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Assessment of Health Literacy Levels Among Women Visiting Comprehensive Health Centers in Gorgan in 2024

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ABSTRACT

This study assessed maternal and pregnancy health literacy and related factors among pregnant women attending rural Comprehensive Health Service Centers in Gorgan County, Iran, in 2024. This descriptive-analytical cross-sectional study included 310 pregnant women selected through stratified random sampling with proportional allocation. Data were collected using a validated Maternal and Pregnancy Health Literacy Questionnaire and a demographic and clinical characteristics checklist. Statistical analyses included the Kolmogorov–Smirnov test, Pearson's correlation coefficient, one-way analysis of variance (ANOVA), and linear regression. Statistical significance was defined as $P < 0.05$. The mean age of participants was 32.13 years. Maternal health literacy was significantly inversely associated with the number of pregnancies ($r = -0.357$, $P = 0.001$) and positively associated with the number of prenatal care visits ($r = 0.176$, $P = 0.002$). Maternal health literacy was associated with pregnancy history and utilization of prenatal care services. These findings emphasize the need for targeted educational strategies to strengthen pregnant women's ability to access, comprehend, and apply health information, which may facilitate appropriate prenatal care and contribute to improved maternal and neonatal health.

Keywords: pregnancy health literacy; Maternal health literacy; prenatal care; pregnant women; rural Comprehensive Health Service Centers; Gorgan

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Introduction

Pregnancy is a physiologically dynamic and socially significant period in which women are required to make frequent decisions concerning nutrition, medication use, prenatal screening, lifestyle, warning signs, healthcare utilization, and preparation for childbirth. The quality of these decisions depends not only on the availability of maternal healthcare services but also on women's capacity to access, understand, evaluate, communicate, and appropriately apply health information. Within this context, health literacy has increasingly been recognized as an important determinant of maternal health because pregnancy exposes women to large volumes of medical and behavioral information that must often be interpreted and acted upon within relatively short periods. Contemporary conceptualizations therefore extend health literacy beyond basic reading and numeracy and describe it as a multidimensional set of competencies enabling individuals to locate, comprehend, critically appraise, and use health information and services to make appropriate health-related decisions (1). This broader perspective is particularly relevant during pregnancy,

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when women continuously interact with healthcare professionals and must translate recommendations into everyday behaviors. Maternal health literacy consequently represents a pregnancy-specific application of health literacy that encompasses knowledge, information-seeking capacity, understanding of maternal health recommendations, decision-making, self-management, and the ability to interact effectively with maternity services (2). Recognition of these dimensions has led to the development of dedicated instruments for assessing maternal health literacy during pregnancy and has strengthened interest in understanding how variations in health literacy may influence the use of prenatal services and maternal and neonatal outcomes (3).

The importance of maternal health literacy is reinforced by the complexity of contemporary antenatal care. Pregnant women are expected to understand recommendations regarding antenatal visits, micronutrient supplementation, healthy weight gain, vaccination, laboratory and imaging examinations, fetal movement, signs of obstetric complications, birth preparedness, and postpartum care. Even women who have access to healthcare may have difficulty benefiting from these services when medical information is complex, communication is inadequate, or available educational material does not correspond to their literacy level and sociocultural circumstances. Systematic evidence indicates that health literacy during the prenatal period varies substantially across populations, with considerable heterogeneity attributable to measurement methods, educational attainment, socioeconomic position, healthcare setting, and demographic characteristics (4). Reviews specifically examining pregnant women have similarly demonstrated that limited health literacy remains common and is associated with several social and health-related characteristics (5). The same body of evidence emphasizes that maternal health literacy cannot be regarded as a fixed personal attribute because it reflects an interaction between individual capabilities and the complexity of information and healthcare environments (6). More recent work has further demonstrated that pregnant women may simultaneously show strengths in some health literacy domains and substantial difficulty in others, supporting a multidimensional rather than binary understanding of health literacy (7).

Maternal health literacy has particular relevance for engagement with antenatal care because women must recognize the value of timely and continuous care and understand how recommended examinations and behaviors contribute to maternal and fetal well-being. Research among pregnant women has demonstrated a relationship between health literacy and knowledge of antenatal care, suggesting that women with stronger health literacy skills may be more capable of understanding the objectives of routine pregnancy monitoring and acting on professional recommendations (8). Evidence from Nigeria has similarly shown relationships among maternal health literacy, utilization of maternal healthcare services, and pregnancy outcomes, indicating that women's ability to interpret health information may influence how effectively they navigate maternity services (9). In Egypt, assessments of women attending antenatal clinics have also identified substantial variation in health literacy according to demographic and socioeconomic characteristics, highlighting the importance of recognizing vulnerable subgroups during prenatal care (10). Studies in Iran provide comparable evidence. Among Iranian pregnant women, maternal health literacy has been associated with educational attainment and patterns of health information seeking, emphasizing the importance of both individual resources and access to suitable sources of health information (11). These findings collectively suggest that maternal health literacy may operate as an important mechanism connecting women's socioeconomic circumstances, information behaviors, and use of healthcare.

The relationship between socioeconomic circumstances and health literacy is especially important because pregnancy occurs within broader social environments that shape access to knowledge, healthcare resources, family support, and decision-making opportunities. Socioeconomic disadvantage has repeatedly been associated with poorer health literacy, and health literacy may partly mediate the pathway through which social inequalities become health inequalities (12). Education is among the most consistently identified determinants because formal education may strengthen reading comprehension, information evaluation, communication skills, and confidence in interacting with health professionals. Occupation, income, household resources, and social support may also influence opportunities to obtain reliable health information. Research focusing on reproductive-aged women has further shown that health literacy is embedded within the broader social determinants of health, reinforcing the need to understand women's literacy-related capacities within their socioeconomic and interpersonal environments rather than as isolated individual characteristics (13). This perspective is particularly relevant for maternal healthcare because pregnancy-related decisions may involve not only the pregnant woman but also her spouse, family, and healthcare providers. Accordingly, maternal and spousal education, employment status, and other household characteristics may contribute to differences in women's ability to access and use maternal health information.

Geographic location is another important dimension because rural and urban populations frequently differ in educational opportunities, access to specialist services, availability of health information, transportation, digital connectivity, and continuity of care. A systematic review comparing health literacy in rural and urban populations indicated that geographical inequalities are relevant to health literacy and that people living in rural areas may encounter distinctive structural barriers to acquiring and applying health information (14). Such differences may become particularly important during pregnancy because repeated access to antenatal services is required throughout gestation. At the same time, rural populations cannot automatically be assumed to have poor health literacy because strong primary healthcare systems, community-based health workers, and regular contact with local health facilities may mitigate some disadvantages. In Iran, Behvarzes and other primary healthcare personnel play a central role in delivering preventive services, health education, screening, and maternal care within rural communities. Nevertheless, qualitative evidence has identified operational and professional challenges within the Behvarz system, indicating that the effectiveness of community-based health education depends on workforce capacity, organizational support, and service conditions (15). Evaluating maternal health literacy among women using rural primary healthcare services is therefore important for determining whether established service structures are successfully enabling women to understand and use pregnancy-related information.

The potential consequences of limited maternal health literacy extend beyond knowledge and may affect health behaviors, self-care, utilization of services, and pregnancy outcomes. Evidence from nulliparous populations has examined associations between health literacy and maternal and neonatal outcomes, illustrating growing concern about whether limited health literacy represents a clinically meaningful risk factor during pregnancy (16). Likewise, prospective evaluations among women attending antenatal classes have explored differences in health literacy between nulliparous and multiparous women and their relationship with delivery outcomes, indicating that parity may be relevant to how women acquire and use pregnancy-related information (17). Although previous pregnancy experience may provide practical

familiarity with antenatal care, greater parity may also be accompanied by childcare responsibilities, reduced time for information seeking, or an assumption that previous experience is sufficient for managing subsequent pregnancies. Consequently, the association between gravidity or parity and health literacy is not necessarily linear and requires empirical assessment in specific healthcare settings.

Maternal health literacy may also contribute indirectly to fetal and neonatal health through its influence on antenatal care attendance, self-care, recognition of complications, and adherence to recommendations. Antenatal care is a central mechanism for identifying maternal and fetal risks, providing preventive interventions, and delivering health education. A systematic review and meta-analysis of African studies found that antenatal care was associated with a reduced likelihood of low birth weight, demonstrating the potential importance of adequate pregnancy monitoring for neonatal outcomes (18). Low birth weight itself has a multifactorial etiology involving maternal demographic, nutritional, clinical, behavioral, and healthcare-related factors (19). Maternal age is another relevant consideration because pregnancy at younger or advanced ages may be associated with different patterns of obstetric risk and healthcare utilization; systematic review evidence confirms variation in maternal and perinatal complications according to maternal age (20). Health literacy may intersect with these risk factors by influencing how women understand recommendations, recognize symptoms, adhere to supplementation or treatment, and seek care when complications arise. It is therefore important to evaluate health literacy alongside obstetric and healthcare-utilization variables rather than treating it as an isolated psychosocial construct.

The health system itself also has a responsibility to reduce literacy-related barriers. Modern health literacy frameworks increasingly distinguish individual health literacy from organizational health literacy, emphasizing that healthcare organizations should make services and information easier to access, navigate, understand, and use. A health-literate healthcare organization is characterized by clear communication, accessible information, responsive service design, support for navigation, and sensitivity to the diversity of service users' literacy needs (21). In maternal healthcare, healthcare providers have an especially important role because women often rely on midwives, nurses, physicians, and community health workers to interpret complex information. However, evidence from a national survey of midwives has shown variation in professionals' self-reported knowledge and skills for assessing and promoting maternal health literacy, indicating that healthcare workers themselves may require targeted preparation to provide literacy-responsive care (22). Improving maternal health literacy therefore cannot be achieved solely by expecting pregnant women to become better information users; healthcare systems must also reduce unnecessary complexity and adapt communication to women's needs.

Interventional research supports the modifiability of health literacy and suggests that pregnancy offers an important window for targeted health education. An Iranian randomized controlled clinical trial demonstrated that health literacy education could improve self-care among pregnant women, indicating that literacy-focused strategies may translate into meaningful behavioral changes (23). At the same time, systematic reviews have emphasized that evidence concerning the effects of health literacy interventions on pregnancy outcomes remains limited and heterogeneous, making it difficult to identify a universally effective intervention model (24). Reviews of interventions among reproductive-aged women with low health literacy similarly indicate that strategies should be adapted to participants' abilities and circumstances, frequently combining clear communication, educational support, behavioral components, and accessible formats (25).

Among socioeconomically disadvantaged adults, interventions appear more promising when they are individualized, culturally responsive, interactive, and directed toward practical skills rather than simply delivering additional written information (26). These principles are highly relevant to pregnancy because antenatal care creates repeated opportunities to assess women's understanding, correct misconceptions, and strengthen their ability to apply health information.

Recent evidence increasingly emphasizes the need for interventions tailored specifically to socially and economically vulnerable pregnant women. A systematic review focusing on low-income pregnant women concluded that improving maternal health literacy requires attention to women's socioeconomic realities, cultural context, communication needs, and access to appropriate educational resources (27). Such findings are important because health literacy interventions that ignore structural barriers may disproportionately benefit women who already possess greater educational and social resources. Group-based antenatal care represents one promising model. A cluster randomized controlled trial in Ghana demonstrated that group antenatal care could improve maternal health literacy, suggesting that interactive approaches that combine professional education, peer support, discussion, and repeated engagement may strengthen women's understanding and confidence (28). These approaches may be particularly useful in settings where healthcare resources are limited because they create opportunities for questions, shared learning, and reinforcement of key messages.

Another important issue concerns the measurement of maternal health literacy. General health literacy instruments may fail to capture pregnancy-specific competencies related to prenatal care, warning signs, pregnancy outcomes, and maternal self-management. This limitation has encouraged development and psychometric evaluation of maternal health literacy instruments designed specifically for pregnancy (2). Validation studies in different cultural and linguistic environments have further demonstrated the need to ensure that health literacy measures are contextually appropriate before they are used to identify vulnerable women or evaluate interventions (3). The heterogeneity identified in systematic reviews of prenatal health literacy partly reflects differences among measurement instruments, thresholds, and dimensions assessed (4). Consequently, studies employing pregnancy-specific validated instruments can provide more clinically and contextually meaningful evidence than those relying exclusively on broad measures of functional health literacy.

Despite increasing international research, substantial gaps remain in knowledge concerning maternal health literacy in specific populations and service settings. Many studies have been conducted in urban hospitals, specialist clinics, or populations with relatively easy access to formal healthcare, while women receiving routine antenatal care through rural primary healthcare systems remain less extensively studied. This gap is relevant because rural residence may influence both health literacy and the way pregnancy-related services are accessed. Moreover, findings from one region cannot necessarily be generalized to another because health literacy depends on healthcare organization, educational opportunities, sociocultural norms, socioeconomic resources, and availability of information. Evidence from different countries has consistently demonstrated heterogeneity in maternal health literacy levels and determinants (7, 8, 10). The Iranian primary healthcare context is distinctive because rural pregnant women commonly receive repeated services through comprehensive health centers and community-based healthcare workers, creating a setting

in which regular healthcare contact may strengthen health literacy while socioeconomic or educational inequalities may continue to produce important differences among women.

Furthermore, the determinants of maternal health literacy should be examined concurrently rather than individually. Education, occupation, maternal age, parity, timing of initiation of prenatal care, and frequency of antenatal visits may be interrelated. Higher education may facilitate understanding of health information, while greater economic resources may improve access to digital information and healthcare. Repeated prenatal visits may strengthen health literacy through ongoing communication with providers, yet women with higher pre-existing health literacy may themselves be more likely to adhere to recommended antenatal schedules. Likewise, previous pregnancy experience may increase practical knowledge while simultaneously reducing active information seeking. These reciprocal and potentially confounded relationships underscore the need for analytical approaches that consider multiple sociodemographic and obstetric variables together. Evidence linking maternal health literacy with information-seeking behavior, service utilization, and pregnancy outcomes provides a basis for such multidimensional analysis (9, 11). Understanding these relationships is especially important for identifying groups requiring tailored educational support rather than applying identical communication strategies to all pregnant women.

The clinical and public health relevance of this issue is ultimately grounded in the possibility that stronger maternal health literacy may improve women's capacity to participate actively in their own care. Women who can understand and critically evaluate health information may be better prepared to recognize warning signs, follow treatment and supplementation recommendations, communicate concerns to healthcare providers, attend prenatal visits, and make informed decisions regarding pregnancy and childbirth. At the same time, international evidence cautions against assuming that higher health literacy will automatically produce favorable outcomes, because pregnancy outcomes are shaped by multiple biological, social, economic, and healthcare-related factors (16, 19). Maternal health literacy should therefore be understood as one modifiable component within a broader system of maternal health determinants. Strengthening this component may nevertheless be especially valuable because it can enhance women's interaction with preventive services that are already available within primary healthcare systems.

Accordingly, generating local evidence on maternal and pregnancy health literacy is necessary for designing health education that reflects women's actual needs. In rural settings, such evidence can inform the work of community health workers, nurses, midwives, and other primary healthcare providers by identifying demographic and obstetric characteristics associated with lower literacy and by clarifying how health literacy relates to prenatal care utilization. It may also support the development of health-literate service environments in which information is communicated in clear, understandable, and actionable forms. Given the established variability in prenatal health literacy, the influence of socioeconomic conditions, and the emerging evidence supporting literacy-sensitive interventions, assessment within specific healthcare populations is an essential prerequisite for targeted maternal health promotion (12, 21, 27).

Therefore, the aim of this study was to assess maternal and pregnancy health literacy among pregnant women attending rural Comprehensive Health Service Centers in Gorgan, Iran, and to examine its relationships with sociodemographic, obstetric, healthcare-utilization, and birth-related characteristics.

Methods and Materials

Study Design and Participants

A descriptive-analytical cross-sectional study was carried out among pregnant women receiving prenatal care at rural health houses affiliated with Comprehensive Health Service Centers in Gorgan County, Iran. Eligible participants were pregnant women with an active prenatal health record registered in the NAB electronic health information system.

The sample size was determined using estimates reported by Khosravi et al., with a 95% confidence level and a 5% margin of error. The calculation yielded an initial sample of 280 participants. To compensate for an anticipated 10% rate of incomplete responses, the required sample was increased to 308. In total, 310 pregnant women who fulfilled the eligibility criteria and provided complete questionnaire responses were included in the final analysis.

Participants were recruited through stratified random sampling using proportional allocation. Rural Comprehensive Health Service Centers served as the strata, with the pregnant women registered at each center forming the corresponding sampling frame. The number of participants recruited from each center was determined according to the proportion of eligible pregnant women receiving services at that center. Subsequently, eligible women within each stratum were selected by simple random sampling until the predetermined allocation was achieved.

First, a list of eligible pregnant women was obtained from each center. The proportion of pregnant women covered by each center relative to the total study population was then calculated, and the corresponding number of participants was allocated to each stratum. Finally, eligible women were selected from each center using simple random sampling (lottery method) until the predetermined sample size for each stratum was reached.

Eligible participants were pregnant women who had at least basic literacy, maintained an active prenatal care record in the NAB electronic health system, and did not have an academic background in medicine or paramedical sciences. Questionnaires with incomplete responses were excluded from the analysis.

Following approval of the research protocol and obtaining the necessary permissions from Golestan University of Medical Sciences and the Gorgan County Health Network, data collection was conducted in coordination with the rural Comprehensive Health Service Centers. Eligible participants were informed about the study objectives and procedures, and written informed consent was obtained before participation. Questionnaires were completed by the participants, with the researcher providing clarification, when necessary, without influencing their responses. Relevant clinical and obstetric information was extracted from health records using a structured checklist.

Data Collection Tools

Data were collected using the standardized Maternal and Pregnancy Health Literacy Assessment Questionnaire (MHLAPQ). The original questionnaire was developed by Mojoyinola in 2011 (Mojoyinola, 2011) as a self-report instrument for assessing maternal and pregnancy health literacy among pregnant and breastfeeding women. The Persian version was subsequently evaluated for validity and reliability by Kharazi, Peyman, and Esmaeili in 2017 and was reduced to 26 items (Kharazi et al., 2017).

The Persian version consists of two separate scales: maternal health literacy and pregnancy health literacy. The maternal health literacy scale contains 14 items across two dimensions: verbal and auditory comprehension (10 items) and self-management (4 items). The pregnancy health literacy scale contains 12 items across two dimensions: prenatal care (7 items) and pregnancy outcomes (5 items). The subscale scores are calculated independently, and the questionnaire does not provide an overall total score.

Responses to all items were recorded using a five-point Likert scale, with scores ranging from 1 (strongly disagree) to 5 (strongly agree). Possible scores on the maternal health literacy subscale ranged from 14 to 70, whereas scores for pregnancy health literacy ranged from 12 to 60. Higher total scores reflected greater levels of health literacy.

In addition to the questionnaire, demographic and obstetric information, including maternal age, maternal and spouse occupation and educational level, gravidity, timing of initiation of prenatal care, and number of prenatal care visits, were collected. Information on birth weight, supplement use, and anemia was obtained from the participants' health records and, when necessary, through participant reports.

Data Analysis

Statistical analyses were performed using SPSS version 18. Descriptive measures, including frequency, percentage, mean, and standard deviation, were calculated to summarize the characteristics of the study variables. The Kolmogorov–Smirnov test was applied to evaluate the normality of continuous data. Associations between continuous variables were examined using Pearson's correlation coefficient. One-way analysis of variance (ANOVA) was used to compare mean health literacy scores among categorical groups, with Tukey's post-hoc test applied for pairwise comparisons when indicated. Multiple linear regression was subsequently conducted to determine variables independently associated with maternal health literacy. All statistical tests were two-tailed, and results were considered statistically significant at $P < 0.05$.

Findings and Results

A total of 310 pregnant women were included in the analysis. The participants had a mean age of 32.13 ± 7.17 years (range, 16–46 years). The mean number of pregnancies was 2.44 ± 1.06, while the mean number of prenatal care visits was 9.03 ± 2.97. The mean timing of initiation of prenatal care was 1.22 ± 0.48. Anemia was reported in 47 participants (15.16%), whereas 263 (84.84%) had no anemia, whereas 263 (84.84%) did not. Other demographic and obstetric characteristics of the mothers are presented in Table 1.

Table 1. Demographic and obstetric characteristics of the study participants (n=310)

Variable		n (%)	Mean ± SD	Range
Age (years)		310	32.13 ± 7.17	16–46
Number of pregnancies		310	2.44 ± 1.06	1–5
Timing of initiation of prenatal care		310	1.22 ± 0.48	1–3
Number of prenatal care visits		310	9.03 ± 2.97	3–20
Supplement use				
Anemia	Yes	47 (15.16)	—	—
	No	263 (84.84)	—	—

The mean maternal health literacy score was 53.70 ± 12.31. The mean scores for verbal–auditory comprehension and self-management were 38.44 ± 9.68 and 15.27 ± 3.18, respectively. The mean pregnancy health literacy score was 47.23 ± 6.00, with mean scores of 27.52 ± 4.30 for prenatal care and 24.02 ± 3.00 for pregnancy outcomes (Table 2).

Table 2. Mean scores of maternal health literacy, pregnancy health literacy, and their domains

Health literacy measure	n	Mean ± SD	Range
Maternal health literacy			
Total maternal health literacy score	310	53.70 ± 12.31	18–70
Verbal–auditory comprehension	310	38.44 ± 9.68	10–50
Self-management	310	15.27 ± 3.18	7–20
Pregnancy health literacy			
Total pregnancy health literacy score	310	47.23 ± 6.00	35–60
Prenatal care	310	27.52 ± 4.30	17–35
Pregnancy outcomes	310	24.02 ± 3.00	13–30

The analysis of correlations between maternal health literacy and demographic and obstetric characteristics showed a significant negative correlation between maternal health literacy and the number of pregnancies (r=−0.357, P=0.001), In contrast, a significant positive correlation was observed between maternal health literacy and the number of prenatal care visits (r=0.176, P=0.002). No statistically significant correlations were observed between maternal health literacy and age, timing of initiation of prenatal care, or birth weight (P>0.05).

Furthermore, pregnancy health literacy was significantly and positively correlated with the number of prenatal care visits (r=0.184, P=0.001) and significantly and negatively correlated with the number of pregnancies (r=−0.277, P<0.001). No statistically significant correlations were observed between pregnancy health literacy and age, timing of initiation of prenatal care, or birth weight (P>0.05) (Table 3).

Table 3. Correlations between maternal and pregnancy health literacy scores and maternal demographic and care-related characteristics

Variable	Maternal health literacy		Pregnancy health literacy	
	r	P-value	r	P-value
Age	−0.082	0.152	0.060	0.292
Timing of initiation of care	−0.009	0.877	−0.087	0.124
Number of pregnancies	−0.357	<0.001	−0.277	<0.001
Number of prenatal care visits	0.176	0.002	0.184	0.001
Birth weight (g)	−0.026	0.647	0.098	0.085

Abbreviations: *r*, Pearson correlation coefficient.

In the multivariable linear regression analysis, higher maternal education (standardized β = 0.216, P < 0.001) and higher spouse education (standardized β = 0.250, P < 0.001) were significantly and positively associated with maternal health literacy. Conversely, a greater number of pregnancies was significantly and inversely associated with maternal health literacy (standardized β = −0.281, P < 0.001). No significant independent associations were observed for age, maternal occupation, spouse occupation, timing of initiation of prenatal care, number of prenatal care visits, birth weight, or anemia (all P > 0.05) (Table 4).

Table 4. Multiple linear regression analysis of demographic and maternal care-related variables associated with maternal health literacy

Variable	Unstandardized β	Standardized β	t	P-value
Constant	51.830	—	8.018	<0.001
Age	−0.012	−0.007	−0.127	0.899
Maternal education	2.382	0.216	3.418	<0.001
Spouse's education	3.295	0.250	4.017	<0.001
Maternal occupation	1.047	0.091	1.596	0.112
Spouse's occupation	−1.389	−0.067	−1.310	0.191
Number of pregnancies	−3.254	−0.281	−4.780	<0.001
Timing of initiation of care	0.741	0.029	0.614	0.540
Number of prenatal care visits	0.361	0.087	1.668	0.096
Birth weight	−0.002	−0.059	−1.240	0.216
Anemia	1.234	0.036	0.750	0.454

Abbreviations: β, regression coefficient; *t*, t-statistic.

Discussion and Conclusion

The present study investigated maternal and pregnancy health literacy among pregnant women attending rural Comprehensive Health Service Centers in Gorgan and examined their relationships with demographic, obstetric, and healthcare-related characteristics. The findings showed that the mean maternal health literacy score was 53.70 ± 12.31, with mean scores of 38.44 ± 9.68 for verbal–auditory comprehension and 15.27 ± 3.18 for self-management. The mean pregnancy health literacy score was 47.23 ± 6.00, including mean scores of 27.52 ± 4.30 for prenatal care and 24.02 ± 3.00 for pregnancy outcomes. Correlational analysis demonstrated that both maternal and pregnancy health literacy were significantly and inversely related to the number of pregnancies and significantly and positively related to the number of prenatal care visits. In contrast, neither form of health literacy was significantly associated with maternal age, timing of initiation of prenatal care, or birth weight. Most importantly, multivariable analysis showed that higher maternal education and higher spousal education independently predicted greater maternal health literacy, whereas a greater number of pregnancies independently predicted lower maternal health literacy. Maternal age, maternal and spousal occupation, timing of initiation of care, number of prenatal visits, birth weight, and anemia did not remain independently associated with maternal health literacy after adjustment for the other variables.

The relatively favorable maternal and pregnancy health literacy scores identified in this study are broadly consistent with the growing body of evidence suggesting that many pregnant women demonstrate adequate competencies in obtaining, understanding, and using pregnancy-related health information, although substantial heterogeneity exists across populations and measurement approaches. A systematic review of health literacy during the prenatal period reported considerable variation across studies, attributable to differences in instruments, socioeconomic conditions, healthcare systems, educational profiles, and recruitment settings (4). Similarly, a systematic review focusing specifically on pregnant women demonstrated that reported health literacy levels ranged considerably and that interpretation of prevalence estimates depends heavily on the conceptual framework and assessment tool employed (5, 6). More recent evidence from the Health Literacy in Pregnancy study likewise indicates that pregnant women may possess strong competencies in some domains while experiencing challenges in others, emphasizing that health literacy is multidimensional rather than a simple adequate–inadequate classification (7). The relatively

favorable scores observed in the present study may partly reflect repeated exposure to pregnancy-related information through Iran's rural primary healthcare network, where pregnant women receive regular education and monitoring from primary healthcare personnel and community health workers. However, the documented challenges experienced by Behvarzes indicate that the effectiveness of such services may vary depending on organizational resources, workload, communication capacity, and local healthcare conditions (15).

The positive association between maternal education and maternal health literacy represented one of the clearest findings of the present study. Maternal education remained independently associated with health literacy after adjustment for the other demographic and obstetric variables, indicating that its contribution cannot be explained solely by differences in age, occupation, parity, or healthcare utilization. This finding is consistent with previous studies identifying formal educational attainment as one of the most persistent determinants of health literacy in pregnancy. The systematic review conducted by Meldgaard et al. demonstrated that educational level was frequently related to prenatal health literacy across different populations (4). Among Iranian pregnant women, Sabetghadam et al. similarly reported higher maternal health literacy among women with greater educational attainment and also found that information-seeking behavior, particularly through Internet-based sources, was associated with health literacy (11). Studies conducted in Turkey and Egypt have likewise identified educational and broader socioeconomic differences in pregnant women's health literacy (8, 10). Education may strengthen literacy-related competencies by improving reading comprehension, critical evaluation of information, familiarity with formal sources of knowledge, and confidence in communication with health professionals. It may also facilitate the ability to distinguish reliable medical information from inaccurate or contradictory messages, an increasingly important capacity given the expansion of digital health information.

Spousal education was also positively and independently associated with maternal health literacy, and its standardized regression coefficient was slightly greater than that of maternal education. This finding highlights the importance of conceptualizing maternal health literacy within the woman's family and social environment rather than treating it exclusively as an individual characteristic. Pregnancy-related decisions are often influenced by spouses and family members, particularly in contexts where family participation affects healthcare seeking, financial decision-making, transportation, and access to information. Evidence concerning the social determinants of health literacy suggests that individual competencies are embedded within broader socioeconomic and relational conditions (13). Likewise, socioeconomic inequalities may influence health outcomes partly through differences in health literacy, access to information, and capacity to navigate healthcare systems (12). A more educated spouse may be better able to assist with interpreting medical recommendations, accessing reliable information, discussing healthcare decisions, and encouraging adherence to prenatal care. The present finding therefore suggests that maternal health literacy interventions could potentially benefit from family-inclusive approaches, particularly where husbands or other household members play important roles in pregnancy-related decisions.

An important finding was the significant inverse relationship between the number of pregnancies and both maternal and pregnancy health literacy. Women with a greater number of pregnancies tended to have lower literacy scores, and the number of pregnancies remained an independent negative predictor of maternal health literacy in the multivariable model. This finding may initially appear counterintuitive

because repeated pregnancies might be expected to increase women's familiarity with maternity services and pregnancy-related information. Nevertheless, prior experience does not necessarily translate into stronger contemporary health literacy. Multiparous women may rely more heavily on previous experiences and therefore engage in less active information seeking during subsequent pregnancies. They may also face greater childcare, household, and family responsibilities, reducing the time available to attend educational activities, search for information, or engage deeply with healthcare professionals. Prospective research comparing nulliparous and multiparous women has emphasized that parity is relevant to health literacy and pregnancy-related outcomes, although its effects may vary according to healthcare exposure and socioeconomic circumstances (17). In contrast, nulliparous women may experience greater uncertainty and therefore seek more information, participate more actively in antenatal education, and ask more questions during clinical encounters.

The inverse relationship between gravidity and health literacy should, however, be interpreted within a broader social context. Greater numbers of pregnancies may be associated with maternal age, lower educational opportunities, socioeconomic disadvantage, or different patterns of healthcare utilization. Health literacy is known to reflect the interaction of educational, economic, social, and health-system factors rather than a single demographic characteristic (1). Previous evidence also suggests that health literacy may contribute to social gradients in health and may partly explain why socioeconomically disadvantaged groups experience poorer access to appropriate services and outcomes (12). Consequently, gravidity may function partly as a marker for cumulative social and family demands rather than as a direct cause of lower health literacy. Nevertheless, because the association remained significant after adjustment for multiple characteristics in the present study, multiparous women may represent an important target group for further assessment and health-literacy-responsive educational support.

Both maternal and pregnancy health literacy were positively correlated with the number of prenatal care visits. Women with higher health literacy therefore tended to have more frequent contact with antenatal services. This result is consistent with previous evidence linking health literacy with knowledge and use of maternity care. Guler et al. demonstrated that health literacy was associated with knowledge of antenatal care among pregnant women, supporting the proposition that women who understand pregnancy-related health information may more readily recognize the value of regular prenatal monitoring (8). Bello et al. similarly found associations between maternal health literacy and utilization of maternal healthcare services, demonstrating the practical relevance of literacy to engagement with formal care (9). Women with stronger health literacy may be better able to understand appointment schedules, appreciate the purpose of screening procedures, recognize risk information, communicate effectively with healthcare professionals, and adhere to recommended follow-up.

However, the relationship between prenatal care utilization and health literacy is likely to be bidirectional. While better-informed women may seek care more consistently, repeated healthcare encounters may themselves strengthen health literacy by providing opportunities to receive, clarify, and reinforce information. Evidence from intervention research supports this interpretation. Lori et al. demonstrated in a cluster randomized controlled trial that group antenatal care improved health literacy among pregnant women, suggesting that antenatal encounters can actively function as literacy-enhancing environments rather than merely as occasions for clinical monitoring (28). Similarly, health literacy education has been

shown to improve self-care behaviors among pregnant women in Iran (23). Therefore, although the number of prenatal visits did not remain an independent predictor in the adjusted regression model, its positive bivariate relationship with both maternal and pregnancy health literacy remains clinically meaningful and underscores the educational potential of routine antenatal services.

The absence of a significant relationship between maternal age and either maternal or pregnancy health literacy also deserves consideration. Previous studies have produced inconsistent findings regarding age, and systematic reviews suggest that its contribution varies across populations (4). Age is intertwined with numerous other characteristics, including educational attainment, parity, employment, technological familiarity, socioeconomic conditions, and previous contact with healthcare. Older women may benefit from greater life experience and familiarity with health services, while younger women may have greater access to digital information and more recent educational experience. These competing influences may explain why age did not independently predict health literacy in the present sample. Furthermore, maternal age has substantial clinical relevance independently of health literacy because both younger and advanced maternal age can be associated with specific maternal and perinatal risks (20). Thus, although age did not directly explain health literacy differences in this study, age-sensitive communication may still be appropriate in antenatal care.

No significant association was observed between health literacy and birth weight. This finding indicates that maternal or pregnancy health literacy, considered alone, may not directly translate into measurable differences in neonatal weight within this cross-sectional sample. Birth weight is a complex outcome shaped by maternal nutritional status, gestational age, placental function, smoking and environmental exposures, chronic and pregnancy-related diseases, fetal characteristics, and adequacy of antenatal care. An umbrella review has demonstrated that low birth weight is associated with numerous maternal clinical and social factors, indicating that no single behavioral or informational determinant is likely to account for substantial variation in this outcome (19). Similarly, antenatal care has generally been associated with reduced risk of low birth weight, but the relationship depends on the adequacy, timing, and quality of care as well as underlying pregnancy risk (18). The lack of association in the present study may therefore indicate that health literacy affects pregnancy outcomes primarily through intermediate behaviors, such as care seeking, self-management, nutrition, treatment adherence, and early recognition of complications, rather than exerting a direct effect on birth weight.

The present results also support the broader view that improving maternal health literacy requires attention to both individual competencies and the responsiveness of healthcare systems. Health-literate healthcare organizations are expected to simplify access to services, communicate clearly, support navigation, and ensure that information is understandable and actionable across different levels of literacy (21). Healthcare professionals are central to this process. Creedy et al. showed that midwives vary in their knowledge and skills related to assessing and promoting maternal health literacy, suggesting that professional education is necessary if antenatal services are to respond effectively to women's different information needs (22). This is particularly relevant for women with lower educational attainment or multiple pregnancies, who emerged as potentially vulnerable groups in the present study.

Existing intervention evidence further suggests that simply providing more information is unlikely to be sufficient. Systematic reviews indicate that health literacy interventions during pregnancy and the

reproductive period have heterogeneous effects, partly because interventions differ considerably in intensity, delivery method, population, and outcomes measured (24, 25). Programs appear more promising when they employ clear language, interactive teaching, skills development, culturally appropriate materials, and repeated communication. Evidence among socioeconomically disadvantaged populations similarly supports interventions adapted to participants' practical needs and social circumstances (26). Recent research focusing on low-income pregnant women further emphasizes multidimensional approaches that address not only individual knowledge but also healthcare-provider communication and structural barriers (27). The use of validated pregnancy-specific instruments is also important for identifying these needs accurately, as maternal health literacy encompasses competencies that may not be captured by general health literacy measures (2, 3).

Overall, the findings indicate that maternal health literacy among pregnant women in rural Gorgan is shaped more strongly by educational and obstetric factors than by maternal age or selected clinical characteristics. Higher maternal and spousal education were independently associated with greater maternal health literacy, whereas a greater number of pregnancies was associated with poorer health literacy. The positive correlations between health literacy and prenatal care attendance further suggest an important relationship between women's informational competencies and their engagement with maternity services. These findings are consistent with international evidence demonstrating that maternal health literacy is influenced by social determinants, educational resources, family circumstances, healthcare engagement, and the responsiveness of health services (7, 13, 27). Strengthening maternal health literacy should therefore be approached as a shared responsibility involving pregnant women, families, healthcare professionals, and primary healthcare organizations rather than solely as an individual educational task.

Several limitations should be considered when interpreting the findings. First, the cross-sectional design prevents determination of temporal sequence or causal relationships; consequently, it cannot be established whether higher health literacy leads to greater prenatal care utilization or whether repeated contact with prenatal services improves health literacy. Second, participants were recruited from rural Comprehensive Health Service Centers in Gorgan County, which may limit generalizability to pregnant women living in urban settings, receiving private maternity care, or residing in regions with different socioeconomic and healthcare characteristics. Third, health literacy was assessed using self-report measures and may therefore have been affected by recall bias, response tendencies, or social desirability. Fourth, although several demographic, obstetric, and healthcare variables were included, potentially relevant factors such as household income, digital health literacy, quality of family support, access to the Internet, pregnancy risk status, and quality and content of antenatal visits were not comprehensively evaluated. Finally, birth weight is determined by numerous maternal, fetal, and clinical factors, and the available study variables were insufficient to fully examine the pathways through which maternal health literacy might influence neonatal outcomes.

Future studies should employ longitudinal designs beginning in early pregnancy and continuing through childbirth and the postpartum period to clarify the temporal relationships between maternal health literacy, healthcare utilization, self-care behaviors, and maternal and neonatal outcomes. Multicenter investigations involving rural and urban populations from different provinces would improve the external validity of the evidence and allow comparisons across healthcare environments. Future research should also assess

potentially influential variables such as socioeconomic status, household income, digital health literacy, health information-seeking behavior, social support, pregnancy risk, healthcare-provider communication, and the quality rather than merely the frequency of prenatal visits. Studies examining parity in greater detail are particularly warranted to determine why women with more pregnancies may demonstrate lower health literacy despite greater experiential familiarity with pregnancy. Intervention studies could additionally compare individualized counseling, group antenatal education, multimedia education, digital interventions, and family-inclusive programs to determine which approaches are most effective for women with lower educational attainment or multiple previous pregnancies.

Maternal health literacy assessment should be incorporated into routine prenatal care so that healthcare professionals can identify women who may have difficulty understanding or applying pregnancy-related information. Educational communication should be adapted to women's educational level, parity, informational needs, and preferred method of learning, with particular attention to women with lower educational attainment and those with multiple pregnancies. Healthcare providers should use plain language, short and actionable messages, visual materials, teach-back techniques, and opportunities for women to ask questions rather than relying primarily on written instructions. Because spousal education was independently related to maternal health literacy, appropriate involvement of spouses and family members in maternal health education may strengthen understanding and support informed decision-making. Rural health centers should also make maximum use of repeated antenatal contacts as opportunities for progressive health education, reinforce key messages across visits, and ensure that community health workers and other maternal healthcare providers are trained to recognize and respond to different levels of health literacy.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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