Those aged 18–29 years have 47% lower odds of limited literacy (Crude OR = 0.53, 95% CI: 0.40–0.71), while individuals aged 30–39 years have 51% lower odds (Crude OR = 0.49, 95% CI: 0.28–0.85). Country of birth is a significant factor, with individuals born outside Portugal having more than four times the odds of limited health literacy compared to Portuguese-born individuals (Crude OR = 4.39, 95% CI: 3.00–6.42). Education level is also crucial. Compared to university graduates, individuals with high school

education have 96% lower odds of limited literacy (Crude OR = 0.04, 95% CI: 0.01–0.14), those with 3rd cycle education have 89% lower odds (Crude OR = 0.11, 95% CI: 0.03–0.37), and those with education up to the 2nd cycle have 78% lower odds (Crude OR = 0.22, 95% CI: 0.06–0.79). Regarding profession/occupation, compared to individuals in intellectual and scientific professions, those in technical professions have 92% lower odds of limited literacy (Crude OR = 0.08, 95% CI: 0.05–0.13), while individuals in undifferentiated professions have 81% lower odds (Crude OR = 0.19, 95% CI: 0.12–0.29). Employment status also shows a significant association with health literacy. Individuals not working professionally have more than five times the odds of limited literacy compared to those employed (Crude OR = 5.12, 95% CI: 3.55–7.38). Financial hardship is another key predictor. Those experiencing difficulty paying monthly expenses have more than five times the odds of limited literacy compared to individuals who find it easy to cover their expenses (Crude OR = 5.34, 95% CI: 3.92–7.27). Regarding pregnancy-related factors, individuals with an unplanned pregnancy have more than three times the odds of limited literacy compared to those with a planned pregnancy (Crude OR = 3.53, 95% CI: 2.62–4.75). Similarly, individuals who initiated pregnancy surveillance at ≥ 12 weeks have more than three times the odds of limited literacy (Crude OR = 3.67, 95% CI: 2.29–5.88). In terms of self-perceived health, individuals who currently rate their health as equal to before have 68% lower odds of limited literacy (Crude OR = 0.32, 95% CI: 0.16–0.62), while those who perceive their health as worse or much worse have 39% lower odds (Crude OR = 0.61, 95% CI: 0.40–0.93). For body mass index (BMI) prior to pregnancy, individuals with normal weight have 52% lower odds of limited literacy compared to those who are underweight (Crude OR = 0.48, 95% CI: 0.23–0.98).

In a second regression approach (first block forward), country of birth remains a significant determinant, with individuals born outside Portugal exhibiting more than twice the odds of limited health literacy compared to those born in Portugal (Adjusted OR = 2.44, 95% CI: 1.58–3.75). Profession/occupation continues to demonstrate a strong association with health literacy, compared to individuals in intellectual and scientific professions, those in technical professions show 75% lower odds of limited literacy (Adjusted OR = 0.25, 95% CI: 0.14–0.44), while individuals in undifferentiated professions exhibit 66% lower odds (Adjusted OR = 0.34, 95% CI: 0.22–0.54). Financial difficulties remain a key predictor. Individuals who report difficulty covering monthly expenses have more than three times the odds of limited health literacy compared to those without financial strain (Adjusted OR = 3.24, 95% CI: 2.29–4.60). Previous self-perceived health does not show a statistically significant association after adjustment. Current self-perceived health continues to be a relevant factor. Compared to those who perceive their health as better or much better, individuals who rate their health as the same demonstrate 76% lower odds of limited literacy (Adjusted OR = 0.24, 95% CI: 0.11–0.51). Those who perceive their health as worse or much worse do not present a statistically significant association (Adjusted OR = 0.61, 95% CI: 0.38–0.99). BMI also becomes significant in this model. Compared to underweight pregnant women's, those with normal weight exhibit 64% lower odds of limited literacy (Adjusted OR = 0.36, 95% CI: 0.15–0.84), however, overweight and obesity do not show statistically significant associations.

In the final adjusted binary logistic regression model (1st bloc: forward, LR method; 2nd bloc: enter method) adjusted for country of birth, educational level, profession/occupation, payment of expenses, planned pregnancy, surveillance pregnancy, previous self-perceived health, current self-perceived health, and BMI remain significant determinants of limited health literacy among pregnant women. Country of birth continues to be a strong predictor, with pregnant women born outside Portugal exhibiting more than twice the odds of limited health literacy compared to those born in Portugal (Adjusted OR = 2.43, 95% CI: 1.56–3.80). Educational level remains a key determinant of health literacy. Compared to pregnant women with university education, those with high school education exhibit 80% lower odds of limited literacy (Adjusted OR = 0.20, 95% CI: 0.05–0.77), while those with 3rd cycle education has 77% lower odds (Adjusted OR = 0.23, 95% CI: 0.06–0.86). Education up to the 2nd cycle does not present a statistically significant association in the fully adjusted model. Profession/occupation continues to demonstrate an association with health literacy. Compared to pregnant women in intellectual and scientific professions, those in technical professions have 64% lower odds of limited literacy (Adjusted OR = 0.36, 95% CI: 0.19–0.70), while those in undifferentiated professions show 58% lower odds (Adjusted OR = 0.42, 95% CI: 0.25–0.68). Financial hardship remains a strong predictor. Pregnant women who report difficulty covering monthly expenses have nearly three times the odds of limited health literacy compared to those without financial strain (Adjusted OR = 2.87, 95% CI: 1.99–4.14). Planned pregnancy is no longer statistically significant in the fully adjusted model. Pregnant women with an unplanned pregnancy exhibit 37% higher odds of limited health literacy (Adjusted OR = 1.37, 95% CI: 0.94–2.00), but this association does not reach statistical significance. Surveillance pregnancy, defined as delayed initiation of prenatal care (≥ 12 weeks), also does not present a significant association with limited health literacy in the final model (Adjusted OR = 0.95, 95% CI: 0.53–1.72). Previous self-perceived health does not show

a statistically significant association after adjustment, indicating that retrospective health perception may not be a strong determinant of health literacy. Current self-perceived health remains a relevant factor. Compared to those who perceive their health as better or much better, pregnant women who rate their current health as the same exhibit 75% lower odds of limited health literacy (Adjusted OR = 0.25, 95% CI: 0.11–0.54). However, those who consider their health as worse or much worse do not present a statistically significant association (Adjusted OR = 0.65, 95% CI: 0.40–1.05). Body Mass Index (BMI) prior to pregnancy continues to be an influential factor. Compared to underweight women, those with normal weight demonstrate 64% lower odds of limited health literacy (Adjusted OR = 0.36, 95% CI: 0.15–0.84). Overweight and obesity do not show significant associations in the final model.

At last, the area under the ROC curve (AUC) for the final model is 0.782, indicating a good level of discriminatory power and suggests that the model has a 78.2% probability of correctly distinguishing between individuals with and without limited health literacy. This result demonstrates that the model reliably differentiates between the two categories, providing a strong basis for its predictive validity in this context.

Discussion

This study offers a comprehensive assessment of general health literacy (HL) among pregnant women from the district of Viseu, in Portugal, based on a large sample and using the HLS_{19}-Q12, an internationally validated instrument.

Compared to national data, pregnant women in our sample exhibited a distinct HL profile, characterized by a higher prevalence of problematic HL. These differences may be partially explained by the sociodemographic characteristics of the sample. A significant proportion of participants reported financial difficulties, lower educational levels, and occupations in less qualified professional groups, all factors known to be associated with reduced health literacy across diverse populations [18, 22, 23]. Such social determinants may attenuate the potential benefits typically linked to younger age and regular contact with healthcare services during pregnancy.

These comparisons position pregnant women in an intermediate profile between general and older populations, underscoring the need to address literacy gaps even among younger adults facing additional structural and socioeconomic vulnerabilities.

A wide range of sociodemographic, behavioral, and health-related variables showed significant associations with limited health literacy, confirming the multifactorial nature of HL during pregnancy. These findings are consistent with previous research that highlights the role of education, income, and occupation as key determinants of HL, particularly in reproductive-aged populations.

Building on these results, it is noteworthy that 46.7% of participants in this study were classified as having limited HL, either problematic or inadequate. This proportion places the sample at the upper end of the range reported in previous international studies conducted among pregnant women, where the prevalence of limited HL typically varies between 15% and 50%, depending on the instrument used, population characteristics, and socio-cultural context [3, 7]. Nearly 38% of women of reproductive age in Brazil were found to have problematic health literacy, as reported in a recent study using the HLS-EU-BR instrument [24], reinforcing the comparability of these findings across cultural and socioeconomic settings. Such figures are particularly concerning given the increased demand for information processing and decision-making during pregnancy, a period in which health-related knowledge and self-management capabilities are essential.

Overall, this study found that while the majority of pregnant women reported positive health behaviors such as high fruit and vegetable consumption and engagement in physical activity and risk behaviors including tobacco and alcohol use, as well as physical inactivity, were still present among a significant proportion of participants. Approximately one in eight women continued smoking during pregnancy, and nearly one in ten reported occasional alcohol consumption, echoing national and international evidence showing that these behaviors persist despite well-known risks [3, 25–27]. Physical inactivity was reported by over 25% of participants, which is consistent with previous findings indicating suboptimal adherence to prenatal exercise recommendations [28–30]. Conversely, nearly 90% of participants reported regular intake of fruits and vegetables, a pattern associated with improved pregnancy outcomes, including reduced risk of low birth weight and hypertensive complications [31–33]. However, as shown in other studies, such dietary behaviors may be unequally distributed across subgroups, particularly among those with limited health literacy [3, 32].

In this sample, limited health literacy was more prevalent among women who smoked, were physically inactive, and reported no or minimal changes in health behaviors during pregnancy. Prior studies confirm that women with lower health literacy may have less access to reliable health information, lower self-efficacy in managing health, and reduced understanding of the risks associated with lifestyle behaviors such as smoking, alcohol intake, and inadequate diet [1, 34, 35]. Furthermore, physical inactivity and excessive pre-pregnancy BMI were more frequent among those with limited HL, reinforcing the relationship between literacy levels, lifestyle

management, and pregnancy-related risk profiles. Health literacy not only influences behavior directly but also mediates how individuals interpret, evaluate, and act on health advice received from professionals. As shown in several international reviews, HL plays a critical role in shaping maternal decision-making and autonomy, especially when managing multiple health messages during pregnancy [7, 36].

Beyond the overall prevalence, this study revealed specific patterns in the distribution of HL. These findings reinforce the importance of understanding how structural inequalities operate in combination. Factors such as being born outside Portugal, having limited education, facing financial hardship and being excluded from formal employment do not act independently. Rather, they intersect and compound the risk of limited health literacy by creating multiple, overlapping barriers. For example, a pregnant woman who is both foreign-born and economically vulnerable may experience cumulative disadvantages, such as language barriers, limited access to information and greater difficulty navigating healthcare services. Framing these results within an intersectional social determinants of health perspective allows for a deeper understanding of the mechanisms that shape health literacy inequalities and underscores the need for antenatal care strategies that are both inclusive and equity-oriented.

Pregnant women reported more difficulties in accessing and appraising health information than in understanding it, patterns similar to those identified in the Portuguese general population [19]. However, the presence of these difficulties even among women actively engaged with healthcare services suggests that current antenatal care encounters may not fully address HL needs. The disaggregated analysis showed marked inequalities in HL levels across various subgroups. Women born outside Portugal, those with lower levels of education, in lower-skilled occupations, or experiencing financial hardship were significantly more likely to have limited HL. For example, 61.3% of pregnant women who reported difficulty covering monthly expenses had limited health literacy, compared to only 22.9% among those without financial strain. Similarly, 76.2% of women who were not professionally active had limited health literacy, in contrast to 38.4% of those employed. These results reinforce the relationship between economic vulnerability, occupational exclusion, and reduced capacity to access, process, and apply health information during pregnancy, as documented in previous international research [3, 5, 7, 37].

Moreover, certain pregnancy-related characteristics, such as unplanned pregnancy and delayed initiation of antenatal care (≥ 12 weeks), were associated with limited HL in the univariate analysis, though these associations did not remain statistically significant after adjustment. This suggests that structural sociodemographic determinants may exert a stronger influence on HL than pregnancy-specific experiences. The final regression model confirmed that limited HL was independently associated with being born outside Portugal, lower educational attainment, occupational category, financial hardship, and current self-perceived health status. These findings highlight how individual and systemic factors converge to shape HL disparities. Notably, women who rated their current health as "the same" compared to before pregnancy had significantly lower odds of limited HL than those who rated it as worse, underlining the bidirectional relationship between HL and perceived well-being.

An unexpected finding was that women who rated their current health as "equal" to before pregnancy had lower odds of limited health literacy than those who perceived it as "better". One possible explanation is that those reporting 'equal' health may be more health-conscious and proactive in maintaining their well-being, reflecting higher levels of health information-seeking and earlier engagement with antenatal care services. Conversely, those perceiving their health as 'better' might reflect subjective optimism rather than actual engagement with health-related information or services. Although this finding warrants further investigation, it highlights the nuanced ways in which perceived health and HL interact during pregnancy.

Interestingly, neither maternal age nor educational level remained significant in the adjusted models in some analyses, which contrasts with findings from general population studies [23]. This may be due to the relative homogeneity of age and schooling within the pregnant population, and the stronger mediating role of financial hardship and occupation. Similar observations were reported in a recent study, which found that financial insecurity could attenuate the effect of education in multivariable models [24]. The results of this study confirm the importance of considering HL within a broader framework of social determinants of health, especially in prenatal care settings. They also support the perspective that pregnancy is a critical window for intervention, where HL-enhancing strategies can have a direct impact on maternal and child outcomes.

In light of these findings, several actionable recommendations can be proposed for antenatal care. Routine assessment of health literacy using brief validated tools could be integrated into early prenatal intake visits to help identify women at risk and enable more personalized care planning. Antenatal education programmes may benefit from adapting their content to include simplified language, visual communication aids, and digital modules tailored to the needs of women with limited health literacy. Particular attention should be given to migrant women and those experiencing financial hardship, who

may face additional systemic barriers. Moreover, providing training for midwives, nurses, and other maternal health professionals in HL-sensitive communication could strengthen their ability to support informed decision-making and contribute to reducing maternal health inequalities.

The regression model presented an acceptable discriminatory capacity in identifying pregnant women at risk for limited HL, as shown by the area under the ROC curve, consistent with established criteria [21]. While this supports the robustness of the statistical model, it is important to interpret associations cautiously given the cross-sectional nature of the data. Nevertheless, this study contributes to an emerging body of research emphasizing the complexity of HL and the necessity of tailoring interventions to population subgroups with specific needs.

Implications for maternal healthcare

The findings from this study have clear implications for maternal healthcare practice and policy. The high prevalence of limited HL among pregnant women, particularly in groups facing social and economic vulnerability, calls for the integration of HL-sensitive approaches within routine prenatal care. Healthcare professionals must be equipped with the skills to identify HL limitations and communicate accordingly, using plain language, visual supports, and confirmation techniques such as teach-back. In addition, prenatal care services should assess HL levels systematically to inform individualized care plans. Given the increasing role of digital platforms in accessing health information, particularly during pregnancy, digital health literacy must also be addressed. From a policy perspective, HL should be considered a central component of maternal health promotion strategies. Incorporating HL indicators into national health surveys and investing in community-level interventions that target the social determinants identified in this study could help reduce HL inequalities and improve maternal outcomes.

Strengths and limitations

This study presents several strengths. First, the use of the HLS_{19}-Q12, a validated, comprehensive, and multidimensional instrument aligned with international standards, enhances the methodological rigor and allows for meaningful comparisons with studies in other countries. Second, the sampling strategy ensured representativeness of the pregnant population in the central region of Portugal, capturing a wide range of sociodemographic and obstetric characteristics. This diversity permitted a detailed exploration of health literacy across various subgroups, enhancing the interpretability and policy relevance of the findings. A further methodological strength was the implementation of a multimodal data collection strategy, whereby participants could respond to the survey online, through interviewer administration, or via self-completed paper questionnaires. This flexible approach increased accessibility for participants with differing digital skills, literacy levels, and personal preferences. Prior research has demonstrated that multimodal survey designs can improve response rates, reduce selection bias, enhance sample composition, and maintain or even improve data quality while controlling costs. These advantages are particularly relevant in studies involving pregnant women, where heterogeneity in socioeconomic and educational backgrounds is common.

Nevertheless, it is important to acknowledge limitations this study. Although the cross-sectional design limits the ability to establish causal relationships between health literacy and its potential determinants, future qualitative work, such as focus groups with pregnant women, could provide valuable insight into the mechanisms and contextual factors underlying these associations. Although the study potentially achieved regional representativeness, given the large sample size, generalization to the national level should be made with caution, not least because representativeness has not been formally ascertained, and different regions may exhibit different social and health service dynamics.

Conclusion

The prevalence of limited general health literacy among pregnant women in this study is considerably high, with nearly half of the participants reporting difficulties in accessing, understanding, and using health information. After controlling for other variables, being born outside Portugal, having a lower level of education, holding a lower-skilled occupation, experiencing financial hardship, and perceiving one's current health as worse or unchanged were independently associated with limited health literacy. These findings emphasize the social gradient in health literacy during pregnancy and highlight the compounded disadvantage faced by socioeconomically vulnerable subgroups.

The identification of key sociodemographic and health-related determinants of limited health literacy in this population reveals the urgent need to incorporate literacy-sensitive strategies into maternal healthcare. Addressing literacy disparities among pregnant women is particularly relevant, as inadequate health literacy may compromise engagement with antenatal care, self-care behaviors, and ultimately, maternal and neonatal outcomes. These results underscore the importance of adapting health communication and prenatal care services to the needs of women with lower health literacy.

From a public health perspective, the findings reinforce the call for integrated health promotion strategies that explicitly consider health literacy as a determinant of

maternal health. Policymakers and healthcare professionals should prioritize interventions that reduce barriers to health information and empower pregnant women with the knowledge and confidence to make informed decisions. In doing so, it will be possible to enhance health equity and contribute to improved health outcomes across the perinatal continuum.

Abbreviations

aOR	Adjusted odds ratios
AUC	Area under the curve
BMI	Body mass index
CL	Confidence limits
cOR	Crude odds rations
HL	Health literacy
HLS19-Q12	12-item version of the health literacy survey from the health
HLS	Health literacy survey
OR	Odds ratio
M-POHL	Measuring population and organizational health literacy
ROC	Receiver operating characteristic
SD	Standard deviation
WHO	World health organization

Supplementary Information

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Supplementary Material 1.

Supplementary Material 2.

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Authors' contributions
NF designed the study. NF and SF collected data. NF performed the analysis, and all the authors interpreted the data. NF wrote the main manuscript text. ES and NF used the software analysis. MF, ES, SF, MA, AC read, provided feedback on, and approved the final version of the manuscript.

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Data availability
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Informed consent was obtained from all participants before any procedure. The study was previously approved by the Institutional Health Ethics Committees of the Hospital Center Tondela-Viseu (reference 29/13/09/2023) and the Central Regional Health Administration (process number 124–2023). Furthermore, all procedures followed the Code of Ethics of the Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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