27 (2022) 200143

Contents lists available at ScienceDirect

Human Nutrition & Metabolism

journal homepage: www.sciencedirect.com/journal/human-nutrition-and-metabolism

Assessing association between paternal smoking status and child malnutrition in Albania: An application of ordinal regression model

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ARTICLE INFO

Keywords:
Paternal smoking
Malnutrition
Albania

ABSTRACT

Background: In this study, an attempt has been made to seek out the impact of paternal smoking status over child malnutrition in Albania.

Methods: For analysis purposes, data were extracted from Albania Demographic and Health Survey (ADHS), 2017/18. The bivariate analysis set up with chi-square test as well as gamma measure were performed to examine the association between child malnutrition and selected covariates. To measure the consequence of paternal smoking status on malnutrition, two different ordinal regression models (Model I: considering only one covariate such as father's smoking status, Model II: covariates of the model I along with demographic and clinical variables) were considered.

Results: Father's smoking status was found to be strongly associated with the increased risk of child malnutrition in Albania and it was statistically significant in both regression models. After controlling all of our demographic and clinical variables, the odds ratio for a smoker father compared to a non-smoker father was 1.109 with 95% confidence interval (1.114, 1.472) for child malnutrition.

Conclusion: This study provides strong evidence for an adverse relationship between father's smoking status and child malnutrition in Albania. Implementing and enforcing several policies such as significant taxes escalation on cigarettes, promoting cessation for the health care system, and implementation of clean indoor air laws would not only reduce the current smoking rates but also smoking prevalence by raising awareness among the young Albanian generation.

1. Introduction

Every year almost 5 million people are dying because of smoking habits and it is predicted that death numbers will be doubled by 2023 and approximately 70% of those deaths will be occurred among the developing countries [1,2]. It is well established that smoking is hazardous for our respiratory system [3] and it escalated the risk of lung cancer as well as bronchitis [1]. The lack of consciousness about the underlying risk related to smoking and actions taken by the corresponding government lead to increase of smokers in poor economic countries. Most of the tobacco companies increased the business to low-income countries because of more profit as well as growing smoking frequency [2]. Some of the research work already sought out the relationship between smoking with the respiratory system, lung cancer, and even cardiovascular diseases [2]. It may consider tobacco have an adverse impact on health and nutrition over families living under poverty in developing countries.

The rate of smoking escalated poverty due to the deduction of money from basic needs of households [4,5]. Research work in Vietnam showed that on average, individuals spent 49.05 USD beyond the annual cigarettes consumption, which is one and half times to education but 5 times for health spending and equal to 33% of yearly food consumption [4].

The scenario of the prevalence of smoking was identified from statistical analysis in Albania. From 1996 to 2000, a study revealed an annual increase of 56% in cigarettes sales [6]. The Albanian health ministry showed an alarming picture of sales from 2000 to 2006 (about 75% of the increase), a massive shift from USD 1056 to 1841 [6]. In 1999, the Economic Research Service calculated USD 2150 consumption beyond cigarettes [7].

It is usual to think that smoking increases poverty in low-income

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https://doi.org/10.1016/j.hnm.2022.200143
Received 22 June 2021; Received in revised form 10 January 2022; Accepted 31 January 2022
Available online 5 February 2022

countries, but it is still not clear about smoking's contribution to malnutrition among under 5 children. We are assuming that a smoker father causes a higher risk of under 5 malnutrition compared to a non-smoker father. Our current research makes an attempt to examine the above hypothesis by applying an ordinal regression model to uncover the actual relationship between smoking and malnutrition among children in Albania.

2. Materials and methods

2.1. Data and variables

For our current research, we have used the Albanian Demographic and Health Survey (ADHS), 2017–2018 data, and our variables were collected from that representative national survey. The ADHS 2017-18 survey was conducted by the Public Health Institute, National Institute of Statistics under Health and Social Protection Ministry of Albania. The funding for ADHS was obtained from Swiss Agency for Development and Cooperation, United Nations, UNICEF, and the United Nations Entity for Gender Equality and the Empowerment of Women with the technical support from ICF. The ADHS surveys were conducted both in rural and urban areas and it used stratified (two stages) cluster sampling for households. For each prefecture on urban as well as rural areas were obtained through stratification [8]. Due to the collection of samples from a finite population, the estimation procedure and testing of the data needed suitable sampling weights adjustment. In our present study, we have used suitable weights for sampling due to the validity and statistical inferences.

In previous studies, 3 different anthropometric indices of physical growth were needed for children nutritional status: height-for-age (stunting), weight-for-height (wasting), weight-for-age (underweight). But the second index is the amalgamation of other two indices [9]. We have used only last case for measuring nutrition status of under-5 children in Albania.

For sought out children nutritional status, initially we have calculated the weight-for-age Z scores (WAZ) by the WHO AnthroPlus Software (version 3.2.2, 2011) [10]. Using WAZ, the nutritional status of children was divided into three ordinal categories and created our main outcome variable:

$$Nutrition\ status = \begin{cases} 1,\ severely\ ma\ln ourished(<-3.0\ WAZ) \\ 2, \mathrm{mod}erately\ ma\ln ourished\ (-3.0\ to-2.0\ WAZ) \\ 3,\ nourished\ (\geq 2.01\ WAZ) \end{cases}$$

Deleting all the missing observations as well as necessary adjustment, we have deal with 2237 (weighted) children nutritional status available for analysis and considered it as our outcome variable.

For our study, number of covariates were used and they are father's smoking status (yes, no), children age with 3 categories (0–11 month, 12–23 month, 24^{+} month), education of mother's and father's with 3 categories (primary or no education, secondary, and higher secondary education), wealth index (WI), place of residence categorized as rural and urban, birth interval (less than 2 years, 2–4 years, 4^{+} years) expressed in months, body mass index (BMI) of the mother's with categories (thin considered for BMI less than 18.5, for 18.5 to 24.9 BMI considered normal, for 24.9^{+} considered over-weight). These covariates were found to be significant factors for child malnutrition in other previous studies [9,11,12].

2.2. Ordinal regression model

For subject i, let Y_i $(i = 1, 2, \ldots, n$ is our outcome variable, which is ordinal with categories $1, \ldots, j, \ldots, c$ and $x_i = (x_{i1}, x_{i2}, \ldots, x_{ik})'$ is the column vector of k covariates values. Theform of our ordinal regression model can be expressed as mathematically [13].

$$\log it[P(Y_i \leq j)] = \alpha_j + \beta' x_i\ for\ j = 1, 2, \ldots, c-1$$

In the above equation, $\log it[P(Y_i \leq j)] = \log[P(Y_i \leq j))/(1 - P(Y_i \leq j)]$

2.3. Statistical analysis

We have performed bivariate and multivariate analysis to assess the association between our covariates and outcome variable nutritional status, which is ordinal. We have used gamma measure [14] for ordinal scale covariates, while chi-square is for nominal scale. The expression for gamma measure is as follows,

$$\widehat{y} = \frac{C_T - D_T}{C_T + D_T}$$

where C_T and D_T are the aggregate of concordant and discordant pairs respectively. The expression for chi-square is,

$$\chi^2 = \sum_{j=1}^{n} \frac{(O_j - E_j)^2}{E_j}$$

where, O_j is the observed and E_j is the expected cell frequency. The test statistic follows a chi-square distribution with (p-1) (q-1), where, p is the number of categories of the covariates and q is our response variable.

The main interest of our current research is to seek out the association between father's smoking status with our outcome variable malnutrition status of children. We have used two models for our main analysis and they are Model I: father's smoking status used as only covariate; Model II: with model I, we have added demographic and efficient variables (age of children, education of father's and mother's, wealth and body mass index (mother), and place of residence) for finding contribution of smoking by controlling all demographical and clinical covariates.

3. Results

3.1. Bivariate analysis

The outputs of our bivariate analysis are presented in Table 1. The result of our analysis (from Table 1) showed a significance association among age of children, father's and mother's education, birth interval, wealth index (WI), and mother's body mass index with our outcome variable nutritional status of children. From our gamma estimation, it can be said that we have a weak positive relationship for the variables father's and mother's education, wealth index, birth interval and mother's BMI but a weak negative relationship with children age to our outcome variable and the results are statistically significant. So, for the increase of variables father's and mother's education, wealth index, birth interval and mother's BMI observations (children) belong to the "nourished" category of our child's nutritional status variable. But for the increase in child's age, individuals are tended to fall into the "malnourished" category of child's nutritional status. The proportion of severely malnourished and moderately malnourished children were found higher between the children having smoker father (10.63% and 29.78%, respectively) as well as living in the rural area (8.7% and 26.5%, respectively. All these selected covariates were found significantly related to the nutritional health status of children. ($p < 0.05$).

3.2. Regression analysis

The main intent of this study was to assess the link between father's smoking status and child malnutrition in Albania. We have used two ordinal regression models and the parameter estimates of these two models are shown in Table 2. In Model I, only one covariate (father's smoking status) was considered to measure the unadjusted effects of

Table 1
Assessing the association between selected covariates and nutrition status of under-five children using gamma measure and chi-square test.

Covariates	Measurement scale	Nutrition status			$\hat{y}$ (p-value)	χ^2 (p-value)
		SeverelyMalnourished n (%)	ModeratelyMalnourished n (%)	Nourishedn (%)		
Father's smoking status	Nominal					
No		157 (7.84)	492 (24.58)	1352 (67.58)		6.289
Yes		25 (10.63)	70 (29.78)	140 (59.59)		(0.043)
Child's age (months)	Ordinal					
0-11		20 (4.6)	64 (14.7)	350 (80.6)	−0.222	
12-23		48 (10.4)	106 (23.0)	307 (66.6)	(0.000)	
24+		107 (8.0)	390 (29.1)	845 (63.0)		
Father's Education	Ordinal					
No or primary		130 (11.4)	346 (30.4)	664 (58.2)	0.360	
Secondary		39 (5.0)	157 (20.3)	579 (74.7)	(0.000)	
Above secondary		06 (1.9)	57 (17.8)	257 (80.3)		
Mother's Education	Ordinal					
No or primary		100 (11.2)	278 (31.2)	513 (57.6)	0.310	
Secondary		70 (6.3)	239 (21.5)	803 (72.2)	(0.000)	
Above secondary		05 (2.1)	43 (18.4)	186 (79.5)		
Wealth Index	Ordinal					
Poor		99 (14.9)	207 (31.1)	359 (54.0)	0.349	
Middle		51 (6.4)	210 (26.3)	538 (67.3)	(0.000)	
Rich		25 (3.2)	143 (18.5)	605 (78.3)		
Place of Residence	Nominal					
Urban		39 (5.9)	144 (21.6)	483 (72.5)		13.188
Rural		136 (8.7)	416 (26.5)	1019 (64.9)		(0.001)
Birth interval (months)	Ordinal					
< 24		117 (8.1)	391 (26.9)	944 (65.0)	0.117	
24-48		40 (7.7)	114 (22.0)	365 (70.3)	(0.004)	
48+		13 (5.6)	51 (22.0)	168 (72.4)		
Mother's BMI	Ordinal					
Thin		56 (12.0)	156 (33.3)	256 (54.7)	0.294	
Normal		100 (7.8)	314 (24.5)	868 (67.7)	(0.000)	
Overweight		18 (3.8)	85 (17.7)	376 (78.5)		

smoking. It can be revealed that the variable had significant ($p < 0.01$) effect on our outcome variable nutritional status of children. The odds children belonging to nutritional status (severely and moderately malnourished) is $[(1.128-1) \times 100] = 13\%$ higher for the children having smoker father compared to the children whose father is a non-smoker. Besides this covariate, we subsume several demographic and clinical covariates into Model II (see Table 2). From this model it is observed that the effect of father's smoking status on child malnutrition is still significant ($p < 0.05$) and it can be said that father's smoking status is an important factor for child malnutrition in Albania due to statistically significant even after controlling the demographic as well as clinical variables.

It is also conclusive from Model II that the odds of staying severely and moderately malnourished category of child's nutrition status is more than double for the children belonging to age group 12–23 months ($OR = 2.216$, $p < 0.001$) and above 24 months ($OR = 2.425$, $p < 0.001$), compared to infants. This odds is significantly lower for higher educated fathers ($OR = 0.788$, $p < 0.001$), higher educated mothers ($OR = 0.597$, $p < 0.001$), coming from middle ($OR = 0.638$, $p < 0.001$) and rich ($OR = 0.406$, $p < 0.001$) income family, having normal ($OR = 0.656$, $p < 0.001$) and over weighted ($OR = 0.475$, $p < 0.001$) mother. However, residential status ($OR = 1.025$, $p > 0.05$) and birth interval ($OR = 0.841$, $p > 0.05$ for $24-48$ months and $OR = 0.786$ for above 48 months) were found to have no significant effect on child malnutrition in this study.

4. Discussion

Our study clearly sought out that parental smoking status is highly associated with an increased risk of malnutrition in children aged 0–59 months in Albania. Form a research work in Indonesia over poor households living in urban areas showed a positive association between fathers' smoking habits with children risk of malnutrition [15]. The study also revealed that the smoking prevalence is almost 74%, which is related to escalation of stunning risk as well as acute wasting for children. Another research work was held in India over 92,486 households (National Family Health Survey II study) indicated same conclusion of our current study [16]. This type of relation is realistic because the household having smoker father, spent a significant proportion of their income on cigarette consumption. As a result, they fail to provide enough nutritious food to the early age of their children and in the long run, their newly born babies suffer from nutrition deficiency.

The consequences of child malnutrition have huge impact on schooling, reduction of adult as well as capable workers [15]. The scenario of the low-income families in Albania is getting worse because of balanced child food and more spending for buying cigarettes. Smoking is enhancing malnutrition among children in the low-income family as well as rising poverty [17] and this impact will have a long-term consequences for the well-being of upcoming generations in Albania.

Not only the smoking status of fathers but also our ordinal regression analyses of large databases (2237 individuals) have shown that age of children, father's and mother's education level wealth index, and mother's BMI are significantly associated with the child malnutrition status. However, our study found that place of residence and birth interval are insignificant to the child malnutrition in Albania.

The huge proportion of smokers in Albania strongly suggested taking effective precautions for the existence of their future generations. Due to the bad impact of smoking on child malnutrition, control over tobacco use may improve the health conditions such as cancer, cardiovascular disease, and respiratory system, as well as reduction of poverty, lead to improve child malnutrition. The good thing is the recent policy taken by the republican government of Albania and it should be implemented strictly to reduce the negative health outcomes as well as poverty.

In conclusion, the analysis from a large nationally representative population from Albania provides strong evidence for an adverse relationship between a father's smoking status and child malnutrition. These findings indicate that to reduce malnutrition, first, it is necessary to reduce the smoking rate. From our study we recommended that

Table 2
Ordinal regression coefficient (Reg. Coef.) and odds ratio (OR) with 95% confidence interval (95% CI) of selected covariates for nutrition status of under-five children in Albania.

Covariates	Model I		Model II	
	Reg. Coef.	OR (95%) CI	Reg. Coef.	OR (95%) CI
Intercept (α_1)	−2.463	-	−1.142	-
Intercept (α_2)	−0.711	-	−0.644	-
Father's smoking status				
No (ref)	-	-	-	-
Yes	0.121	1.128 (1.133, 1.425)**	0.104	1.109 (1.114, 1.472)*
Child's age (months)				
0–11 (ref)			-	-
12-23			0.796	2.216 (1.442, 2.325)***
24+			0.886	2.425 (1.432, 2.278)***
Father's Education				
No or primary (ref)			-	-
Secondary			−0.210	0.810 (0.742, 1.113)
Above secondary			−0.237	0.788 (0.753, 0.926)***
Mother's Education				
No or primary (ref)			-	-
Secondary			−0.401	0.669 (0.656, 1.024)
Above secondary			−0.514	0.597 (0.742, 0.942)***
Wealth Index				
Poor (ref)			-	-
Middle			−0.448	0.638 (0.652, 0.874)***
Rich			−0.898	0.406 (0.563, 0.823)***
Place of Residence				
Urban (ref)			–	–
Rural			0.225	1.025 (0.837, 1.514)
Birth interval (months)				
< 24 (ref)			–	–
24-48			−0.172	0.841 (0.952, 1.321)
48+			−0.240	0.786 (0.852, 1.224)
Mother's BMI				
Thin (ref)			-	-
Normal			−0.421	0.656 (0.458, 0.688)***
Overweight			−0.743	0.475 (0.265, 0.443)***

Note: ***p value < 0.001, **p value < 0.01, *p value < 0.05; ref: reference category.

effective actions should be taken immediately such as reduction of smoking rates, rising the taxes over cigarettes, banning public places smoking as well as smoking in the indoor environment. Routine screening for parental tobacco use using a document sheet prepared by the health professionals will be an effective intervention. Based on the record, several motivational messages should be delivered by the child's health care provider, so that the parents become alert about their child's health. Finally, social awareness should be risen among the general people to reduce adverse health outcomes as well as the existence of future generations.

Author contributions

Ashis Talukder: Conceptualization, Data curation, Methodology, Writing-original draft, Formal Analysis, Supervising, Writing-review & editing. **Muhammad Mahmudul Hasan:** Methodology, Writing-original draft, Writing-review & editing. **Asikunnaby:** Writing-original draft, Writing-review & editing.

Funding

No financial support for the research, authorship, and/or publication of this article.

Competing interests

The authors declared no personal or financial conflicts of interest.

Availability of data and materials

The secondary datasets ADHS 2017/18 are freely available in the following website:http://dhsprogram.com/data/available-datasets.cfm.

Ethical approval

This study conducted the analyses using publicly available ADHS data from demographic health surveys. The ADHS was approved by the Institute of Public Health (IPH) and the Institute of Statistics (INSTAT). ICF Macro Institutional Review Board in Calverton, Maryland, USA also provided partial technical assistance to approve the project. The written consent form was taken from all survey participants. So, in this study, additional ethical approval was not necessary as the analysis was based on secondary data.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Centers for Disease Control and Prevention, Use of cigarettes and other tobacco products among students aged 13–15 years – worldwide, 1999–2005, MMWR Morb. Mortal. Weekly Rep. 55 (2006) 553–556.
[2] J. de Beyer, L.W. Brigden (Eds.), Tobacco Control Policy: Strategies, Successes, and Setbacks, The World Bank and Research for International Tobacco Control, Washington, DC, 2003.
[3] M.C. Aubry, J.L. Wright, J.L. Myers, The pathology of smoking related lung diseases, Clin. Chest Med. 21 (2000) 11–35.
[4] C.N.H. Jenkins, P.X. Dai, D.H. Ngoc, H.V. Kinh, T.T. Hoang, S. Bales, et al., Tobacco use in Vietnam: prevalence, predictors, and the role of the transnational tobacco corporations, J. Am. Med. Assoc. 227 (1997) 1726–1731.
[5] D. Efroymson, S. Ahmed, J. Townsend, S.M. Alam, A.R. Dey, R. Saha, et al., Hungry for tobacco: an analysis of the economic impact of tobacco consumption on the poor in Bangladesh, Tobac. Control 10 (2001) 212–217.
[6] O. Shafey, S. Dolwick, G.E. Guindon (Eds.), Tobacco Control: Country Profiles, second ed., American Cancer Society, Atlanta, 2003.
[7] The World Bank, Albania health sector note. Report No. 32612-AL [homepage on the Internet], [cited 2008 Feb 26]. Available from: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/04/26/000160016_20060426172842/Rendered/PDF/32612.pdf, February 2006.
[8] Institute of Statistics, Institute of Public Health, ICF, Albania Demographic and Health Survey 2017-18, Institute of Statistics, Institute of Public Health, and ICF, Tirana, Albania, 2018.
[9] S. Das, R.M. Rahman, Application of ordinal logistic regression analysis in determining risk factors of child malnutrition in Bangladesh, Nutr. J. 10 (2011) 124.
[10] World Health Organization, Anthro for Personal Computers, Software for Assessing Growth and Development of the World'S Children, Version 3.2.2, World Health Organization, Geneva, Switzerland, 2011, 2011, Availableonline: http://www.who.int/childgrowth/software/en/. (Accessed 30 June 2017).
[11] A. Talukder, Factors associated with malnutrition among under-five children: illustration using Bangladesh demographic and health survey, 2014 data, Children 4 (2017) 10, https://doi.org/10.3390/children4100088.
[12] S. Das, J. Gulshan, Different forms of malnutrition among under five children in Bangladesh: a cross sectional study on prevalence and determinants, BMC Nutr. 3 (2017) 1.

[13] A. Agresti, Analysis of Ordinal Categorical Data, John Wiley & Sons, Inc., Hoboken, NJ, USA, 2010.
[14] L.A. Goodman, W.H. Kruskal, Measures of association for cross classifications, J. Am. Stat. Assoc. 49 (1954) 732–764.
[15] M. de Onis, Child growth and development, in: R.D. Semba, M.W. Bloem (Eds.), Nutrition and Health in Developing Countries, Humana Press, Totowa, NJ, 2001, pp. 71–91.
[16] S. Bonu, M. Rani, P. Jha, D.H. Peters, S.N. Nguyen, Household tobacco and alcohol use, and child health: an exploratory study from India, Health Pol. 70 (2004) 67–83.
[17] J. de Beyer, C. Lovelace, A. Yürekli, Poverty and tobacco, Tobac. Control 10 (2001) 210–211.