Health Literacy and Anxiety about Aging in Middle-Aged Adults. A Cross-Sectional Study in Babol, Iran

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Background and Objective: Middle-aged adults often experience anxiety related to aging, particularly as they face life challenges and health-related concerns associated with getting older. Health literacy is a key factor in managing well-being during this stage of life, especially when dealing with chronic conditions. This study explores the relationship between anxiety about aging and health literacy in middle-aged individuals.

Material and Methods: A descriptive correlational study was carried out in 2024, involving 431 middle-aged residents of Babol city. Participants were selected through convenience sampling. Data were gathered using a demographic questionnaire, the Lasher and Faulkender Anxiety about Aging Scale (AAS) with a Cronbach's alpha coefficient of 0.82, and the Iranian Health Literacy Questionnaire (HELIA) with a Cronbach's alpha coefficient of 0.94. Statistical analysis was conducted using SPSS version 16, including independent t-tests, ANOVA, regression analysis, and Pearson's correlation coefficient.

Results: The average score for anxiety about aging was 49.50±8.98, indicating a moderate level, while the mean health literacy score was 67.69±13.86, indicating an adequate level of health literacy. Anxiety about aging was significantly associated with gender (P=0.01), occupation (P=0.02), education (P=0.026), marital status (P=0.029), and income (P=0.002). Health literacy was significantly related to age (P=0.002), education (P=0.001), occupation (P=0.002), insurance coverage (P=0.001), income (P<0.001), and sources of health information (P=0.005). A significant inverse relationship was found between anxiety about aging and health literacy (r=-0.425, P<0.001). All dimensions of anxiety about aging were inversely correlated with every domain of health literacy (P<0.001).

Conclusion: Enhancing health literacy within middle-aged population could play a pivotal role in reducing anxiety related to aging, as individuals with higher health literacy are better equipped to manage health-related challenges and make informed decisions. It is crucial for policymakers

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to design and implement educational programs that focus on enhancing health literacy and alleviating anxiety about aging among middle-aged individuals.

Keywords: Aging, Anxiety, Health Literacy, Middle Age

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Introduction

People worldwide are living longer, with the global population aged 60 years and over expected to rise significantly by 2030 and 2050. The World Health Organization (WHO) defines aging as the process of experiencing physical, psychological, and social changes over time (1). Aging is a universal phenomenon that is characterized by typical trajectories later in life for different attributes (2). Aging process is not simply a matter of physical or biological decline but a complex interplay of various factors influencing the well-being and quality of life of older adults (3). Globally, due to increasing life expectancy and declining fertility rates, the elderly population is rapidly growing (1). Furthermore, social and economic development has contributed to longer life expectancy worldwide, such that the growth rate of the elderly population now exceeds that of the general global population. In Iran, it is projected that if the current trend continues, individuals aged 60 and over will make up 28% of the total population by the year 2050 (4). The rapid rise in the elderly population in Iran is expected to become particularly evident after the year 2036 (1415 in the Iranian calendar). This trend implies that individuals currently in middle age will reach old age within the next 15 years (4).

Over the years, increasing biases and stereotypes about older adults have become more prevalent, hindering their productivity and social engagement (5). Age-related stereotypes, beyond influencing behaviors and approaches to elderly care, can also shape individuals' personal experiences of their own aging process. These biases may lead to the social isolation of the elderly generation, limiting their ability to participate positively in society and potentially increasing aging anxiety across all age groups (5). Anxiety About Aging (AAA) is a type of anxiety characterized by a fear of getting older. It refers to an individual's fear of the potential physical, psychological, and social changes associated with aging (6), and it often stems from concerns

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and apprehensions about the aging process (7). Experiencing anxiety about aging may impair a person's ability to engage in social interactions, reduce enjoyment in interpersonal relationships, and diminish overall life satisfaction, ultimately resulting in loneliness and psychological stress (8).

Middle age is often marked by experiences such as retirement and the "empty nest syndrome," as well as situational crises like job loss, economic instability, or the loss of family members or friends, all of which may heighten the significance of addressing anxiety about aging in this population (9-12). Middle age is defined as the stage of life that follows early adulthood and precedes old age. In most studies, it is generally considered to range from ages 40 to 60. According to Erikson's theory, it corresponds to the seventh stage of psychosocial development, characterized by the conflict between generativity and stagnation (13-16).

Middle age serves as a bridge between youth and old age. It is considered the most important phase of adulthood and is often referred to as the "golden period" of life. However, many individuals in this age group are not adequately prepared to face the challenges of later life and may be particularly vulnerable. Notably, the emergence of the first physical signs of aging, commonly observed during middle age, can trigger anxiety about aging in this population (17, 18). During this period, feelings that life is approaching its end and the anxiety associated with that realization tend to intensify.

On the other hand, the World Health Organization defines healthy aging as "the process of developing and maintaining the functional ability that enables well-being in older age." This highlights the importance of preparing for and addressing well-being and functional capacity from middle age to support healthier aging later in life (19).

One of the key factors in reducing anxiety among individuals is health literacy (20). Health literacy is a fundamental concept in public health, recognized for its role in empowering individuals to make informed health-related decisions and improve health outcomes (21). Health literacy refers to the cognitive and social skills that determine an individual's motivation and ability to access, understand, and use information in ways that promote and maintain health (22). Individuals with limited health literacy are less likely to engage in health-related decision-making, are less inclined to express their health concerns, and often experience

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ineffective communication with healthcare providers and caregivers (23). Health literacy, due to its impact on individuals' decision-making abilities, is considered a crucial factor in improving public health and reducing healthcare costs. As such, it has been recognized globally as a significant determinant of health (24). It is believed that people with inadequate health literacy tend to have poorer health status, limited knowledge about disease prevention, lower participation in preventive clinical services for chronic illnesses, and greater difficulty understanding or correctly interpreting health-related instructions. Assessing health literacy is thus an essential component of any effort to prevent the adverse consequences of low health literacy and to minimize disparities in healthcare delivery (25).

As previously mentioned, achieving healthy and active aging requires appropriate foundations during the pre-elderly stages of life, particularly in middle age. Given that middle-aged individuals will form the future elderly population of the country, and considering that studies have shown elevated levels of general anxiety in this group due to numerous life challenges (9, 11, 12), conducting research in this population can serve as a gateway to promoting healthy and active aging. One common form of anxiety experienced by middle-aged individuals is anxiety about aging, which tends to increase as people grow older. Anxiety about aging may contribute to both physical and mental health problems. By identifying the factors that influence anxiety about aging, it is possible to support individuals in adapting to the aging process (17).

Health literacy is considered an important and influential factor in managing and reducing anxiety. However, there is a limited body of research focusing on anxiety about aging and health literacy among middle-aged populations, particularly in Iran (8). Exploring these concepts can contribute to expanding the existing knowledge in this area. In light of the importance of these issues in enhancing the quality of life of middle-aged adults and supporting them toward achieving healthy and active aging, this study was conducted to investigate the relationship between health literacy and aging anxiety among middle-aged individuals living in Babol city in the year 2024 (1402 in the Iranian calendar).

Materials and Methods

Design and Participants

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This descriptive-correlational study was conducted throughout January and February of 2024 to examine the relationship between health literacy and anxiety about aging among middle-aged individuals residing in Babol, Iran. The study population consisted of 431 middle-aged individuals aged 40 to 60 years. Participants were recruited through convenience sampling from various community settings and common gathering places including public parks, governmental offices, and local mosques. These locations were chosen to ensure diversity in the sample and improve accessibility to the target population.

Inclusion criteria were the ability to read and write (to enable questionnaire completion), no use of psychotropic medications, no history of neurological or psychiatric disorders, no diagnosis of terminal illness (as reported by the participants), and no major life crises (e.g., divorce, job change, or relocation) within the previous six months. Participants who failed to answer all questionnaire items were excluded from the analysis.

A convenience sampling method was used. Based on prior studies by Abdollahi et al. and Vafaee-Najar et al, the minimum required sample size was estimated at 431 participants, using a 95% confidence level, an estimated standard deviation of 10.6, and a margin of error of 1 (d = 1) (26, 27).

Data Collection Instruments

Data was collected using three tools: a demographic information form, the Lasher and Faulkender's Anxiety about Aging Scale (AAS), and the Health Literacy for Iranian Adults (HELIA) questionnaire. The demographic information form included variables such as age, gender, education level, occupation, marital status, presence of chronic underlying conditions, monthly income, health insurance coverage, and sources of health-related information. This form was completed by participants at the beginning of the study.

Anxiety about Aging Scale (AAS)

The Anxiety about Aging Scale (AAS) was developed by Lasher and Faulkender in 1993 (28). This scale consists of 20 items and assesses various dimensions of anxiety related to aging. It includes four subscales: fear of elderly people, psychological concerns, physical appearance, and fear of loss, each comprising five items. The scale uses a 5-point Likert format ranging from 1 (strongly agree) to 5 (strongly disagree). For negatively worded items (items 2, 5, 6, 8, 14, 17,

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and 20), reverse scoring was applied. Total scores range from 20 to 100, with higher scores indicating greater levels of anxiety about aging. The original instrument demonstrated good internal consistency, with a Cronbach's alpha coefficient of 0.82 (28).

The Persian version of the AAS has been previously used among older adults in Iran (29). Since the target population of the present study was middle-aged adults, the tool was translated into Persian using a forward–backward translation method. Two bilingual experts in health and nursing reviewed the translated version for content accuracy and cultural relevance. Based on their feedback, modifications were made to certain items for clarity and appropriateness. Subsequently, two English-language experts independently back-translated the revised Persian version into English. After comparing the back-translated version with the original English scale and ensuring conceptual equivalence, content and face validity were assessed through expert panel review, involving three experienced faculty members. Revisions were incorporated based on expert consensus to ensure both cultural and scientific relevance. The final Persian version of the scale, comprising 20 items, was used in this study. In the current study, the instrument showed excellent internal consistency, with a Cronbach's alpha coefficient of 0.94, confirming its reliability.

To assess the construct validity of the Persian version of the AAS for use in a middle-aged population, a Confirmatory Factor Analysis (CFA) was good. But, since this instrument had already been validated and its reliability confirmed in previous studies within the Iranian context, and considering that reliability is a necessary—though not sufficient—condition for validity, the present study relied solely on face and content validity, assessed through expert judgment. The Cronbach's alpha results further indicated that the instrument possessed acceptable reliability. Therefore, construct validity via confirmatory factor analysis (CFA) was not undertaken in this sample.

Health Literacy for Iranian Adults (HELIA)

The Health Literacy for Iranian Adults (HELIA) questionnaire was developed in 2014 by Montazeri and colleagues to assess the level of health literacy among Iranian adults (30). This instrument consists of 33 items covering five key domains: reading, access, comprehension, appraisal, and decision-making behavior. Each item is rated using a five-point Likert scale, and the total score ranges from 33 to 165. This raw score is then converted to a standardized scale

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ranging from 0 to 100. Based on the standardized score, health literacy is classified into different levels. A score between 0 and 66 indicates limited health literacy, which is further divided into inadequate (0 to 50) and marginal (50.1 to 66) literacy. Scores between 66.1 and 100 indicate adequate health literacy, which is further divided into sufficient (66.1 to 84) and excellent (84.1 to 100) levels.

The original questionnaire demonstrated acceptable internal consistency, with Cronbach's alpha coefficients ranging from 0.72 to 0.89, confirming its reliability. In the present study, the reliability of the HELIA questionnaire was reassessed using a sample of 30 participants aged 40 to 60 years. The overall Cronbach's alpha was calculated to be 0.94, confirming the strong internal consistency of the instrument. Additionally, reliability for each of the five domains ranged from 0.73 to 0.94, indicating high reliability across all domains of health literacy measured by the questionnaire.

After obtaining written informed consent and ensuring participants of the confidentiality of their information, data collection began. Participants were first requested to fill out a demographic information form, followed by the Anxiety about Aging Scale (AAS) and then the Health Literacy for Iranian Adults (HELIA) questionnaire. Approximate time of 20 minutes was considered to reply to the items of the questionnaires. This study received ethical approval from the Ethics Committee of Iran University of Medical Sciences (IR.IUMS.REC.613/1402).

Statistical Analyses

Data were analyzed using SPSS software version 16, incorporating both descriptive and inferential statistics. Descriptive statistics included frequency distribution tables. For inferential analysis, independent t-tests, analysis of variance (ANOVA), regression analysis, and Pearson correlation coefficient were employed. Regarding missing data, participants who did not complete all items of the questionnaires were excluded from the analysis (listwise deletion). The rate of missing data was very low (less than 2%), and it was considered random. Therefore, no imputation method was applied. Prior to conducting the multiple regression analyses, the necessary assumptions were checked. The linearity of the relationships between the independent variables and the outcomes was assessed visually using partial regression plots and was found to be satisfactory. Homoscedasticity (constant variance of residuals) was confirmed by visual inspection of the plot of standardized residuals against standardized

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predicted values, which showed no discernible pattern. The absence of multicollinearity among the predictor variables was ensured, as all Variance Inflation Factor (VIF) values were below 5 (and notably below the conservative threshold of 10). Additionally, the residuals were approximately normally distributed. A significance level of $P \leq 0.05$ was considered for all statistical tests.

Results

A total of 500 individuals were approached to participate in the study. Among them, 431 individuals agreed to participate and completed the questionnaires, yielding a response rate of 86.2%. 69 individuals declined to participate, primarily due to lack of time or interest. Additionally, no participants were excluded after enrolment since all completed the questionnaires fully and met the inclusion criteria. The recruitment process followed a STROBE-compliant flow, is illustrated in **Figure 1.**

The demographic characteristics of participants, as well as their health literacy and anxiety about aging scores based on individual variables, are presented in **Table 1**. The mean score of health literacy among the middle-aged participants was 67.69 with a standard deviation of 13.86, indicating an adequate level of health literacy. The mean score of anxiety about aging was recorded as 49.50 with a standard deviation of 8.98, indicating a moderate level. As shown in Table 1, health literacy was significantly associated with age (P=0.002), educational level (P=0.001), employment status (P=0.002), health insurance coverage (P=0.001), income level (P<0.001), and sources of health information (P=0.005). Anxiety about aging showed significant associations with gender (P=0.01), employment status (P=0.02), marital status (P=0.029), income level (P=0.002), and educational level (P=0.026).

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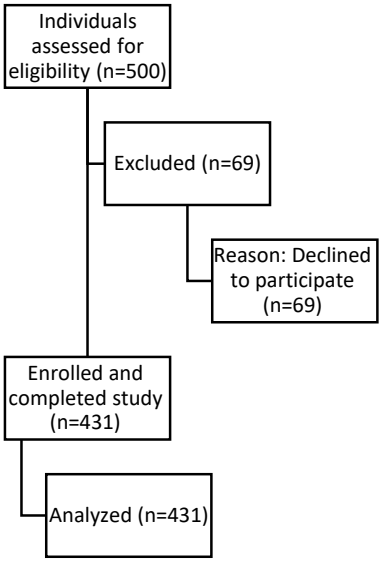

Figure 1. STROBE-compliant recruitment flowchart

Table 2 displays the mean and standard deviation of health literacy and its subdomains, as well as anxiety about aging and its dimensions. **Table 3** presents the Pearson correlation coefficients between health literacy and its subdomains with anxiety about aging and its dimensions. Pearson correlation analysis showed a significant inverse relationship between health literacy and anxiety about aging ($r=-0.425$, $P<0.001$). Additionally, all subdomains of health literacy were inversely and significantly correlated with all dimensions of anxiety about aging.

Variables that were significantly associated with health literacy and anxiety about aging were entered into multiple regression models. The significant predictors are presented in **Tables 4 and 5**, respectively. The results of multiple regression analysis showed that among the variables, health insurance coverage and educational level together predicted 18.5% of the variance in health literacy among middle-aged individuals ($R^2=0.185$). Furthermore, among all variables, government employment, self-employment, and an income range of 5 to 10 million IRR predicted 6% of the variance in anxiety about aging ($R^2=0.067$).

Table 1. Frequency distribution of study participants based on demographic characteristics according to health literacy and anxiety about aging variables

Demographics	Subgroups	N (%)	Anxiety about Aging	Test Result	Health Literacy	Test Result
			Mean (SD)		Mean (SD)	
Age	40-45	170 (39.4)	49.61 (9.18)	p=0.484	69.05 (13.77)	p=0.002
	46-50	135 (31.1)	49.98 (8.93)		69.93 (12.13)	
	51-55	72 (16.7)	49.68 (8.13)		65.30 (13.84)	
	56-60	54 (12.5)	47.76 (9.38)		62.58 (17.29)	

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Mean: 47.92±5.70			r= -0.049 p=0.31			p=0.001
Gender	Male	194 (45)	48.28 (9.48)	p=0.01	68.42 (13.26)	p=0.472
	Female	237 (55)	50.51 (8.44)		67.45 (14.55)	
Academic Education	Yes	162 (37.6)	50.25 (9.11)	p=0.026	73.84 (12.18)	p<0.001
	No	269 (62.4)	48.27 (8.66)		64.30 (13.78)	
Job	Housekeeper	173(40.1)	50.52 (8.46)	p=0.02	65.86 (14.42)	p=0.002
	Self-employed	139 (32.3)	49.36 (9.96)		66.87 (14.20)	
	Government	96 (22.3)	49.09 (7.99)		72.41 (12.39)	
	Retired	23 (5.3)	44.43 (9.11)		70.42 (11.36)	
Marital Status	Single	16(3.7)	55.31 (10.69)	p=0.029	62.54 (16.11)	p=0.274
	Married	404 (93.7)	49.31 (8.83)		68.14 (13.93)	
	Divorced / Deceased Partner	11 (2.6)	48.27 (9.90)		66.39 (11.72)	
Insurance Coverage	Yes	365 (84.7)	49.27 (8.79)	p=0.197	68.98 (13.28)	p<0.001
	No	66 (15.3)	50.82 (9.97)		61.83 (16.13)	
Monthly Income (Million Tomans)	Less than 5	176 (40.4)	50.84 (8.40)	p=0.002	65.21 (15.35)	p<0.001
	Between 5 to 10	119 (27.6)	50.15 (9.67)		67.11 (12.80)	
	Between 10 to 20	126 (29.2)	47 (8.65)		71.66 (11.97)	
	More than 20	10 (2.3)	49.90 (9.48)		77.66 (13.41)	
Illness	Yes	68(15.8)	50.51 (8.86)	p=0.313	68.67 (14.11)	p=0.617
	No	363 (84.2)	49.31 (9)		67.74 (13.97)	
Source of Health Information	Radio & TV	133 (30.9)	48.44 (10.13)	p=0.280	67 (15.73)	p=0.005
	Books, Magazines, newspapers	10 (2.3)	51 (11.59)		71.13 (10.88)	
	health care providers	109 (25.3)	49.20 (7.58)		68.63 (13.52)	
	Internet & social media	132 (30.6)	49.79 (8.92)		69.42 (12.87)	
	Friends & Relatives	23 (5.3)	51.87 (8.29)		57.31 (11.44)	
	No Answer	24 (5.6)	52.29 (7.46)		69.76 (10.85)	
(Significance Level = p)						

Table 2. Mean Scores of Aging Anxiety and Health Literacy among Middle-Aged Individuals

Anxiety About Aging and its Dimensions	Fear of Elderly People	Psychological Concerns	Physical Appearance	Fear of Loss	Anxiety About Aging
Mean (SD)	9.91 (2.81)	12.25 (3.01)	11.68 (3.46)	15.66 (3.42)	49.50 (8.98)
Health Literacy and its Subdomains	**Inadequate** Frequency (Percentage)	**Marginal** Frequency (Percentage)	**Sufficient** Frequency (Percentage)	**Excellent** Frequency (Percentage)	**Mean (SD)**
Reading	164 (38.1)	84(19.5)	84 (19.5)	58 (13.5)	60.52 (21.78)
Access	82 (19)	103(23.9)	181 (42)	65 (15.1)	67 (17.53)
Comprehension	57 (13.2)	74 (17.2)	165 (38.3)	135 (31.3)	72.45 (19.47)
Appraisal	131 (30.4)	94 (21.8)	159 (36.9)	47 (10.9)	62.35 (19.52)
Decision-making and Behaviour	56 (13)	106 (24.6)	186 (43.2)	83 (19.3)	69.97 (16.02)
Health Literacy	44 (10.2)	132 (30.6)	203 (47.1)	52 (12.1)	67.69 (13.86)

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Table 3. The Relationship between Health Literacy and Its Subdomains with Anxiety about Aging and Its Dimensions

Anxiety About Aging	Health Literacy					
	Reading	**Access**	**Comprehension**	**Appraisal**	**Decision-making and Behaviour**	**Health Literacy**
Fear of elderly people	r=-0.111 P<0.001	r=-0.217 P<0.001	r=-0.162 P<0.001	r=-0.232 P<0.001	r=-0.178 P<0.001	r=-0.232 P<0.001
Psychological concerns	r=-0.223 P<0.001	r=-0.309 P<0.001	r=-0.264 P<0.001	r=-0.273 P<0.001	r=-0.338 P<0.001	r=-0.378 P<0.001
Physical appearance	r=-0.319 P<0.001	r=-0.307 P<0.001	r=-0.317 P<0.001	r=-0.327 P<0.001	r=-0.200 P<0.001	r=-0.362 P<0.001
Fear of loss	r=-0.156 P<0.001	r=-0.139 P<0.001	r=-0.157 P<0.001	r=-0.174 P<0.001	r=-0.200 P<0.001	r=-0.226 P<0.001
Anxiety About Aging	r=-0.292 P<0.001	r=-0.343 P<0.001	r=-0.328 P<0.001	r=-0.357 P<0.001	r=-0.322 P<0.001	r=-0.425 P<0.001
(Pearson Correlation Coefficient = r) (Significance Level = r)						

Table 4. Regression Model of Factors Influencing Health Literacy in Middle-Aged Individuals

Variable	Unstandardized Coefficients		Standardized Coefficients	T	P	The 95% confidence interval for B	
	B	SE	Beta			Lower bound	Upper bound
Intercept	52.27	10.00		5.226	0.000	32.611	71.935
Education Level	4.592	0.711	0.393	6.457	0.000	3.194	5.990
Insurance Coverage	4.573	1.819	0.118	2.514	0.012	0.997	8.150
R Square = 0.185							

Table 5. Regression Model of Factors Influencing Anxiety about Aging in Middle-Aged Individuals

Variable	Unstandardized Coefficients		Standardized Coefficients	T	P	The 95% confidence interval for B	
	B	SE	Beta			Lower bound	Upper bound
Intercept	46.228	4.067		11.367	0.000	38.234	54.223
Self-employed Job	4.194	1.990	0.218	2.107	0.036	0.282	8.107
Government job	5.195	2.119	0.241	2.452	0.015	1.030	9.360
Income Between 5-10 million Tomans	2.582	1.156	0.129	2.234	0.026	0.311	4.854
R Square = 0.067							

Discussion

The present study aimed to determine the relationship between health literacy and anxiety about aging among middle-aged individuals in the city of Babol, Iran. The results indicated an average score of 49.50 for anxiety about aging. Among the dimensions of anxiety about aging, the highest mean was related to the fear of loss, while the lowest mean was for the fear of elderly people. This finding is consistent with the results of a few previous studies (26, 31, 32) . The health literacy level of the middle-aged participants was within the adequate health literacy

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range. This finding is consistent with the results of several previous studies (33-35), but also diverges from others (24, 27, 36) . Possible reasons for the divergence between the present study and previous ones include the impact of health education programs and the overall increase in public awareness and access to health information over time (36, 37) . Social media platforms have enabled the rapid and widespread dissemination of health information, especially during and after the COVID-19 pandemic. Health and governmental organizations use social media to share news, guidelines, and updates on current health issues, allowing the public to access health information more directly and quickly than ever before (37) .

The results of the present study, which show higher anxiety about aging in women compared to men, are in line with previous studies (38, 39) . According to the Double Standard of Aging theory, societal expectations for women to maintain physical beauty and appearance, which tends to decline with age, can lead to the experience of aging anxiety (40, 41). In contrast, men are evaluated based on their achievements and assets, and this evaluation tends to improve with age, which may explain why women experience higher anxiety about aging than men (17). Additionally, older women may face more health-related issues than men (41) and Women have higher rates of chronic conditions, such as arthritis, depression, osteoporosis and related fractures than men(42). Physical and appearance-related changes in women, such as increased facial wrinkles or the loss of fertility with the onset of menopause (32, 40) , may further complicate the experience of anxiety about aging in women.

Another key finding of this study was that participants with higher incomes tend to experience less anxiety about aging. This result is consistent with previous studies (26, 43) . One possible explanation is that factors such as job loss or reduced income during middle age and early retirement can lead to increased anxiety. Moreover, the financial strain of caring for aging parents, covering the cost of children's education, and addressing other financial obligations may contribute to the anxiety about aging in those with lower incomes (44) .

The results indicated that housewives experienced higher levels of anxiety about aging compared to retirees. Although no previous studies directly support this result, it is likely that retirees experience lower anxiety levels due to the reduction of work-related stress and an increase in leisure time (45). In contrast, housewives may face heightened psychological stress and anxiety, primarily due to spending long hours alone at home and the physical and emotional exhaustion that comes with managing household responsibilities, which could contribute to greater anxiety about aging (46).

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The findings of this study revealed that single individuals experience higher anxiety about aging compared to married individuals. These results are in agreement with existing literature (43). Living with a spouse provides emotional and social support, which can effectively reduce anxiety. A successful marriage and life satisfaction with a spouse contribute to lower levels of anxiety and depression, as well as improved mental health in middle-aged individuals (47, 48). According to the Social Clock Theory, societal expectations for individuals to achieve specific goals or milestones, such as having a job, getting married, or having children, within certain time frames, can lead to anxiety about aging for those who have not accomplished these tasks by the expected age (17). Based on this theory, middle-aged individuals who remain unmarried as they grow older may experience increased anxiety about aging (17).

Higher levels of education were found to be associated with lower anxiety about aging. This finding aligns with studies that have also linked anxiety about aging to educational level (43, 49). Education, through its impact on psychological well-being and individuals' outlook on life, can help reduce anxiety about aging. Furthermore, higher education, by influencing an individual's socio-economic status, can play a significant role in reducing anxiety about aging (39, 50, 51).

Older middle-aged individuals were found to have lower health literacy, a finding consistent with previous research (33, 35, 36, 52) . Older individuals typically have lower education levels, which negatively affects their ability to read, understand, interpret, and utilize health information (53, 54). Additionally, as middle-aged individuals age, cognitive decline, diminished vision and hearing abilities, and slower processing speed may contribute to a decrease in their health literacy (53, 54).

Higher education was found to be associated with higher health literacy, a finding that supports the findings of previous studies (33, 36, 52). Higher education equips individuals with the knowledge and skills needed to effectively understand and utilize health information. This can help individuals critically evaluate health information and make informed decisions regarding their health (55).

Individuals with government jobs had higher health literacy levels compared to housewives and those with self-employed occupations. Similar studies have also reported higher health literacy among employed individuals compared to the unemployed (27, 35, 52). This finding may be related to the health and medical benefits, including regular check-ups, provided by government organizations to their employees (56). Accordingly, health literacy can vary

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between government employees and self-employed individuals due to differences in their access to health information, available resources, and educational levels.

Participants with higher income levels had higher health literacy, which is in line with earlier research outcomes (24, 34, 35, 52). Individuals with higher incomes have greater opportunities to access health resources and are more likely to receive health education, which enables them to acquire essential health skills, make informed decisions about their well-being, and engage in behaviors that promote overall health (57-59) .

Middle-aged individuals with insurance coverage had higher health literacy compared to those without insurance. Similar outcomes have been reported in past research (27). Individuals with insurance coverage are more likely to utilize healthcare services and engage more frequently with the healthcare system. Access to primary care and screenings is higher among those with insurance coverage, which may explain the association between increased health literacy levels and being insured in middle-aged individuals (60).

Health literacy was found to be associated with the source of health information. Individuals who obtained their health information from trusted sources such as healthcare professionals, radio and television, and the internet had higher health literacy levels compared to those who relied on friends and acquaintances. This finding highlights the importance of obtaining health information from credible and reliable sources in enhancing health literacy among middle-aged individuals (61). Health literacy frameworks define that individuals should be capable of acquiring, comprehending, and applying health information. Consequently, having access to reliable sources of health information plays a key role in shaping an individual's health literacy level (62, 63).

An additional finding of this study was the negative correlation between health literacy and anxiety about aging. Although no prior studies directly corroborated this result, this correlation can be explained by the fact that middle-aged individuals with inadequate health literacy may struggle to comprehend health-related information, which could lead to increased anxiety about health risks and aging (64, 65). Research shows that higher health literacy can reduce the negative effects of health anxiety and encourage healthier lifestyle choices (66, 67). Furthermore, certain personality traits, such as higher levels of neuroticism, may exacerbate anxiety, as individuals with these traits tend to have lower health literacy and greater challenges in managing health-related stress (68). This aspect, however, was not explored in the current study and could be a valuable direction for future research to better understand how

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personality influences the relationship between health literacy and anxiety about aging. Overall, improving health literacy is essential in mitigating anxiety about aging, and further exploration of personality traits could provide a more comprehensive understanding of this relationship.

It is crucial to emphasize that due to the cross-sectional design of this study, we cannot establish causal relationships between health literacy and anxiety about aging. The observed inverse association, while strong and significant, does not allow us to conclude whether higher health literacy reduces anxiety about aging or whether lower anxiety facilitates the acquisition of health literacy skills. The relationship may also be bidirectional or influenced by unmeasured confounding variables. Therefore, the findings should be interpreted as highlighting a significant correlation that warrants further investigation through longitudinal or interventional studies.

Study Limitations and Strengths: One limitation of this study is that data collection was conducted solely in the city of Babol, which may reduce the generalizability of the findings to the broader middle-aged population. Additionally, due to challenges in accessing the study participants, the researcher had to sample from multiple locations, which may introduce variability or bias in the sample, as participants from different locations might have different characteristics or experiences that could affect the results. Despite efforts to maintain a quiet environment and facilitate higher focus for participants during the completion of the research instruments in less crowded spaces, there remained a possibility of participants being distracted when responding, given the public nature of the data collection sites. Furthermore, this study has methodological limitations. No correction for multiple comparisons (e.g., Holm-Bonferroni) was applied to the bivariate tests, which increases the risk of Type I errors. Additionally, the assumptions of the linear regression models (linearity, homoscedasticity, and multicollinearity) were not formally diagnosed. Future studies should incorporate these advanced statistical checks to confirm and strengthen the observed associations.

Conclusion

The results of this study indicate that the anxiety about aging among middle-aged individuals in Babol is at a moderate level, with the primary contributing factor being the fear of loss. Furthermore, the health literacy of middle-aged individuals in Babol was found to be adequate, with the highest performance observed in their ability to comprehend and interpret health-related information. The study identified significant associations between anxiety about aging and factors such as gender, income, occupation, education, and marital status. Additionally, health literacy was found to be related to age, education, occupation, income, insurance

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coverage, and sources of health information. Enhancing health literacy within middle-aged population could play a pivotal role in reducing anxiety related to aging, as individuals with higher health literacy are better equipped to manage health-related challenges and make informed decisions.

Based on the findings of this study, it is crucial for policymakers and relevant stakeholders to design and implement educational programs that focus on enhancing health literacy and alleviating anxiety about aging among middle-aged individuals. Such interventions can be conducted in primary-care counselling, insurer-linked education, workplace programs and community workshops. Interventions carried out whether in community level or directly to the individual can be effective in promoting health literacy level (69, 70). Nurses specializing in geriatric care are essential to community-based initiatives, particularly in the areas of prevention and fostering successful aging. Such initiatives would contribute significantly to promoting healthy and active aging. Furthermore, the study highlights the impact of various demographic factors, such as occupation and education level, on both aging-related anxiety and health literacy. These findings align with previous research across different populations, highlighting the importance of addressing these factors in efforts to improve overall well-being in middle-aged individuals.

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