论著·公共卫生智库

面向宫颈癌消除的社会经济精准防控策略:教育、收入、居住地对宫颈癌前病变及浸润癌的差异化影响

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[摘要] **目的** 社会经济地位(socioeconomic status, SES)不平等在宫颈癌自然史连续谱(从癌前病变到浸润癌)中的作用模式目前尚不清晰。本研究旨在系统探讨不同维度的SES与不同阶段宫颈病变风险的关联,为识别高危人群、制定精准防控策略提供科学依据。**方法** 采用病例-对照设计,纳入2024年10月至2025年9月于陆军军医大学第一附属医院妇科就诊的508例女性受试者,依据病理诊断结合《国际疾病分类(第十版)》(international classification of diseases, 10th revision, ICD-10),编码将宫颈上皮内瘤变、宫颈原位癌及宫颈浸润癌设为3个病例组,无宫颈病变者为对照组。问卷收集教育水平、家庭年收入、个人月工资及居住地经济水平4个SES指标。鉴于结局变量具有有序性且比例优势假设不成立,构建3个独立的二分类Logistic回归模型分别分析各SES指标与不同病变阶段的关联,估算*OR*及95%*CI*,并调整年龄、体质量指数(body mass index, BMI)及人乳头瘤病毒(human papillomavirus, HPV)疫苗接种状态等混杂因素;通过方差膨胀因子(variance inflation factor, VIF)检验多重共线性,采用多项Logistic回归进行敏感性分析。**结果** 共纳入508例患者,其中无病变组74例(14.6%)、宫颈上皮内瘤变组213例(41.9%)、宫颈原位癌组110例(21.7%)、宫颈浸润癌组111例(21.8%)。多因素Logistic回归分析结果显示,高中及以上文化程度与宫颈上皮内瘤变(*OR*=0.475, 95%*CI*: 0.258~0.877, *P*=0.017)及宫颈浸润癌(*OR*=0.361, 95%*CI*: 0.175~0.746, *P*=0.006)发生风险降低相关,但与宫颈原位癌无显著关联;个人月工资>5 000元与宫颈浸润癌发生风险降低相关(*OR*=0.332, 95%*CI*: 0.137~0.806, *P*=0.015);非富裕地区女性宫颈浸润癌发生风险较富裕地区增加92%(*OR*=1.920, 95%*CI*: 1.005~3.668, *P*=0.048)。家庭年收入与各阶段病变的关联均无统计学意义。模型3所有变量的VIF <1.12,提示不存在多重共线性。敏感性分析采用多项Logistic回归,以无病变组为共同参照,结果显示各SES指标与病变阶段的相对风险比(relative risk ratio, RRR)与上述独立二分类模型方向一致,提示结果稳健。**结论** 社会经济差异对中国女性宫颈病变风险的影响呈现维度差异性。高中及以上教育水平与宫颈上皮内瘤变及宫颈浸润癌发生风险降低独立相关,而居住地经济水平和个人月工资水平主要影响宫颈浸润癌发生风险。**对策** 建议通过整合筛查至基层计划生育体系、实施数据驱动的瓶颈分析与微干预、强化社区动员与家庭参与等策略,系统性消除低教育水平及非富裕地区人群在宫颈癌疫苗接种、筛查与治疗环节面临的可及性壁垒,确保消除宫颈癌目标公平惠及弱势人群。

[关键词] 宫颈上皮内瘤变;宫颈浸润癌;社会经济地位;病例对照研究

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Socioeconomically targeted strategies for cervical cancer elimination: differential effects of education, income, and residence on cervical precancerous lesions and invasive cancer

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[**Abstract**] Objective The pattern of socioeconomic status (SES) inequality across the natural history continuum of cervical cancer (from precancerous lesions to invasive cancer) remains unclear. This study aims to systematically investigate the associations between different dimensions of SES and risk at various stages of cervical lesions, providing scientific evidence for identifying high-risk populations and formulating targeted prevention and control strategies. Methods A case-control design was adopted. A total of 508 female patients who visited Department of Gynecology at the First Affiliated Hospital of Army Medical University between October 2024 and September 2025 were enrolled. Based on pathological diagnosis combined with international classification of diseases, 10th revision (ICD-10) coding, cervical intraepithelial neoplasia (CIN), cervical carcinoma *in situ*, and invasive cervical cancer were designated as 3 case groups, with the women free of cervical lesions serving as the control group. Four SES indicators, that is, education level, household income, occupational income, and area-level economic development, were collected *via* questionnaires. Given that the outcome, variable was ordinal and the proportionul odds assumption was violated three independent binary logistic regression models were constructed to analyze the associations between each SES indicator and different lesion stages, estimating ORs and 95%*CIs*, with adjustment for age, body mass index (BMI), and human papillomavirus (HPV) vaccination status as confounders. Multicollinearity was assessed using variance inflation factor (VIF), and sensitivity analysis was performed using multinomial logistic regression. Results A total of 508 patients were enrolled, including 74 (14.6%) in the lesion-free group, 213 (41.9%) in the CIN group, 110 (21.7%) in the carcinoma *in situ* group, and 111 (21.8%) in the invasive cervical cancer group. Multivariate logistic regression analysis revealed that high school education and above was associated with reduced risks of CIN (*OR*=0.475, 95%*CI*: 0.258 to 0.877, *P*=0.017) and invasive cervical cancer (*OR*=0.361, 95%*CI*: 0.175 to 0.746, *P*=0.006), but showed no statistically significant association with carcinoma *in situ*. occupational income >5 000 yuan was associated with a reduced risk of invasive cervical cancer (*OR*=0.332, 95%*CI*: 0.137 to 0.806, *P*=0.015). Women from non-affluent areas exhibited a 92% increased risk of invasive cervical cancer compared with those from affluent areas (*OR*=1.920, 95%*CI*: 1.005 to 3.668, *P*=0.048). No significant associations were observed between household income and cervical lesions at any stage. All VIF values for variables in Model 3 were <1.12, indicating absence of multicollinearity. Sensitivity analysis using multinomial logistic regression with the lesion-free group as the common reference showed that the relative risk ratios (RRRs) of SES indicators across lesion stages were consistent in direction with the independent binary models, suggesting robust findings. Conclusion The impact of socioeconomic disparities on cervical lesion risk among Chinese women exhibits dimensional heterogeneity. High school education and above is independently associated with reduced risks of CIN and invasive cervical carcinoma, whereas residence economic level and occupational income primarily influence the risk of invasive cervical cancer. **Countermeasures** Integration of screening into grassroots family planning systems, implementation of data-driven bottleneck analysis and micro-interventions, and strengthening of community mobilization and family engagement are recommended to systematically eliminate accessibility barriers faced by populations with low education level and in non-affluent areas regarding HPV

vaccination, screening, and treatment, ensuring equitable progress toward cervical cancer elimination goals for disadvantaged populations.

[**Key words**] cervical intraepithelial neoplasia; invasive cervical cancer; socioeconomic status; case-control study

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2022年全球癌症统计数据显示,宫颈癌在全球女性癌症发病谱和死亡谱上均居第4位[1]。同年,我国宫颈癌新发病例15.07万例,死亡病例5.57万例,疾病负担极为沉重[2]。宫颈上皮内瘤变(cervical intraepithelial neoplasia, CIN)作为宫颈癌的癌前病变,包括CIN Ⅰ、CIN Ⅱ和CIN Ⅲ级,是阻断其向浸润癌进展的关键干预节点。队列研究[3-4]表明,在积极监测联合及时干预的管理策略下,CIN Ⅰ级与CIN Ⅱ级病变的自然消退率分别可达60%和50%;而这种基于病变级别的风险分层管理高度依赖筛查可及性和健康素养,因此,社会经济地位(socioeconomic status, SES)成为影响干预效果的关键非生物学因素[6-8]。

尽管SES作为健康的根本社会决定因素已被广泛认可[9],但现有研究多聚焦于低SES人群诊断分期晚、生存率低的问题,未能阐明SES与不同病变阶段的关联是源于生物学易感性差异(如免疫清除能力)还是医疗服务利用差异(如筛查可及性)。此外,SES与人乳头瘤病毒(human papillomavirus, HPV)疫苗接种、肥胖等行为/生物因素高度相关,既往研究在评估SES的独立效应时,对这些混杂因素的控制尚不充分[10-14]。

为落实世界卫生组织《加速消除宫颈癌全球战略》目标,识别可干预的危险因素[15],本研究采用病例对照研究设计,系统探讨教育、收入、居住地等多维度SES与宫颈上皮内瘤变(CIN Ⅰ、CIN Ⅱ)、宫颈原位癌(CIN Ⅲ)及宫颈浸润癌的独立关联,严格校正年龄、体质量指数(body mass index, BMI)和疫苗接种史等混杂因素,旨在通过识别特定SES维度的关键影响窗口期,为我国在资源限制条件下优化筛查资源配置、制定差异化健康教育策略提供证据,助力消除宫颈癌领域的社会经济不平等。

1 对象与方法

1.1 研究对象

研究采用病例-对照研究设计方案[16],于2024年10月至2025年9月招募自陆军军医大学第一附属医院妇科门诊及住院就诊的女性受试者。根据医院电子病历系统数据及病理科登记记录,研究期间共评估517例受试者,排除9例(早孕1例、其他恶性肿瘤2例、器官功能不全1例、信息缺失>20%者5例),最终纳入508例(对照组74例,病例组434例)。本研究获得陆军军医大学第一附属医院伦理审查委员会审批[(A)KY2024086]。

1.2 纳入、排除标准

纳入标准:①签署知情同意书;②参加妇科筛查及流行病学调查;③年龄≥20岁;④接受宫颈病理检查并获取明确诊断结果。排除标准:①妊娠期女性;②合并其他部位恶性肿瘤;③问卷信息缺失超过20%;④合并严重心、脑、肾等器官功能不全或处于疾病急性发作期。研究对象筛选流程见图1。

1.3 宫颈上皮内瘤变、宫颈原位癌和宫颈浸润癌诊断

宫颈病变诊断均以组织病理学结果为金标准。对于肉眼可疑或筛查异常(高危HPV阳性/细胞学ASC-US及以上)者,由经验丰富的妇科医生行规范的阴道镜检查,通过醋酸白试验与碘试验,于最可疑部位多点活检并送病理科进行检测,由2名经验丰富的病理医师共同阅片。本研究的结局指标为宫颈病变的病理学诊断。主要采用CIN分级系统作为诊断标准[17],具体分为:无病变、CIN Ⅰ级、CIN Ⅱ级、CIN Ⅲ级和浸润癌。同时,为便于疾病分类统计,参照《国际疾病分类(第十版)》(international classification of diseases, 10th revision, ICD-10),CIN Ⅰ、CIN Ⅱ级归属于N87编码,CIN Ⅲ级归类为D06编码,CIN Ⅰ和CIN Ⅱ级有较高消退率,CIN Ⅲ级进展为浸润癌的风险显著。

1.4 社会经济地位指标

通过面对面访谈结合线上电子问卷(问卷星平台)与纸质问卷收集受试者人口学特征,如年龄(筛查时)、身高、体质量、婚姻状况、居住地址、近5年平均家庭年收入、近5年个人月工资平均水平及受教育程度等。调查表参考相关文献设计[18-22]。问卷调查由经

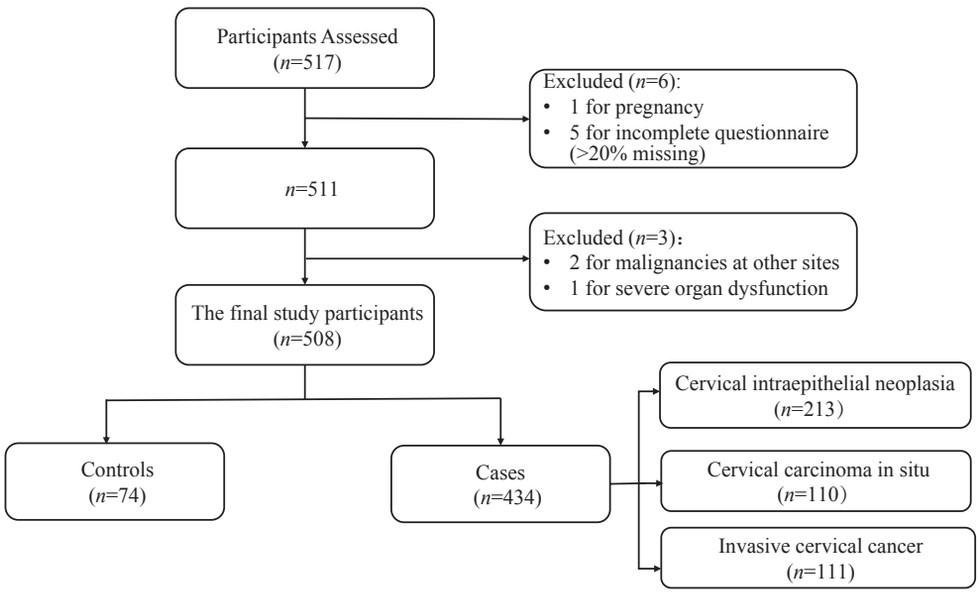


图1 研究对象筛选流程图

Figure 1 Flowchart of participant selection

统一培训的研究人员执行,使用标准化话术以减少偏倚;采用Excel软件建立数据库,对问卷数据进行录入、保存及分类整理,由专人核查数据逻辑错误及填写完整性,确保数据真实性与可靠性。基于LI等[23]提出的SES多维评估框架(涵盖个体教育、收入及居住地经济水平),本研究从教育水平、家庭年收入、个人月工资水平及居住地经济水平4个维度评估SES。

1.4.1 教育水平 教育水平分为2类:低教育水平(初中及以下),较高教育水平(高中及以上,包括中专)[9]。

1.4.2 家庭年收入 家庭年收入指近5年平均家庭年收入(万元/年)。参考中国家庭追踪调查2016—2022年数据显示我国家庭年收入均值约为10万元/年[24],结合本研究开展时间(2024—2025年)及重庆地区经济发展水平,将家庭年收入划分为2类:低家庭收入组(≤10万元/年)和较高家庭收入组(>10万元/年)。

1.4.3 个人月工资水平 询问近5年个人月平均工资水平,以5 000元/月作为阈值进行划分[25]。

1.4.4 居住地经济水平 依据2024年国家统计局县域统计标准[26],以受试者居住县域的人均GDP是否达到或超过全国同期平均水平为界,分为富裕地区(人均GDP≥全国平均)与非富裕地区(人均GDP<全国平均)。

1.5 协变量定义

本研究纳入的协变量包括年龄、HPV疫苗接种情况、BMI及吸烟史。其中,HPV疫苗接种未区分具体类型及剂次,因现有研究证实不同疫苗类型及剂次对16/18型病变保护效力相当[10, 27],BMI作为连续变量采集,按《中国成人超重和肥胖症预防控制指南》二分类为<28 kg/m^2(非肥胖)和≥28 kg/m^2(肥胖),吸烟史缺失率为6.1%,采用多重插补法处理缺失值。

1.6 样本量计算

本研究采用多重Logistic回归分析,参照PEDUZZI等[28]提出的EPV原则。以信息最完整的模型3为例,共纳入5个预测变量(含SES主变量1个、年龄3组产生2个哑变量、HPV疫苗接种史1个哑变量、BMI 1个哑变量)按EPV≥10计算,每组分析至少需要50个结局事件。本研究病例组共434例(宫颈上皮内瘤变213例、宫颈原位癌110例、宫颈浸润癌111例),对照组74例。满足EPV要求;总体508例可确保各病变亚组与对照组比较时的统计稳定性与效能。

1.7 统计学分析

数据整理分析使用R 4.3.3软件,本研究纳入的指标均为分类变量,采用频数(%)进行描述。针对每个社会经济指标(教育水平、家庭年收入、个人月工资水平、居住地经济水平),分别构建三个独立的二分类Logistic回归模型(对应宫颈上皮内瘤变、宫颈原位癌、宫颈浸润癌),估算*OR*和95%*CI*。为控制混杂,构建调整模型:模型1仅纳入社会经济指标;模型2在模型1基础上调整年龄;模型3进一步调整BMI和HPV疫

苗接种状态。并通过方差膨胀因子(variance inflation factor, VIF)检验多重共线性。将模型3中的协变量BMI替换为吸烟史,同时采用多项Logistic回归模型以无病变组为参照组,同时估计社会经济因素对各病变阶段的相对风险比(relative risk ratios, RRR)作为敏感性分析。通过Wald检验直接比较3个二分类Logistic模型间的系数差异。双侧P值<0.05为差异具有统计学意义。

2 结果

2.1 研究人群的基线特征

本研究共纳入508例受试者(47.3±11.8岁)。年龄(χ^2=31.839, P<0.001)、教育水平(χ^2=21.284, P<0.001)、个人月工资水平(χ^2=8.065, P=0.045)、BMI(χ^2=11.625, P=0.009)及HPV疫苗接种史(χ^2=14.828, P=0.002)在4组间分布差异均具有统计学意义;而家庭年收入、居住地经济水平及吸烟史组间差异无统计学意义。从年龄分布来看,随宫颈病变程度加重,≥48岁研究对象占比呈上升趋势(无病变组40.5%、宫颈上皮内瘤变组53.5%、宫颈原位癌组50.0%、宫颈浸润癌组76.6%)。低教育水平(初中及以下)在宫颈浸润癌组占比最高(79.3%),详见表1。

2.2 较高教育水平显著降低宫颈上皮内瘤变发生风险

与低教育水平相比,较高教育水平与宫颈上皮内瘤变发生风险负相关,该关联在调整不同协变量后仍稳定存在。未调整协变量时(模型1),较高教育水平与宫颈上皮内瘤变发生相关,OR值为0.449(95%CI: 0.262~0.768, P=0.004);调整年龄后(模型2),关联仍具有统计学意义(OR=0.519, 95%CI: 0.289~0.931, P=0.028);进一步纳入BMI和HPV疫苗接种状态调整后(模型3),较高教育水平对应的OR值为0.475

表1 无病变组、宫颈上皮内瘤变组、宫颈原位癌组和宫颈浸润癌组研究对象的基线特征比较[例(%)]

Table 1 Baseline characteristics of the participants with different cervical lesion severity[n(%)]

Variable	Non lesion (n=74)	Cervical intraepithelial neoplasia (n=213)	Cervical carcinoma in situ (n=110)	Invasive cervical cancer (n=111)	χ^2	P
Age/years					31.839	<0.001
20 to 38	29 (39.2)	54 (25.4)	37 (33.6)	16 (14.4)		
39 to 47	15 (20.3)	45 (21.1)	18 (16.4)	10 (9.0)		
≥48	30 (40.5)	114 (53.5)	55 (50.0)	85 (76.6)		
Education level					21.284	<0.001
Lower secondary or below	35 (47.3)	142 (66.7)	67 (60.9)	88 (79.3)		
Upper secondary and above	39 (52.7)	71 (33.3)	43 (39.1)	23 (20.7)		
Household income					1.953	0.580
Low	49 (66.2)	157 (73.7)	76 (69.1)	81 (73.0)		
High	25 (33.8)	56 (26.3)	34 (30.9)	30 (27.0)		
Occupational income					8.065	0.045
Low salary	55 (74.3)	175 (82.2)	92 (83.6)	100 (90.1)		
High salary	19 (25.7)	38 (17.8)	18 (16.4)	11 (9.9)		
Area-level economic development					5.306	0.150
Non-affluent regions	31 (41.9)	113 (53.1)	61 (55.5)	65 (58.6)		
Affluent regions	43 (58.1)	100 (46.9)	49 (44.5)	46 (41.4)		
BMI/ (kg/m^2)					11.625	0.009
<28.0	68 (91.9)	206 (96.7)	101 (91.8)	96 (86.5)		
≥28.0	6 (8.1)	7 (3.3)	9 (8.2)	15 (13.5)		
HPV vaccination history					14.828	0.002
Yes	17 (23.0)	41 (19.2)	14 (12.7)	6 (5.4)		
No	57 (77.0)	172 (80.8)	96 (87.3)	105 (94.6)		
Smoking history					5.549	0.140
Yes	7 (9.5)	15 (7.0)	16 (14.5)	8 (7.2)		
No	67 (90.5)	198 (93.0)	94 (85.5)	103 (92.8)		

(95%*CI*: 0.258~0.877, *P*=0.017),提示较高教育水平可能是宫颈上皮内瘤变的保护因素,详见表2。模型3所有变量的VIF远低于10(范围:1.00~1.10),提示模型不存在显著多重共线性问题。敏感性分析结果显示,上述关联仍具有统计学意义。

2.3 SES与宫颈原位癌风险无显著统计学关联

在Logistic回归模型中,SES与宫颈原位癌的关联均未达到统计学显著性。其中教育水平与宫颈原位癌的关联:初步分析(模型1)显示,以低教育水平为参照,较高教育水平与宫颈原位癌风险降低存在关联趋势(*OR*=0.576, 95%*CI*: 0.317~1.045),但未达到统计学显著性(*P*=0.070)。居住地与宫颈原位癌的关联:以富裕地区为参照,居住于非富裕地区女性罹患宫颈原位癌风险趋于升高。不同模型中,居住于非富裕地区女性发生宫颈原位癌的*OR*值均大于1,且*P*值接近0.05但未达到统计学显著性,提示非富裕地区女性可能增加宫颈原位癌风险。家庭年收入和个人月工资水平与宫颈原位癌未发现统计学关联。详见表3。模型3所有变量的*VIF*远低于10(范围:1.00~1.12),提示模型不存在显著多重共线性问题。

2.4 较高教育水平、较高工资水平是宫颈浸润癌的保护因素,而居住于非富裕地区是其危险因素

教育水平与宫颈浸润癌发生风险呈负相关,模型3中,较高教育水平的女性宫颈浸润癌发生风险较低(*OR*=0.361, 95%*CI*: 0.175~0.746, *P*=0.006),对比低教育水平女性。个人月工资水平与宫颈浸润癌的关联:与低工资水平相比,较高工资水平与宫颈浸润癌发生风险呈负相关,该关联在调整后仍具有统计学意义(*OR*=0.332, 95%*CI*: 0.137~0.806, *P*=0.015)。居住地与宫颈浸润癌的关联:不同模型中,居住于非富裕地区与宫颈浸润癌发生风险呈正相关(模型1:*OR*=1.960, 95%*CI*: 1.079~3.559, *P*=0.027;模型2:*OR*=1.981, 95%*CI*: 1.043~3.763, *P*=0.037;模型3:*OR*=1.920, 95%*CI*: 1.005~3.668, *P*=0.048),提示居住于非富裕地区是宫颈浸润癌的独立危险因素。家庭年收入与宫颈浸润癌未发现统计学关联,详见表4。模型3所有变量的VIF远低于10(范围:1.00~1.10),提示模型不存在显著多重共线性问题。调整模型3中的协变量BMI为吸烟史,敏感性分析结果显示,多数

表2 SES与宫颈上皮内瘤变之间的关联(*n*=287)

Table 2 Association between socioeconomic status (SES) and cervical intraepithelial neoplasia (*n*=287)

Variable	Model 1		Model 2		Model 3	
	OR (95%*CI*)	*P*	*OR* (95%*CI*)	*P*	*OR* (95%*CI*)	*P*
Education level (ref. Lower secondary or below)						
Upper secondary and above	0.449 (0.262—0.768)	0.004	0.519 (0.289—0.931)	0.028	0.475 (0.258—0.877)	0.017
Household income (ref. Low)						
High	0.669 (0.395—1.236)	0.219	0.760 (0.425—1.359)	0.354	0.748 (0.417—1.342)	0.331
Occupational income (ref. Low wage)						
High salary	0.629 (0.335—1.179)	0.148	0.678 (0.357—1.287)	0.235	0.702 (0.367—1.344)	0.286
Area-level economic development (ref. Affluent regions)						
Non-affluent regions	1.228 (0.719—2.095)	0.452	1.187 (0.686—2.053)	0.540	1.195 (0.688—2.076)	0.528

表3 SES与宫颈原位癌之间的关联(*n*=184)

Table 3 Association between SES and cervical carcinoma *in situ* (*n*=184)

Variable	Model 1		Model 2		Model 3	
	OR (95%*CI*)	*P*	*OR* (95%*CI*)	*P*	*OR* (95%*CI*)	*P*
Educational level (ref. Lower secondary or below)						
Upper secondary and above	0.576 (0.317—1.045)	0.070	0.601 (0.312—1.158)	0.128	0.626 (0.320—1.223)	0.170
Household income (ref. Low)						
High	0.877 (0.467—1.654)	0.682	0.966 (0.504—1.850)	0.916	0.930 (0.483—1.793)	0.829
Occupational income (ref. Low wage)						
High wage	0.566 (0.274—1.171)	0.125	0.614 (0.291—1.294)	0.199	0.617 (0.290—1.311)	0.209
Area-level economic development (ref. Affluent regions)						
Non-affluent regions	1.727 (0.952—3.132)	0.072	1.777 (0.974—3.239)	0.061	1.741 (0.950—3.192)	0.073

关联仍具有统计学意义。

2.5 敏感性分析:基于多项Logistic回归的稳健性检验

基于多项Logistic回归分析结果(表5),SES各维度与宫颈病变自然史的关联呈现如下特征:相对于高中及以上学历者,初中及以下学历女性发生宫颈上皮内瘤变的风险为2.063倍(95%*CI*:1.123~3.791,*P*=0.020),发生宫颈浸润癌的风险增加153.8%(*RRR*=2.538,95%*CI*:1.235~5.217,*P*=0.011),但与宫颈原位癌的关联无统计学意义(*RRR*=1.565,95%*CI*:0.799~3.062,*P*=0.191)。居住地因素显示,非富裕地区居民发生宫颈浸润癌的风险为富裕地区居民的1.952倍(95%*CI*:1.055~3.613,*P*=0.033),对宫颈原位癌呈现边缘性关联(*RRR*=1.706,95%*CI*:0.936~3.110,*P*=0.081),而与宫颈上皮内瘤变无显著关联(*P*=0.484)。收入指标中,低个人月工资与宫颈浸润癌的关联呈边缘显著性(*RRR*=2.230,95%*CI*:0.958~5.194,*P*=0.063),但对癌前病变阶段均无显著影响;低家庭年收入与病变各阶段的关联均未达统计学显著性。Wald检验显示,上述社会经济因素对癌变不同阶段的效应量差异均无统计学意义,提示SES对宫颈癌自然史连续谱的影响未观察到显著的阶段异质性。

3 讨论

本研究系统分析了4项核心SES指标与不同阶段宫颈病变风险的独立关联。发现教育水平是宫颈上皮内瘤变及宫颈浸润癌的关键保护因素,但与原位癌无显著关联;个人工资与居住地仅与宫颈浸润癌发生风险独立相关;而家庭收入在各级病变中均未显示统计学上显著影响。

3.1 教育水平是抵御各级宫颈病变的最稳定因素

本研究最突出的结论是,较高教育水平作为独立保护因素,可覆盖从癌前病变到浸润癌的整个宫颈病变进程,对宫颈上皮内瘤变与宫颈浸润癌均有显著保护作用。在调整了年龄、BMI与HPV疫苗接种状态后的模型3中,较高教育水平仍使宫颈上皮内瘤变风险显著降低52.5%,宫颈浸润癌发生风险显著降低63.9%。针对宫颈原位癌,虽未达统计学显著性,但仍

表4 SES与宫颈浸润癌之间的关联(*n*=185)

Table 4 Association between SES and invasive cervical cancer(*n*=185)

Variable	Model 1		Model 2		Model 3	
	OR(95%*CI*)	*P*	*OR*(95%*CI*)	*P*	*OR*(95%*CI*)	*P*
Education level(ref. Lower secondary or below)						
Upper secondary and above	0.235(0.123—0.448)	<0.001	0.331(0.165—0.665)	0.002	0.361(0.175—0.746)	0.006
Household income(ref. Low)						
High	0.726(0.383—1.374)	0.325	0.755(0.379—1.501)	0.422	0.747(0.373—1.498)	0.412
Occupational income(ref. Low wage)						
High salary	0.318(0.141—0.717)	0.006	0.321(0.135—0.766)	0.010	0.332(0.137—0.806)	0.015
Area-level economic development(ref. Affluent regions)						
Non-affluent regions	1.960(1.079—3.559)	0.027	1.981(1.043—3.763)	0.037	1.920(1.005—3.668)	0.048

表5 SES与宫颈癌及癌前病变关联的多项Logistic回归分析结果(*n*=508)

Table 5 Association between SES and cervical lesions by multinomial logistic regression analysis(*n*=508)

Variable	Cervical intraepithelial neoplasia		Cervical carcinoma in situ		Invasive cervical cancer	
	RRR(95%*CI*)	*P*	*RRR*(95%*CI*)	*P*	*RRR*(95%*CI*)	*P*
Education level(ref. Upper secondary and above)						
Lower secondary or below	2.063(1.123—3.791)	0.020	1.565(0.799—3.062)	0.191	2.538(1.235—5.217)	0.011
Household income(ref. High)						
Low	1.326(0.741—2.371)	0.342	1.078(0.569—2.045)	0.817	1.091(0.561—2.122)	0.798
Occupational income(ref. High wage)						
Low salary	1.429(0.747—2.732)	0.281	1.601(0.762—3.365)	0.214	2.230(0.958—5.194)	0.063
Area-level economic development(ref. Affluent regions)						
Non-affluent regions	1.213(0.706—2.085)	0.484	1.706(0.936—3.110)	0.081	1.952(1.055—3.613)	0.033

可观察到风险降低37.4%的趋势(*OR*=0.626)。

教育对宫颈浸润癌的保护作用与瑞典一项全国性队列研究结论高度一致[29],而教育对宫颈上皮内瘤变的防护效应与教育水平差异导致的HPV认知及预防行为差异相吻合,共同印证了教育作为核心健康资本的重要价值。其机制在于,教育程度的提升可直接强化个体健康素养,促使女性更主动地进行HPV疫苗接种、定期宫颈筛查等宫颈癌预防措施,同时养成更健康的生活行为习惯[30-31]。因此,针对低教育水平女性群体开展精准化、通俗化的宫颈癌防治知识宣教,具有极高成本效益比。

3.2 居住地经济水平与个人收入是宫颈浸润癌的特定危险因素

较低的个人工资与居住于非富裕地区是宫颈浸润癌的独立危险因素,但对癌前病变的影响相对有限。具体而言,在宫颈浸润癌患者中,非富裕地区女性的宫颈浸润癌发生风险是富裕地区的1.920倍,高工资使宫颈浸润癌风险降低66.8%。然而,在宫颈上皮内瘤变与原位癌阶段,与居住地经济水平和个人收入均无显著统计学关联。这表明,社会经济层面的劣势影响在病变进展至浸润癌时影响才尤为凸显,可能与晚期诊断、治疗及时性差及生存率较低密切相关[32-33]。这提示,在推进"消除宫颈癌"行动中,必须加大医疗资源向非富裕地区倾斜,而且应重点保障低收入职业女性的宫颈筛查覆盖范围与治疗可及性,以阻断癌前病变向晚期癌症的进展。

尽管个人工资水平与浸润癌风险显著相关,家庭年收入(高*vs*低)却未显示出统计学关联。这提示女性个体可支配的经济资源比家庭总体收入更能反映其健康投资能力。

3.3 原位癌作为过渡期的特殊表现:社会经济差异的"筛查窗口"效应

本研究发现SES与宫颈病变进展呈非线性关联:教育水平从宫颈上皮内瘤变的显著保护(*OR*=0.475,*P*=0.017)减弱至原位癌的边缘关联(*OR*=0.626,*P*=0.170),再强化至浸润癌的强保护(*OR*=0.361,*P*=0.006);职业收入与居住地经济水平亦仅在浸润癌阶段显现显著关联。这种"宫颈上皮内瘤变显著-原位癌不显著-浸润癌显著"的"中间塌陷"模式,反映了宫颈原位癌(CIN Ⅲ)作为疫苗和筛查敏感型病变的特殊流行病学特征。

CIN Ⅲ的生物学特性决定了其易感性差异易被筛查行为掩盖。美国CDC监测数据显示,2008—2022年间CIN Ⅲ发病率在20~24岁女性中下降80%,25~29岁下降37%,且下降幅度显著大于CIN Ⅱ,提示CIN Ⅲ主要由HPV16/18引起,对疫苗预防和筛查检出最为敏感[34]。在资源可及的情况下,高SES女性通过高接种率和高筛查依从性已被"过度保护";相反,低SES女性的CIN Ⅲ可能因筛查不足而未能被及时发现,直接进入浸润癌阶段(症状期)。表1清晰印证了这一选择偏倚:原位癌组中高教育比例(39.1%)反常地高于发育不良组(33.3%),接近非病变对照组水平(52.7%),不符合"病变严重程度与SES负相关"的生物学梯度。

原位癌作为"筛查窗口期"病变,其病例组成混杂了"过度诊断"与"真实风险"。高SES女性的原位癌多为筛查检出的、在癌前阶段即被筛查阻断的HPV16/18相关病变(符合疫苗普及后CIN Ⅲ患病率显著下降的流行病学特征)[35];而低SES女性若未进入筛查系统,其CIN Ⅲ可能快速进展为浸润癌,导致原位癌病例组中低SES人群代表性不足。相比之下,浸润癌多因症状就诊,较少受筛查行为干扰,故能呈现更纯粹的SES梯度(教育低水平79.3%,收入低水平90.1%)。这一发现提示,当CIN Ⅲ可通过疫苗和筛查被广泛"消除"时,浸润癌的SES不平等反而更能反映真实的医疗资源可及性差异。

3.4 宫颈癌防治措施建议

世界卫生组织2020年发布《加速消除宫颈癌全球战略》,确立2030年"90-70-90"目标:90%女孩15岁前完成HPV疫苗接种,70%女性35岁及45岁前接受高质量筛查,90%确诊患者获得规范治疗[36]。结合本研究结果建议:① 将筛查整合至基层计划生育与初级保健体系,在非富裕地区基层医疗机构(乡镇卫生院、社区卫生服务中心)建立计划生育-宫颈癌筛查整合服务点,利用现有计划生育登记系统识别适龄女性,避免单独建立筛查体系造成的地理可及性壁垒[37];② 实施数据驱动的瓶颈分析与微干预,在低SES地区医疗机构部署级联分析工具,每月识别筛查流程中的具体瓶颈(如人员培训不足、客户拒绝等);针对识别出的瓶颈实施本地化微干预:开展医护人员宫颈癌筛查技能培训、通过健康讲座和社区健康志愿者动员客户;③ 强化社区动员与家庭参与,针对低教育水平家庭存在的"疫苗安全性顾虑"及"无症状即无风险"认知,开展"面对面健康讲座+社区健康志愿者上门动员"的组合干预;在非富裕地区中学设置流动接种点时,需配合针对低教育水平家长的小组讨论式教育,而非单向信息传递,确保15岁前接种率达标[38]。

本项研究的局限性在于:① 选择偏倚,本研究对照来源于因妇科症状或体检就诊并经筛查证实无宫

颈病变的医院人群,而非社区来源的健康女性。由于病例与对照均来自同一医院来源,无法代表产生病例的源人群,SES可能与就医行为及入院概率相关,导致关联强度估计偏离真实值,未来研究应采用以人群为基础的病例对照设计或前瞻性队列研究以验证本结论。② 信息偏倚,社会经济地位指标(如既往收入、居住地变迁)通过问卷调查获取,可能存在回忆不准确或社会期望应答,导致暴露分类错误,我们已进行多种敏感性分析验证结果的可靠性。

综上所述,本研究证实,即使在调整HPV疫苗接种等关键混杂因素后,较低教育水平仍是宫颈上皮内瘤及浸润癌的主要风险标志较低,个人月工资水平及居住于非富裕地区则主要与宫颈癌相关。临床及公共卫生实践中,应优先针对低教育水平、低收入及非富裕地区女性开展筛查宣传与组织工作,将社会经济风险评估纳入基层宫颈健康管理体系,更早识别高危个体,优化防控资源分配,为实现精准消除宫颈癌的目标提供可行路径。

利益冲突 本文所有作者声明不存在利益冲突

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