Wiley
European Journal of Cancer Care
Volume 2025, Article ID 3235446, 12 pages
https://doi.org/10.1155/ecc/3235446

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Research Article

Maternal Quality of Life During Pregnancy and Early Childhood Cancer: A Mixed-Methods Case-Control Study

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Received 3 April 2025; Revised 17 June 2025; Accepted 3 September 2025

Academic Editor: Hua Yuan

Introduction: This study investigates the relationship between maternal quality of life during pregnancy and childhood cancer risk, hypothesizing that lower maternal well-being increases the likelihood of cancer development in children.
Methods: This embedded explanatory sequential mixed-methods case-control study was conducted in Kerman, Iran, including 191 children under six, with 136 diagnosed with cancer in 2023. From these, 73 mothers of affected children were purposefully selected and compared to 118 mothers of healthy children, matched by age and socioeconomic status. Maternal factors (e.g., age, education, employment, medical history, and lifestyle) were assessed using validated questionnaires (GHQ-28, SES), administered through structured interviews. Logistic regression (SPSS 28) and Python-based heatmap visualization were used for analysis. Qualitative data were extracted from interview narratives and analyzed thematically.
Results: Between 2014 and 2023, pediatric cancer diagnoses increased, especially malignant types. Significant maternal factors included older age, unemployment, lower education, medical history, and smoking. Paternal education, occupational exposure, and smoking also contributed. Qualitative themes—persistent anxiety, depressive thoughts, and perceived lack of purpose—offered contextual depth to the statistical findings.
Conclusions: Maternal quality of life during pregnancy significantly influences childhood cancer risk. Integrated interventions addressing maternal mental health, socioeconomic disparities, and occupational exposures are essential. Public health policies should prioritize maternal well-being to create protective environments for children.

Keywords: case-control study; childhood cancer; maternal quality of life; pregnancy; socioeconomic factors

1. Introduction

Stress during pregnancy and childbirth can have long-term effects on both mothers and their children [1]. Maternal quality of life during pregnancy is influenced by factors such as sleep problems, depression, and anxiety, which negatively impact physical and mental health domains [2]. Depression symptoms and prenatal mental disorders directly affect quality of life, while social support can mitigate minor pregnancy ailments [3].

Addressing stress and anxiety during pregnancy is crucial, as they are linked to preterm deliveries, growth issues, and adverse health outcomes for children [4]. Childhood acute lymphoblastic leukemia (ALL) is the most common pediatric cancer, with various risk factors identified. Maternal exposure to pesticides during pregnancy and low-dose ionizing radiation in early childhood show convincing evidence of association with ALL [5]. Genetic alterations and parental lifestyle factors, including paternal

alcohol consumption and smoking, contribute to ALL risk [6, 7]. Environmental factors such as electromagnetic fields and proximity to nuclear facilities also show some level of association [5].

Positive maternal mental health during pregnancy is linked to lower risks of mental and behavioral disorders in children, even among mothers with mental health challenges [8].

Children of mothers with comorbid anxiety and depression have higher probabilities of following problematic emotional and behavioral trajectories. However, prenatal psychological interventions may mitigate these risks, emphasizing the importance of mental health care for expectant mothers [9]. A meta-analysis found that high maternal stress during pregnancy increases the risk of autism spectrum disorder, obesity, and infantile colic in children [10].

Additionally, prenatal maternal stress can activate the HPA axis, leading to elevated cortisol that adversely affects fetal brain development and increases the risk of neurobehavioral disorders [11].

In addition to HPA axis dysregulation, previous studies have proposed that oxidative stress and epigenetic modifications during gestation may disrupt fetal immune and neurological development, thereby increasing susceptibility to malignancies in early childhood [6, 7].

Factors such as young maternal age, low education, economic hardship, and lack of social support negatively impact maternal mental health, while employment, older age, and strong social networks have protective effects [12–14].

Cancer imposes significant physical, emotional, and financial burdens on individuals, families, and society, particularly for low-income households facing treatment-related expenses [15, 16]. In Iran, cancer is the most common chronic noncommunicable disease and the third leading cause of mortality, underscoring the need for early screening and preventive measures [17].

A recent study at Afzalipour Hospital in Kerman highlighted a surge in childhood cancer cases among children under six, with increasing diagnoses and deaths over the past decade.

Therefore, this study hypothesizes that lower maternal quality of life during pregnancy is significantly associated with an increased risk of early childhood cancer.

This study aims to explore the relationship between maternal quality of life during pregnancy and childhood cancer risk, addressing gaps in understanding how maternal health and other parental factors influence child health outcomes. By investigating these connections, this research seeks to inform strategies for reducing childhood cancer risk and improving children's health.

2. Methods

2.1. Study Design. This study employed an embedded explanatory sequential mixed-methods design, integrating a quantitative case-control framework with embedded qualitative data collection. The dominant phase was quantitative, using validated tools to assess maternal health and socioeconomic status (SES), while qualitative insights were gathered through interview-based administration of the GHQ-28 to capture contextual psychological experiences during pregnancy. This approach allowed for both statistical analysis and interpretive depth, enhancing the understanding of maternal quality of life in relation to childhood cancer risk.

The study was approved by the Ethics Committee of Kerman University of Medical Sciences (IR.KMU.AH.REC.1402.179). Prior to data collection, written informed consent was obtained from all participants for both participation and publication of identifiable data (e.g., medical history and socioeconomic information). Ethical protocols ensured confidentiality and compliance with data protection standards. This mixed-methods study employed a case-control design to explore the relationship between maternal quality of life and childhood cancer, approved by Kerman University of Medical Sciences (IR.KMU.AH.REC.1402.179). Prior to data collection, written informed consent for both participation and publication of identifiable information (e.g., medical history and socioeconomic data) was obtained from all participants. Consent procedures were reviewed and approved by the ethics committee, ensuring compliance with confidentiality and data protection standards.

The quantitative component utilized a case-control approach, comparing mothers of children under six diagnosed with cancer at Afzalipour Hospital (case group) with mothers of healthy children (control group), matched for age and SES. The qualitative component involved in-depth interviews and patient file reviews to gather detailed insights. Both methods were integrated to minimize limitations, with structured questionnaires, interviews, and file reviews employed for comprehensive data collection.

2.1.1. Case Group. The case group consisted of mothers of children under 6 years old diagnosed with cancer at Afzalipour Hospital.

2.1.2. Control Group. The case group consisted of mothers of children under 6 years old with no cancer diagnosis at Afzalipour Hospital.

Both control groups were matched with the case group for age and SES to reduce confounding factors.

2.1.3. Inclusion Criteria. Only mothers with clear recollections of pregnancy were included in the study to reduce recall bias.

2.1.4. Demographics. The mean age of case mothers was 35.06 ± 6.15 years, with an economic status score of 8.82 ± 2.6. The control group had an average age of 34 years and an economic status score of 9.

Objective data (e.g., medical records and laboratory tests) were collected to supplement self-reports.

This study followed an embedded mixed-methods design, in which qualitative data were integrated within

structured GHQ-28 interviews. While the primary analysis was quantitative, the interview-based administration of the GHQ-28 allowed participants to elaborate on their responses. These elaborations were recorded and analyzed thematically to contextualize the statistical findings, particularly regarding anxiety, depression, and social withdrawal during pregnancy.

2.2. Sampling Strategy

2.2.1. Case Group. Mothers of children with cancer were selected using purposive sampling, with inclusion criteria refined to minimize selection bias. Inclusion criteria included mothers with children under six who were recently diagnosed with cancer and had clear recollections of their pregnancy.

2.2.2. Control Group. Mothers of healthy children were selected using random sampling to ensure a representative sample. Both groups were matched for age and SES to reduce confounding.

2.3. Sample Size. In 2023, 136 children were diagnosed with cancer, leading to the selection of 73 case mothers. The control group comprised 118 mothers.

A sample size of 191 children under six was calculated to detect mean differences between groups using SPSS 28. The formula for two independent populations was applied:

$$n = \frac{\left(z_{1-(a/2)} + z_{1-B}\right)\left(\sigma_1^2 + \sigma_2^2\right)}{\left(\mu_1 - \mu_2\right)}. \quad (1)$$

Data from three studies on maternal quality of life with sick and healthy children informed the calculation, ensuring robustness. The power calculation included an effect size of 0.5, an alpha level of 0.05, and a power of 0.8, which further strengthened the methodological rigor.

2.4. Data Collection Tools

2.4.1. Quantitative Data. Data were collected through structured questionnaires administered during interviews with mothers. The 28-item General Health Questionnaire (GHQ) was used to assess maternal health, demonstrating high reliability (split-half coefficient of 0.95, Cronbach's alpha of 0.93). SES was measured using a validated scale (Cronbach's alpha of 0.83). To reduce self-report bias, objective measures (e.g., medical records and employment data) were also collected.

2.4.2. Validation Process. The SES scale was validated through pilot testing and factor analysis, ensuring its reliability in the study population [18]. The GHQ's validity was confirmed through confirmatory factor analysis in previous studies [19].

The SES scale provided a multidimensional assessment of participants' socioeconomic conditions. In this study, the term "SES score" refers to the total score derived from the full 25-item scale. In contrast, the terms "economic status" and "social class" refer to specific components within the SES scale, including reported income, income adequacy, and self-assessed social class placement. This distinction was maintained throughout the analysis to ensure conceptual clarity.

2.4.3. Qualitative Component. The GHQ-28 questionnaire was administered through structured, face-to-face interviews conducted by trained researchers. During this process, participants were encouraged to elaborate on their answers or share relevant experiences when prompted. These responses were audio-recorded and transcribed with consent.

The qualitative data served two key purposes: (1) enabling the research team to assess the clarity and completeness of maternal pregnancy recall and exclude participants with insufficient recall capacity and (2) providing deeper insights into the psychosocial experiences of mothers during pregnancy.

Thematic analysis, based on Braun and Clarke's framework, was used to identify key themes that aligned with significant GHQ domains (e.g., anxiety, depressive thoughts, and social withdrawal). This embedded qualitative approach added interpretive depth to the quantitative findings.

2.5. Data Analysis Methods

2.5.1. Quantitative Analysis. Data were analyzed using SPSS 28 and Microsoft Excel. T-tests were used to compare economic status and maternal age, and logistic regression was used to assess odds ratios.

The correlation heatmap was generated using Python with the Seaborn and Matplotlib libraries for data visualization and analysis.

Propensity score matching was applied to control for confounders.

2.5.2. Qualitative Data. Patient files were reviewed to gather detailed clinical information, including the child's diagnosis, treatment history, and maternal health during pregnancy. Memory aids (e.g., timelines) were provided during interviews to improve recall accuracy.

2.6. Multicollinearity Assessment. Correlation analysis and heatmap visualization were used to identify potential multicollinearity among independent variables. While certain variables (e.g., maternal age at childbirth and marriage) showed high correlation ($r > 0.90$), the regression models were evaluated for multicollinearity using the Variance Inflation Factor (VIF), and variables exceeding acceptable thresholds were excluded or interpreted with caution. No major multicollinearity was detected in the final models.

3. Results

3.1. Trends in Pediatric Cancer Incidence. From 2014 to 2023, pediatric cancer data reveals a concerning rise in both frequency and severity of cases. The increase in diagnoses,

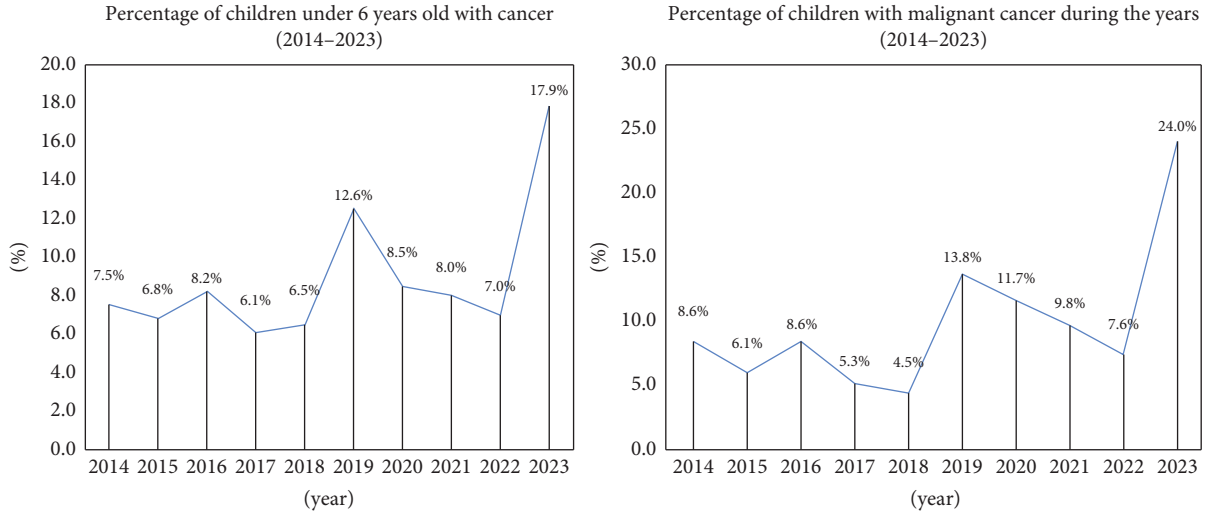

Figure 1: Percentage of children with cancer and malignant cancer during the years (2014–2023).

particularly of malignant types, suggests a shift toward more aggressive cancers. These findings highlight the urgent need for research, awareness, and public health interventions to support affected children (Figure 1).

3.2. Parental and Child Variable Analysis. Kerman's study analyzes maternal and child variables affecting cancer diagnoses in children under six. Maternal age showed higher cancer rates in older mothers (21.9% over 40 vs. 11% under 30). Education mattered: 63% of mothers without university education had children diagnosed, versus 37% with degrees. Employment status revealed higher unemployment among diagnosed mothers (76.7% during pregnancy). Smoking was significant: 13.7% of mothers with diagnosed children smoked, compared to 0.9%. Child gender showed no difference, with 60.3% boys and 39.7% girls diagnosed. Maternal factors strongly influence childhood cancer likelihood (Table 1).

3.3. Factors Influencing Childhood Cancer Diagnosis: Univariate Logit Analysis (No Interaction Effects). Univariate logit regression identified key factors influencing childhood cancer diagnoses ($p \leq 0.05$). Younger maternal age at marriage (19–33 years), nonuniversity maternal education ($B = -2.248$), and maternal unemployment before ($B = -1.213$) and during pregnancy ($B = -1.124$) increased risk. Nonsmoking mothers ($B = 2.922$) and fathers ($B = 1.647$) had higher odds. Maternal medical history ($B = 0.637$), anxiety ($B = 0.103$), and depression ($B = 0.081$) during pregnancy also raised risks. Paternal education ($B = -2.476$) and child's age ($B = 0.466$) were significant. These factors highlight maternal and paternal influences on childhood cancer likelihood (Table 2).

3.4. Multivariate Logistic Regression Analysis of Influential Factors in Childhood Cancer Incidence. Multivariate logistic regression identified key factors influencing childhood cancer incidence ($p \leq 0.05$). Fathers working in industries like copper, steel, and chemicals had higher risks ($p = 0.008$), while self-employed fathers showed reduced risks ($\beta = -2.835$). Nonsmoking fathers ($p = 0.009$) and nonuniversity-educated parents (mothers: $\beta = -1.913$; fathers: $\beta = -2.116$) increased odds. Maternal medical history ($p = 0.006$) and unemployment before pregnancy ($\beta = -1.561$) were significant. Higher birth order ($\beta = -1.319$) lowered risk, while increasing child age ($\beta = 0.630$) raised it. Quality of life trended toward significance ($p = 0.058$) (Table 3).

3.5. Correlation Analysis of Risk Factors for Childhood Cancer Diagnosis. This heatmap presents the correlation between various maternal, paternal, and child-related factors influencing childhood cancer diagnosis. The intensity of the colors represents the strength and direction of relationships between variables, with darker shades indicating stronger correlations.

Maternal age at childbirth and maternal age at marriage show a strong positive correlation, suggesting that mothers who marry later tend to have children at an older age.

Maternal medical history has moderate positive correlations with childhood cancer diagnosis, highlighting the potential impact of maternal health conditions.

Birth order is negatively correlated with childhood cancer diagnosis, indicating that firstborn children might have a slightly higher risk compared to later-born siblings.

Maternal and paternal smoking are positively correlated with childhood cancer diagnosis, reinforcing smoking as a potential risk factor.

Employment during pregnancy exhibits a negative correlation with childhood cancer diagnosis, suggesting that unemployed mothers during pregnancy might experience different exposures or stress factors that could be linked to childhood cancer (Figure 2).

3.6. Thematic Analysis of Embedded Qualitative Data. Qualitative insights derived from GHQ-28-based interviews revealed three recurring psychosocial themes that contextualize the significant quantitative findings:

Table 1: Parents and children's frequency of investigated variables.

Variables	Not diagnosed with cancer	Diagnosed with cancer	Total
Maternal age			
Under 30	(3.15%) 18	(11%) 8	(13.6%) 26
30–40	(38.1%) 45	(38.4%) 28	(38.2%) 73
35–40	(39%) 46	(28.8%) 21	(35.1%) 67
40 <	(7.6%) 9	(21.9%) 16	(13.1%) 25
Maternal age at marriage			
18 ≥	(9.3%) 11	(28.8%) 21	(16.8%) 32
19–23	(32.2%) 38	(38.4%) 28	(34.6%) 66
24–28	(45.8%) 54	(23.3%) 17	(37.2%) 71
29–33	(8.5%) 10	(2.7%) 2	(6.3%) 12
34 ≤	(4.2%) 5	(6.8%) 5	(5.2%) 10
Maternal age at childbirth			
18 ≥	(4.2%) 5	(2.7%) 2	(3.7%) 7
19–23	(7.6%) 9	(8.2%) 6	(7.9%) 15
24–28	(30.5%) 36	(35.6%) 26	(32.5%) 62
29–33	(31.4%) 37	(26%) 19	(29.3%) 56
34 ≤	(26.3%) 31	(27.4%) 20	(26.7%) 51
Maternal education			
Nonuniversity	18 (15.3%)	46 (63%)	64 (33.5%)
University	100 (84.7%)	27 (37%)	127 (66.5)
Family status of the couple			
Stranger	(74.6%) 88	(47.9%) 35	(64.4%) 123
Family	(25.4%) 30	(52.1%) 38	(35.6%) 68
Maternal employment before pregnancy			
Unemployed	(44.1%) 52	(72.6%) 53	105 (%55)
Employed	(55.9%) 66	(27.4%) 20	86 (%45)
Maternal employment during pregnancy			
Unemployed	(51.7%) 61	(76.7%) 56	117 (61.3%)
Employed	(48.3%) 57	(23.3%) 17	74 (38.7)
Maternal birth order			
1	(22.9%) 27	(37%) 27	(28.3%) 54
2 ≤	(77.1%) 91	(63%) 46	137 (71.7%)
Maternal medical history			
Yes	(45%) 53	(31.5%) 23	(39.8%) 76
No	(55%) 65	(68.5%) 50	(60.2%) 115
Maternal smoking before and during pregnancy			
No	(99.1%) 117	(86.3%) 63	(94.8%) 181
Yes	(0.9%) 1	(13.7%) 10	(5.2%) 10
Employment status of fathers			
Employee	(40.7%) 48	(15.1%) 11	(31%) 59
Self-employed/private sector	(44.1%) 52	(52.1%) 38	(47.1%) 90
Industries (copper, steel, electricity, rubber, and chemicals)	(13.6%) 16	(31.5%) 23	(20.4%) 39
Unemployed	(1.7%) 2	(1.4%) 1	(1.5%) 3
Educational level of fathers			
Nonuniversity	33 (28%)	60 (82.2%)	93 (48.7%)
University	85 (72%)	13 (17.8%)	98 (51.3%)
Fathers' smoking status			
Nonsmoker	(94.1%) 111	(75.3%) 55	(86.9%) 166
Smoker	(5.9%) 7	(24.7%) 18	(13.1%) 25
Gender			
Boy	(53.4%) 63	(60.3%) 44	(56%) 107
Girl	(46.6%) 55	(39.7%) 29	(44%) 84
Child's age			
(1–0)	(12.7%) 15	(0%) 0	(7.9%) 15
(2–1.1)	(0.8%) 1	(0%) 0	(0.5%) 1
(3–2.1)	(11%) 13	(2.7%) 2	(7.9%) 15
(4–3.1)	(14.4%) 17	(9.6%) 7	(12.6%) 24
(5–4.1)	(23.7%) 28	(27.4%) 20	(25.1%) 48
(6–5.1)	(37.3%) 44	(60.3%) 44	(46.1%) 88
Child's birth order			
1	(31.4%) 37	(50.7%) 37	(38.7%) 74
2 ≤	(68.6%) 81	(49.3%) 36	(61.3%) 117

Table 2: Univariate logistic regression analysis of maternal and paternal factors associated with childhood cancer risk.

Variables		*B*	S.E.	Wald	df	Sig.	Exp (*B*)	95% C.I. for exp (*B*)	
								Lower	Upper
Maternal age at marriage	Quantitative numerical variable	−0.065	0.032	4.196	1	0.041	0.937	0.880	0.997
	Constant	1.022	0.742	1.896	1	0.169	2.779		
	(≥ 18)			18.203	4	0.001			
	(19–23)	−0.952	0.448	4.519	1	0.034	0.386	0.160	0.928
	(24–28)	−1.802	0.465	15.049	1	0.0001	0.165	0.066	0.410
	(29–33)	−2.256	0.859	6.892	1	0.009	0.105	0.019	0.565
	(≤ 34)	−0.647	0.734	0.776	1	0.378	0.524	0.124	2.207
	Constant	0.647	0.372	3.018	1	0.082	1.909		
Maternal age at childbirth		0.013	0.028	0.237	1	0.626	1.014	0.960	1.070
Constant		−0.879	0.835	1.110	1	0.292	0.415		
Degree of familiarity in marital relationship	Stranger Family	1.158	0.316	13.474	1	0.0001	3.185	1.716	5.911
Constant		−0.922	0.200	21.286	1	0.0001	0.398		
Maternal employment before pregnancy	No Yes	−1.213	0.321	14.250	1	0.0001	0.297	0.158	0.558
Constant		0.019	0.195	0.010	1	0.922	1.019		
Maternal employment during pregnancy	No Yes	−1.124	0.333	11.427	1	0.001	0.325	0.169	0.623
Constant		−0.086	0.185	0.214	1	0.644	0.918		
Paternal employment status	Industries (copper, steel, electricity, rubber, and chemicals)			16.010	3	0.001			
	Employee	−0.677	0.389	3.021	1	0.082	0.508	0.237	1.090
	Self-employed/private sector	−1.836	0.467	15.486	1	0.0001	0.159	0.064	0.398
	Unemployed	−1.056	1.267	0.694	1	0.405	0.348	0.029	4.169
Constant		0.363	0.326	1.243	1	0.265	1.438		
Maternal birth order	1 2 ≤	−0.682	0.327	4.358	1	0.037	0.505	0.266	0.959
Constant		0.000	0.272	0.000	1	1.000	1.000		
Child's birth order	1 2 ≤	−0.682	0.327	4.358	1	0.037	0.505	0.266	0.959
Constant		0.000	0.272	0.000	1	1.000	1.000		
Maternal education	Nonuniversity University	−2.248	0.353	40.631	1	0.0001	0.106	0.053	0.211
Constant		0.938	0.278	11.390	1	0.001	2.556		
Paternal education	Nonuniversity University	−2.476	0.368	45.175	1	0.0001	0.084	0.041	0.173
Constant		0.598	0.217	7.609	1	0.006	1.818		
Maternal medical history	No Yes	0.637	0.315	4.082	1	0.043	1.890	1.019	3.506
Constant		−0.879	0.254	12.019	1	0.001	0.415		

Table 2: Continued.

Variables		B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I. for exp (B)	
								Lower	Upper
Paternal smoking status	Nonsmoker Smoker	1.647	0.475	12.019	1	0.001	5.190	2.046	13.165
Constant		−0.702	0.165	18.134	1	0.0001	0.495		
Mathers' smoking status	Nonsmoker Smoker	2.922	1.060	7.591	1	0.006	18.571	2.324	148.405
Constant		−0.619	0.156	15.692	1	0.0001	0.538		
Gender	Boy Girl	−0.281	0.302	0.866	1	0.352	0.755	0.418	1.365
Constant		−0.359	0.196	3.338	1	0.068	0.698		
Age of the child		0.466	0.126	13.570	1	0.000	1.593	1.243	2.040
Constant		−2.696	0.642	17.617	1	0.000	0.067		
Economic status		−0.072	0.054	1.762	1	0.184	0.930	0.836	1.035
Constant		0.177	0.514	0.118	1	0.731	1.193		
The child's age		1.079	0.278	15.034	1	0.000	2.942	1.705	5.076
Constant		−4.066	1.095	13.787	1	0.000	0.017		
Maternal physical health during pregnancy		−0.052	0.037	1.999	1	0.157	0.950	0.884	1.020
Constant		0.608	0.781	0.606	1	0.436	1.836		
Maternal social functioning during pregnancy		−0.075	0.047	2.580	1	0.108	0.927	0.846	1.017
Constant		0.910	0.875	1.081	1	0.298	2.485		
Maternal anxiety during pregnancy		0.103	0.032	10.617	1	0.001	1.108	1.042	1.179
Constant		−1.977	0.487	16.450	1	0.000	0.138		
Maternal depression during pregnancy		0.081	0.033	5.840	1	0.016	1.084	1.015	1.157
Constant		−1.340	0.388	11.923	1	0.001	0.262		
Quality of life (composite of 4 subscales)		−0.044	0.014	10.532	1	0.001	0.957	0.932	0.983
Constant		3.238	1.153	7.886	1	0.005	25.473		

Table 3: Multivariate logistic regression with interaction effects of parental and socioeconomic variables.

Variables		*B*	S.E.	Wald	df	Sig.	Exp (*B*)	95% C.I. for exp (*B*)	
								Lower	Upper
Degree of familiarity in marital relationship	Stranger Family	2.431	0.653	13.871	1	0.000	11.373	3.164	40.882
Maternal employment before pregnancy	No Yes	−1.561	0.603	6.702	1	0.010	0.210	0.064	0.684
Paternal employment status	Industries (copper, steel, electricity, rubber, and chemicals)			11.698	3	0.008			
	Employee	−1.870	0.724	6.672	1	0.010	0.154	0.037	0.637
	Self-employed/private sector	−2.835	0.848	11.188	1	0.001	0.059	0.011	0.309
	Unemployed	−2.653	1.661	2.549	1	0.110	0.070	0.003	1.829
Child's birth order	1 2 ≤	−1.319	0.537	6.045	1	0.014	0.267	0.093	0.765
Maternal education	Nonuniversity University	−1.913	0.647	8.737	1	0.003	0.148	0.042	0.525
Paternal education	Nonuniversity University	−2.116	0.584	13.138	1	0.000	0.120	0.038	0.378
Maternal medical history	No Yes	1.835	0.667	7.580	1	0.006	6.267	1.697	23.149
Paternal smoking status	Nonsmoker Smoker	2.757	1.049	6.910	1	0.009	15.752	2.016	123.058
Childs age		0.630	0.218	8.328	1	0.004	1.878	1.224	2.882
Quality of life (composite of 4 subscales)		−0.045	0.023	3.599	1	0.058	0.956	0.913	1.001
Constant		3.231	2.742	1.389	1	0.239	25.308	3.231	2.742

1. Unexplained Anxiety and Emotional Disconnection

   Many mothers reported episodes of persistent anxiety during pregnancy, often without a clear cause. They described feeling detached from their surroundings and experiencing intrusive worries.

   "I was scared for no reason. . . just a constant unease that I couldn't shake off." (Participant #9)

   "Even during normal checkups, I still expected something bad to happen." (Participant #17)

2. Perceived Lack of Purpose and Social Invisibility

   Several participants expressed dissatisfaction with their roles as full-time homemakers, describing a loss of identity and a sense of uselessness compared to employed peers.

   "I felt like I had no role. Other women were working and achieving things—I was just at home doing nothing important." (Participant #6)

   "I didn't feel like a valuable person. I wanted to contribute more but felt stuck." (Participant #21)

3. Hopelessness and Depressive Outlook

   Reflections often included themes of emotional exhaustion, lack of motivation, and a bleak view of the future.

   "I didn't enjoy anything. I lost interest in everything around me." (Participant #14)

   "I had no hope. It felt like life had paused, and I wasn't living anymore." (Participant #19)

   These themes offer explanatory depth to the statistically significant associations between anxiety, depression, and maternal quality of life during pregnancy and the risk of childhood cancer.

4. Discussion

The alarming trend in pediatric cancer data from 2014 to 2023 demands immediate attention. The rise in both the frequency and severity of diagnoses, particularly in malignant cancer types, signifies a troubling shift requiring urgent research focus. The data suggest not only an increase in childhood cancer cases but also a transition toward more aggressive forms of the disease [20, 21]. This highlights the need for enhanced awareness campaigns and targeted public health initiatives to mitigate childhood cancer risks.

The study underscores the critical role of maternal quality of life in influencing childhood cancer risk. A decrease in quality of life, measured through anxiety, depression, social interactions, and physical well-being, is associated with higher cancer risk in children. Maternal well-being is closely tied to child health; challenges like stress, lack of support, and poor physical health can negatively impact fetal development and increase susceptibility to diseases like cancer. High levels of maternal stress and depression are strongly linked to childhood cancer risk [3, 4, 9–11]. Social and environmental factors within families can exacerbate these issues, emphasizing the interconnectedness of maternal and child health. Strategies enhancing maternal well-being are essential for childhood cancer prevention and broader public health initiatives [22, 23]. Comprehensive public health measures addressing multiple risk factors are essential for reducing childhood cancer incidence.

Consanguineous marriage (marriage within the family) is another critical risk factor. Childhood cancer incidence often correlates with socioeconomic and environmental conditions, highlighting the need to address disparities in education and family support systems [24, 25]. A holistic understanding of childhood cancer risk must integrate these societal influences to develop strategic interventions prioritizing health equity. Improving access to education and strengthening family support frameworks can significantly reduce childhood cancer incidence and improve outcomes.

Environmental carcinogens, particularly from occupational exposures in industries like copper, steel, and chemicals, are significant contributors to childhood cancer risk. Stringent occupational safety regulations are needed to protect parents and caregivers from hazardous exposures, potentially reducing childhood cancer risk [5, 26]. Robust workplace health and safety standards can mitigate environmental factors linked to childhood cancer, promoting healthier outcomes.

Low maternal health status—marked by unemployment, low educational attainment, and underlying health conditions—is associated with increased cancer risk in offspring. This relationship highlights the importance of maternal well-being in preventing childhood cancer. The findings align with existing literature emphasizing socioeconomic disparities as a crucial aspect of prevention and treatment efforts [27–29].

Interventions supporting maternal health, providing access to education and employment, and addressing mental health challenges during pregnancy are essential for reducing childhood cancer burden and improving outcomes. Promoting health equity and addressing social determinants of health are critical components of comprehensive care.

Age amplifies the influence of environmental exposures. As children grow, their physiological development may render them more vulnerable to environmental carcinogens. Age-specific considerations must be incorporated into ecological health policies and interventions to mitigate childhood cancer risks [30, 31].

Children born to couples under 18 years old are at higher risk than those born to older parents, a correlation linked to maternal age and birth spacing due to early marriage. Addressing early marriage and its associated determinants is crucial for childhood cancer prevention and improving child health outcomes [26, 32].

4.1. Policy and Practice Implications. The findings of this study highlight several areas where targeted interventions and policies could reduce the risk of childhood cancer by improving maternal well-being.

Integrate maternal mental health screening (e.g., GHQ-28 or similar tools) into routine prenatal care, particularly during the first and third trimesters.

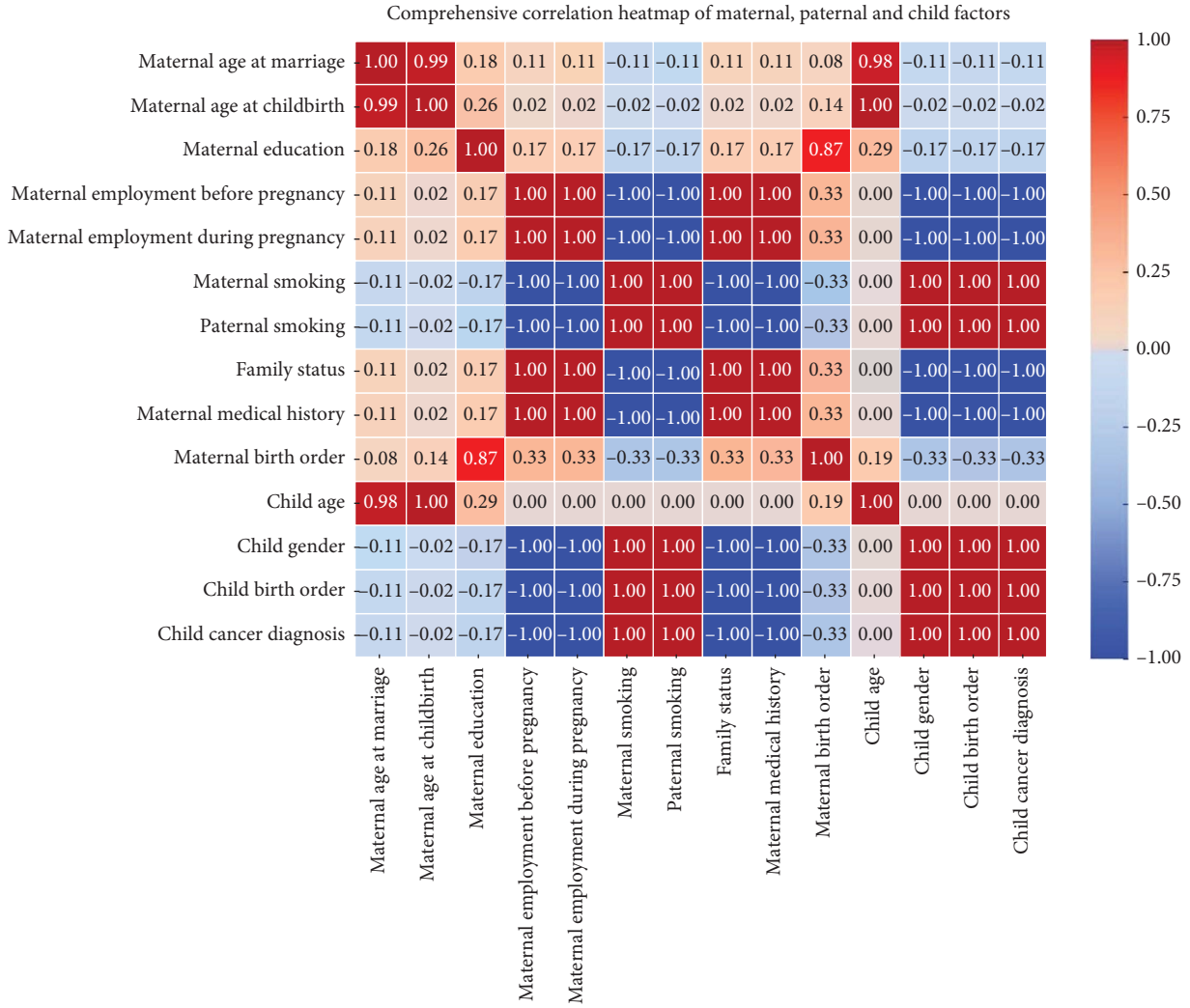

Figure 2: Correlation heatmap of maternal, paternal, and child-related factors affecting childhood cancer diagnosis.

Promote employment support programs for women of reproductive age, including flexible maternity leave and re-entry pathways for housewives seeking to return to work.

Develop community-based education programs to raise awareness about the long-term impact of stress, depression, and socioeconomic hardship during pregnancy.

Implement workplace hazard prevention strategies for fathers employed in high-risk industries (e.g., chemical, steel, rubber) with occupational exposures.

Tailor family support interventions for socially isolated mothers, including home visitation services and peer support networks.

These actions, if integrated into public health strategies, may reduce preventable exposures and psychosocial risk factors that influence early-life disease vulnerability.

4.2. Limitations. This study provides valuable insights but acknowledges limitations. While the mixed-methods design reduces reliance on cross-sectional analysis, self-reported data may introduce recall bias, and unaccounted confounders could influence results. Future research should incorporate longitudinal designs and objective measures to explore a wider range of factors affecting childhood cancer etiology for a more robust understanding.

5. Conclusions

This research highlights the urgent need to address rising childhood cancer rates and severity from 2014 to 2023. Maternal well-being significantly influences a child's cancer risk, underscoring the importance of integrating maternal health into public health initiatives. Socioeconomic factors, environmental exposures, and lifestyle choices, particularly smoking, interact to increase childhood cancer risk. Efforts must focus on improving maternal health, reducing socioeconomic disparities, enforcing environmental safety regulations, and providing healthcare and social support. Educating families and addressing workplace hazards are vital. A comprehensive approach prioritizing maternal and child well-being is essential to reduce childhood cancer rates and promote healthier futures.

Data Availability Statement

The datasets supporting this study cannot be made publicly available due to ethical restrictions and patient confidentiality agreements under the IR.KMU.AH.REC.1402.179 ethics approval. However, anonymized data are available from the corresponding author upon reasonable request, subject to approval by Kerman University of Medical Sciences' ethics committee.

Ethics Statement

This study was approved by the Ethics Committee at Kerman University of Medical Sciences (Approval Number: IR.KMU.AH.REC.1402.179).

Consent

Written informed consent for publication was obtained from all participants prior to data collection, including permission to use identifiable information (e.g., medical history and socioeconomic data).

Disclosure

This article was prepared in the authors' personal capacities; no authors represent governmental or institutional view. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

Author Contributions

Behnaz Aflatoonian (MSc): study design, data collection, analysis, and manuscript drafting.

Hossein Mirzaei (PhD): study design, data analysis, and critical revision (corresponding author).

Morteza Hashemian (MD): data collection and manuscript editing.

Mohammad Reza Aflatoonian (PhD): statistical analysis and literature review.

Funding

This research received no specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgments

We sincerely thank the patients and staff at Afzalipour Hospital, Kerman University of Medical Sciences, for their invaluable cooperation.

AI Disclosure. During manuscript preparation, ChatGPT (OpenAI) was used to assist with editing and condensing text to meet word count requirements. The AI tool was solely employed for refining language and reducing redundancy in the discussion and methods sections; all scientific content, data interpretation, and conclusions remain entirely the authors' own.

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