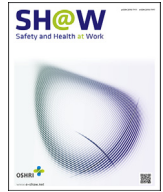




Contents lists available at ScienceDirect

Safety and Health at Work

journal homepage: www.e-shaw.net

Original Article

How the Bidi Tobacco Industry Harms Child-workers: Results From a Walk-through and Quantitative Survey



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ARTICLE INFO

Article history:

Received 10 June 2019

Received in revised form

14 February 2020

Accepted 25 February 2020

Available online 5 March 2020

Keywords:

Child

Child health

Child-workers

ABSTRACT

Objective: Bidi is an inexpensive, low-processed, hand-rolled tobacco product. In Bangladesh, especially in Rangpur, tobacco farming and bidi processing are common. In this study, we aimed to evaluate the impact of bidi making on children working in bidi factories.

Methods: This qualitative (walk-through survey) and quantitative (questionnaire-based survey and a urine cotinine level quantitation) study was conducted in Rangpur, Bangladesh in 2017. Study population included child-workers aged ≤ 14 years who were regularly employed as bidi makers.

Findings: The results of the walk-through survey revealed hazardous working environments at bidi factories. For the quantitative survey, 171 child-workers were categorized into “less-working” (<5 hours/day) and “more-working” (≥ 5 hours/day) groups; additionally, “forced-working” (forced into work by parents) and “voluntary-working” (working voluntarily) groups were delineated within the same population. In the logistic regression analysis, odds ratios (ORs) of respiratory symptoms and unusual absence (absent ≥ 5 days/month) were higher in the “more-working” group than in the “less-working” group (unusual absence: OR, 2.91; 95% confidence interval [CI], 1.43–5.94), and this association became higher in the “forced-working” group with longer working hours (OR, 5.68, 95%CI 2.30–14.00).

Conclusions: Cheap, hand-rolled tobacco (bidi) is harmful to the health of bidi-making child-workers. Children in poverty bow to the demands of cheap labor and poverty and jeopardize their health and future prospects by working in bidi factories. Tobacco control policies should consider the social effects of tobacco beyond its biological effects.

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1. Introduction

Bidi is a hand-rolled tobacco product that is inexpensive [1], less-processed, but more harmful [2,3], and it is smoked widely in Bangladesh and other countries in South Asia [4]. Furthermore, bidi smoking is common among young adults [3] because of its accessibility and low cost [5]. Previous studies have investigated the health of workers in the bidi industries. In addition to adults, more than 300,000 children work in bidi factories in India [6]. However, information about these child workers is extremely limited.

Although several newspapers have reported about child labor in bidi factories, research articles are not available. In 2011, Roy et al [7] qualitatively reported that improper ventilation and abundant dust in workplaces caused nausea and vomiting among

researchers. In 2014, an oral health study of bidi workers in Bangladesh was conducted. However, information about the age of the workers was not provided [8]. Moreover, a study of tobacco farm workers aged >20 years was conducted in Bangladesh [9].

During the process of making bidi, the workers are inevitably exposed to tobacco powder through their bare skin and respiratory tracts. Cutaneous exposure to tobacco could impair wound healing [10], and this kind of environmental exposure to tobacco smoking increases the risk of genotoxicity [11]. Previous studies have focused on biological monitoring and health effects among workers in the bidi industry. However, the number of studies conducted on adult workers is limited [12]. Thus, a walk-through survey must be conducted to evaluate and identify the status of child labor in bidi factories in Bangladesh.

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Moreover, not only tobacco exposure but also child labor can be harmful to children's health. A well-designed cross-country data analysis has shown that the prevalence of child labor is correlated to the mortality rate of adolescents ($R^2 = 0.78$) [13]. A Brazilian cohort study that investigated the long-term health effects of child labor on adulthood [14] showed that getting a first job at a young age directly worsens health conditions during adulthood and indirectly results in a low education level. Hence, educational and physical health factors should be evaluated when investigating child labor.

Herein, qualitative (walk-through survey) and quantitative (questionnaire-based survey and urinary cotinine test) studies of child labor in bidi factories were conducted. We assessed the cultural and social factors that led to child labor in tobacco factories and hypothesized that children who work longer hours in factories have more subjective symptoms and lower levels of education. The results of the present study can raise social awareness regarding child labor and can establish a cornerstone for initiating changes in the social and cultural roles of children.

2. Materials and methods

This study used qualitative and quantitative methods. The qualitative study was conducted via a walk-through survey for the conceptualization of a subsequent quantitative study that included a questionnaire-based survey and urine cotinine examination. This study was reviewed and approved by the institutional review board (IRB) of Rajshahi University (IRB number: 89/320/IAMEBBC/IBSC, 2017), and all participants and their parents provided informed consent.

2.1. Walk-through study

To identify the causes of child labor in the tobacco industry, a walk-through study was performed. Three Korean and two Bangladeshi researchers visited the field site in Rangpur district (northern Bangladesh) for 2 days in May 2017. There were several bidi factories in Rangpur district, and various products are available in different factories. Moreover, the steps in bidi processing varied between factories. That is, some factories process harvested tobacco leaves into tobacco powder, and some process the papers. Meanwhile, others assemble bidi cigarettes, which is the final product.

In brief, the steps involved in bidi processing in Rangpur include the following: (1) farming and harvesting tobacco leaves; (2) producing tobacco powder; (3) cutting large papers into card-sized pieces; (4) rolling the paper; and (5) pouring tobacco powders, closing the bidi cigarettes, and placing them inside the packages. These various processes are performed in factories in the whole district of Rangpur, and most factories have no presence on the Internet. Moreover, several factories did not have any signs on their buildings, and the border of the bidi industrial area, where factories are located, is not appropriately identified. Therefore, the search for bidi factories was difficult, and finding bidi factories with child workers was even more challenging without the help of local habitants or officers. Thus, we had to contact these people before our visit and convince them to provide assistance. One of our researchers in Bangladesh had communicated with a local manager who could contact the factories before our visit. It was hard to obtain permission to visit the factories because child labor is not officially permitted by the government. However, we obtained approval from two factories.

Home visits and observing in-home bidi making were not part of the original plan because we only wanted to visit factories on the first day. However, it was a temporal holiday, and all factories were

shut down that day. Thus, people were not working in the factory, and only few managers were present. Moreover, one of the factory managers recommended visiting local villages and houses where we could meet child workers. Hence, we visited two houses in the local villages and were able to observe in-home bidi making.

On the second day, we met child workers in the bidi factories. The factory managers maintained a short distance from us during our visit, and we were not allowed to take photos of child workers as much as we wanted. Moreover, the factory managers themselves were reluctant to take photos or record videos. Therefore, electronic recording was not performed inside the factory. We had to recall all the data obtained during the interview, which included what we saw and heard in the factory, and wrote them down after exiting the factories. Then, we discussed and shared our written records every evening to obtain the best information that could be used. Using such data, the process of bidi making from the initial handling of raw materials to the packaging of final products was cautiously reviewed.

2.2. Quantitative survey

A few weeks after our short field trip, we distributed the questionnaires to investigate the health status of child workers in bidi factories. After completing the questionnaires, we sent them to Bangladesh to start the investigation. The questionnaire regarding demographic characteristics, job-related characteristics, educational determinants and backgrounds, as well as subjective perceptions about the health-related impacts of tobacco was established via a consensus decision. In addition, subjective symptoms and urinary cotinine levels were examined.

To recruit the study participants, Bangladeshi researchers and trained survey staff visited the factories from June to July 2017. The researchers visited the factories where the interviews were conducted because the other factories were not cooperative. The researchers explained and directly provided general information about our study to the children. Younger child workers usually worked in the factory with their guardians, such as parents or older siblings. The guardians agreed and allowed the child workers to participate in our study. The participants were not randomly sampled. However, they were eager to answer the survey questions and underwent the urine cotinine stick test. Moreover, child workers with family members who were not smokers were recruited.

The inclusion criterion was a child worker whose minimum age was in accordance with the convention as per the International Labour Organization (ILO; (1973). Accordingly, in areas with underdeveloped economies and educational facilities, the minimum age for admission to employment is 14 years [15–17]. In total, 198 participants were recruited after providing informed consent and participating in the survey. However, 27 participants aged >14 years and children with family members who were active smokers were excluded. Finally, 171 participants were included.

The daily working hours of the participants was investigated using the open question "How many hours do you usually spend in making bidis in a day?" and the participants were also asked about their reason for working, which were as follows: "have to earn money for living," "no guardians," "compelled by parents," and "have nothing else to do."

Similarly, we added the question "How many hours do you usually spend in the bidi factory?" During our field trip, we saw children playing at the factory because they had no work or they had already achieved their quota. Instead of leaving the factory, these children stayed at the factory and played near their friends or guardians. Either working or not working in the factory could expose children to environmental tobacco smoke. Thus, we added a

question about accurate working hours and hours spent in the factory. Hence, working hours include working hours at home and in the factory. Meanwhile, hours spent in the factory include working and playing hours in the factory.

The participants were categorized into the less- and more-working groups based on daily working hours (4 hours/d). That is, in all participants, the median value of daily working hours was 4 hours/d. Participants who had a specific reason for working, including forced by their parents or had to generate income, were classified under the forced-working group, whereas others were categorized under the voluntary-working group. Subjective health complaints were investigated and categorized as respiratory symptoms (cough, sputum, sneezing, runny nose, dyspnea, wheezing, and sore throat), musculoskeletal symptoms (back pain and pain in the neck and/or shoulder, arms, and legs), psychological symptoms (depression, anxiety, and insomnia), and neurological symptoms (headache, eyestrain, and dizziness). The exact question in the questionnaire is “Within the last week, did you experience any symptom that bothers you?” The symptoms were presented with a checkbox, and an empty space for writing down what they wanted was also provided. Children had multiple choices for this question.

The question “How many days were you absent from school within the last month?” was used, and an absence ≥ 5 days in a month was defined as frequent absence. The participants who completed the questionnaire underwent urine stick sampling for the assessment of urinary cotinine levels. NicoTests for Safe Kids (5 ng/mL cutoff; USHealthTests, Albany, NY, USA) was used to determine the presence of cotinine in the urine.

Even children or adolescents who are exposed to second-hand smoking have urinary cotinine levels < 5 ng/mL [18–20]. Thus, a cutoff level of 5 ng/mL may be a good indicator of nicotine exposure during bidi making.

Descriptive analyses were performed using Chi-square test and two-way *t*-test to compare the differences between the groups. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated using the multivariate logistic regression model after adjusting for age and sex. All statistical analyses were performed

using SAS statistical software (version 9.4; SAS Institute Inc., Cary, NC, USA). A two-tailed *p* value < 0.05 was considered to be statistically significant.

3. Results

3.1. Walk-through survey

Agriculture was the predominant feature in Rangpur, and most of their lands are used for farming by villagers living in surrounding area. Educational institutions, including schools, are located in distant regions far from these places.

The process of bidi production includes the following: (1) cutting papers into a size suitable for bidi rolls; (2) purchasing and receiving bidi papers from the factory; (3) making empty paper rolls at home; (4) bringing the empty rolled bundles to the factory and filling and wrapping rolls with tobacco powder; and (5) packing them into vinyl packets (25 sticks per packet).

Cutting of large-sized papers into smaller ones customized for bidis was predominantly performed by adult workers who could use machines. Child workers were not observed in the cutting room.

Card-sized papers were distributed to the workers. Usually, one family member visited the factories and purchased the papers to bring them home. Family members who did not work outside the home participated in rolling because it was perceived as a safe and easy way to make money. Two participants, who were siblings, demonstrated the roll-making process to the researchers. Simple metal sticks were used to make bidis of uniform thickness, and glue was used to fix. First, the workers placed the paper on the hand and rolled it around the stick. Then, the rolls were fixed by applying glue (dark gray-colored, ingredients unknown) with bare hands. Next, the bidi brand symbol was attached on the mouth side, and the roll was closed. Fig. 1C and D show images of an ordinary home in the local community. By repeating the abovementioned steps, the workers made thousands of empty paper rolls at home and tied them into bundles with a band.



Fig. 1. Pictures taken at village areas and local communities. (A) A mother and her daughter making bidis at their home. (B) Bundles of empty bidi rolls prepared for being brought to the factory. (C and D). A boy and his older brother demonstrate how to make a roll to visiting researchers (informal sector).



Fig. 2. Pictures taken at the bidi factory. (A and B) Empty workplaces in the factory during the weekend. (C and D) Crowded workspaces during a working day. In a four-storied building, all the floors were crowded with workers, including child workers. (E) Completed bidi packets: children were paid when they gave these packets to the manager. (F–I) Working conditions of the child workers: bare hands and feet of the child workers were exposed to the brown-colored tobacco powder. Tobacco powder was spread all around the workers.

Next, to fill the paper rolls, some workers purchased the tobacco powder along with the bidi papers and filled the rolls at home. However, most workers brought empty rolls to the factory, so that they can be filled with tobacco. Child workers with or without their adult guardians came to the factory with bunches of empty bidi rolls. In the bidi factory, there were no spaces or machines specifically designed for producing bidis. Effective ventilation systems were not available, and the size and number of windows were not adequate. Tobacco powder was scattered all over the floor, and a strong, sharp smell of tobacco permeated the entire space. The workers gathered the powder using bare hands and poured the powder over a bunch of empty bidi rolls. Then, they shook the rolls to evenly distribute the powder. After filling the rolls, the workers wrapped them one by one to close the fire-side of the bidi to prevent the tobacco powder from spilling out. During this process, tobacco powder was expelled into the air (Fig. 2).

An assigned worker subsequently packed the handmade bidis into packets (25 sticks per packet), sealed it with the branded sticker, and prepared the bidi for final submission to the counter. The workers finally received money after submission. Except during paper cutting, the children were engaged in every step of bidi making.

The home environment was not different from the harsh factory environment described above. Several families made bidis in

general living spaces. The house was not partitioned into working and living spaces. The families usually make bidis, cook meals, and sleep in the same space. Fig. 1A shows a mother and her daughter making bidis in their home, with a bed on the mother's side and kitchen furniture on the daughter's side (Fig. 1A and B).

Although most factories were in rural or semi-urbanized areas, the elementary schools were located at a relatively far distance. Some children who were interviewed usually worked at the bidi factory in the morning and attended school at 11 AM. Sometimes, they worked after school to assist their parents.

3.2. Quantitative survey

The average age of the children was 10.18 years, and most were boys ($n = 119$, 69.59%). The average age when the children started making bidi was 2.12 years. The average daily working hours was 4.61 hours, and the average daily hours spent in the factory was 5.22 hours. Most child workers did not wear protective equipment, such as masks and gloves ($n = 155$, 90.64%). The average number of days of absence from school within 1 month was 5.68 days, and 80 participants (46.78%) worked while being sick within 1 year. Child workers usually stay at the factory even if they do not have work; therefore, the daily hours spent in the factory is not always similar to the daily working hours for bidi making. The less-

Table 1
General characteristics of the study participants

	Total Mean ± SD, N(%) (n = 171)	Less working group Mean ± SD, N(%) (n = 83)	More working group Mean ± SD, N(%) (n = 88)	p
Age (y)	10.18 ± 1.36	10.05 ± 1.45	10.30 ± 1.28	0.2376
Gender				0.4522
Boy	119(69.59)	55(66.27)	64(72.73)	
Girl	52(30.41)	28(33.73)	34(27.27)	
School level				0.6765
Kindergarten	3(1.75)	2(2.41)	1(1.14)	
Elementary school	150(87.72)	74(89.16)	76(86.36)	
Middle school	17(9.94)	7(8.43)	10(11.36)	
High school	1(0.58)	0(0.0)	1(1.14)	
No. of family	5.27 ± 1.87	5.19 ± 1.95	5.34 ± 1.80	0.6058
No. of child-worker in family	1.94 ± 0.92	2.08 ± 0.90	1.81 ± 0.93	0.0496
Proportion of child income in household	27.72 ± 15.61	30.60 ± 19.40	25.00 ± 10.28	0.0210
Starting age of bidi making	2.12 ± 1.48	1.86 ± 1.38	2.38 ± 1.54	0.0217
Daily staying hours in bidi factory*	5.22 ± 1.63	4.80 ± 1.92	5.60 ± 1.22	0.0023
Job performance				
Farming & processing tobacco leaves	62(36.26)	27(32.53)	35(39.77)	0.4091
Delivering tobacco leaf, powder, or rolls	26(15.20)	11(13.25)	15(17.05)	0.6332
Rolling paper	62(36.26)	35(42.17)	27(30.68)	0.1608
Putting tobacco powders into the roll	24(14.04)	8(9.64)	16(18.18)	0.1654
Personal protective equipment (mask)				0.0652
Wear	16(9.36)	4(4.82)	12(13.64)	
Not wear	155(90.64)	52(89.66)	103(91.15)	
Absent days last month	5.68 ± 3.99	5.09 ± 4.77	6.22 ± 3.06	0.1254
Importance of education				0.4215
Not important	30(17.54)	17(20.48)	13(14.77)	
Important	141(82.46)	66(79.529)	75(85.23)	
Dreaming job				0.6265
Professionals	35(20.47)	14(16.87)	21(23.86)	
Public officers	50(29.24)	24(28.92)	26(29.55)	
Engineer	21(12.28)	12(14.46)	9(10.23)	
Garments	11(6.43)	7(8.43)	4(0.88)	
Other	54(31.58)	26(31.33)	28(31.82)	
Reasons to work				1.00
Voluntary	58(33.92)	28(33.73)	30(34.09)	
Forced	113(66.08)	55(66.27)	58(65.91)	
Work while sick (last 1 y)				0.5419
No	91(53.22)	42(50.60)	49(55.68)	
Yes	80(46.78)	41(49.40)	39(44.32)	

SD, standard deviation.

* Indicates how long the child workers stay at the factory. Child workers usually stay at the factory even if they do not have work. Therefore, the daily hours spent in the bidi factory is not always similar to daily working hours. The average working hours for bidi making was 4.61 ± 1.99 hours/d, and the daily hours spent in the bidi factory was 5.22 ± 1.63 hours/d.

Table 2
Subjective symptoms and results of the urine cotinine test (>5 ng/mL)

	Total Mean ± SD, N(%) (n = 171)	Less working Mean ± SD, N(%) (n = 83)	More working Mean ± SD, N(%) (n = 88)	p
Respiratory symptom	123(71.93)	55(66.27)	68(77.27)	0.1525
Muscular symptom	102(59.65)	53(63.86)	49(55.68)	0.3509
Nervous symptom	171(100.0)	58(100.0)	113(100.0)	–
Psychological symptom	12(7.02)	0(0.00)	12(13.64)	0.0003
Positivity of urine cotinine sampling (>5 ng/mL)	165(96.49)	83(100.0)	82(93.18)	0.0289

SD, standard deviation.

working group had a younger starting age (1.86 vs. 2.38 years, $p = 0.0217$) and fewer hours spent daily in the factory (4.80 vs. 5.60 hours, $p = 0.0023$) than the more-working group (Table 1).

Respiratory, muscular, and psychological symptoms were investigated. In terms of physical symptoms, 123 (71.93%), 102 (59.65%), 171 (100%), and 12 (7.02%) participants presented with respiratory, muscular, neurologic, and psychological symptoms, respectively. In total, 165 of 171 participants [less-working group,

83 (100%); more-working group, 82 (93.18%)] had urinary cotinine levels >5 ng/mL (Table 2).

Moreover, 50 children (41.32%) [less-working group, 15 (49.40%); more-working group, 35 (39.77%)] showed frequent absence from school. This was more common in the more-working group than in the less-working group (Table 3). The less-working group showed higher workplace presenteeism than the more-working group [41 (49.40%) vs. 39 (44.32%)].

Table 3
Absence from school and workplace presenteeism

	Total	Less working	More working	<i>p</i>
	Mean ± SD, N(%)	Mean ± SD, N(%)	Mean ± SD, N(%)	
	(<i>n</i> = 171)	(<i>n</i> = 83)	(<i>n</i> = 88)	
Absent in school 5 d or more in last month	50(41.32)	15(18.07)	35(39.77)	0.0032
Experience of workplace presenteeism for last 1 y	80(46.78)	41(49.40)	39(44.32)	0.5071

SD, standard deviation.

Multivariate logistic regression was used to assess the association between working hours and respiratory symptoms and that between working hours and frequent school absence. Moreover, a sensitivity analysis was conducted after stratifying the participants according to the motivation for child labor. In terms of forced-working and voluntary-working, the results did not differ significantly. We adjusted sex and age for the analysis. The more-working group had a higher OR (1.90, 95% CI: 0.95–3.81) than the less-working group, with respect to the prevalence of respiratory symptoms. However, in the sensitivity analysis based on the reason for working, the more-working group had a significantly higher OR (3.04, 95% CI: 1.22–7.58) than the forced-working group. Meanwhile, the OR of the voluntary-working group did not significantly differ (Fig. 3).

Regarding the associations between working hours and frequent school absence, the more-working group had a significantly higher OR (2.91, 95% CI: 1.43–5.94) than the less-working group. Analysis of the reason for working showed that in the forced-working group, children working for more hours had a significantly higher OR (5.68, 95% CI: 2.30–14.00). However, the OR of the voluntary-working group (0.557, 95% CI: 0.14–2.23) did not significantly differ.

4. Discussion

To the best of our knowledge, this is the first qualitative walk-through survey to assess the nature of child labor in bidi factories. Child workers are exposed to harmful solvents, noise, and dust, and proper safety measures are not followed in various

workplaces [21]. Recently, review articles have revealed the health effects of hazardous exposure among child laborers and reported the symptoms of ill health, poor nutritional status and physical growth, musculoskeletal pain, and infectious diseases, including tuberculosis and HIV infections. Moreover, the review highlighted the physical and psychological abuse faced by child laborers during work [22]. Sexual assault of female child workers (aged <12 years) has also been reported [23]. However, studies about child labor in bidi factories are not available.

When we visited the bidi factory on a workday, it was almost impossible to open our eyes, and we experienced immediate respiratory symptoms and skin itching because of floating dust and powders. The area where tobacco powder is filled inside the paper roll was dusty with a sharp smell in the air. Without active smoking, children were constantly exposed to tobacco via inhalation and direct skin contact with tobacco powder and its alkaloids, including nicotine. Unfortunately, we did not quantify the concentration of dusts or tobacco-derived products in the ambient air. However, Bhisey et al [12] have conducted a study about biological monitoring of bidi industry workers, which included quantifying the dust concentration, and they reported that the dust concentration that can be inspired was 150-fold higher in the bidi factory than in the control environment. This kind of environment puts workers in bidi industries at risk of lung diseases and other health problems [12]. Mittal et al [24] have previously reported the high prevalence of eye problems and headache. In other studies, workers had higher levels of cotinine and elevated mutagenic burden [12]. Tobacco-derived products and its alkaloids are known to have

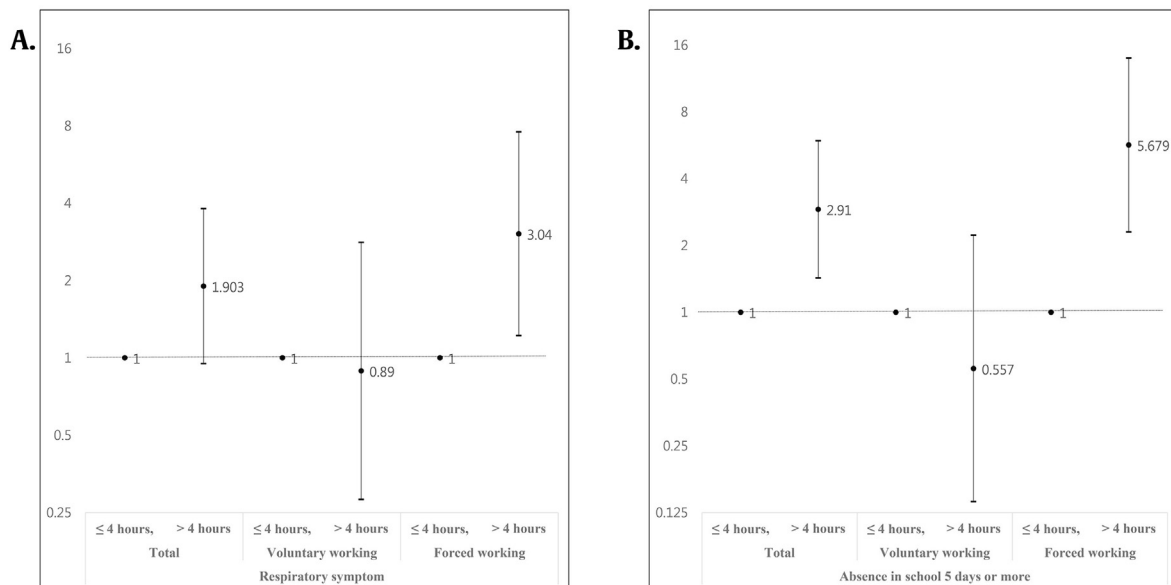


Fig. 3. (Odds ratio) (A) Schematic figure representing the differences in odds ratios for respiratory symptom experience with respect to daily working hours. (B) Schematic figure representing the differences in odds ratios for unusual absence (≥5 days/mo) with respect to daily working hours.

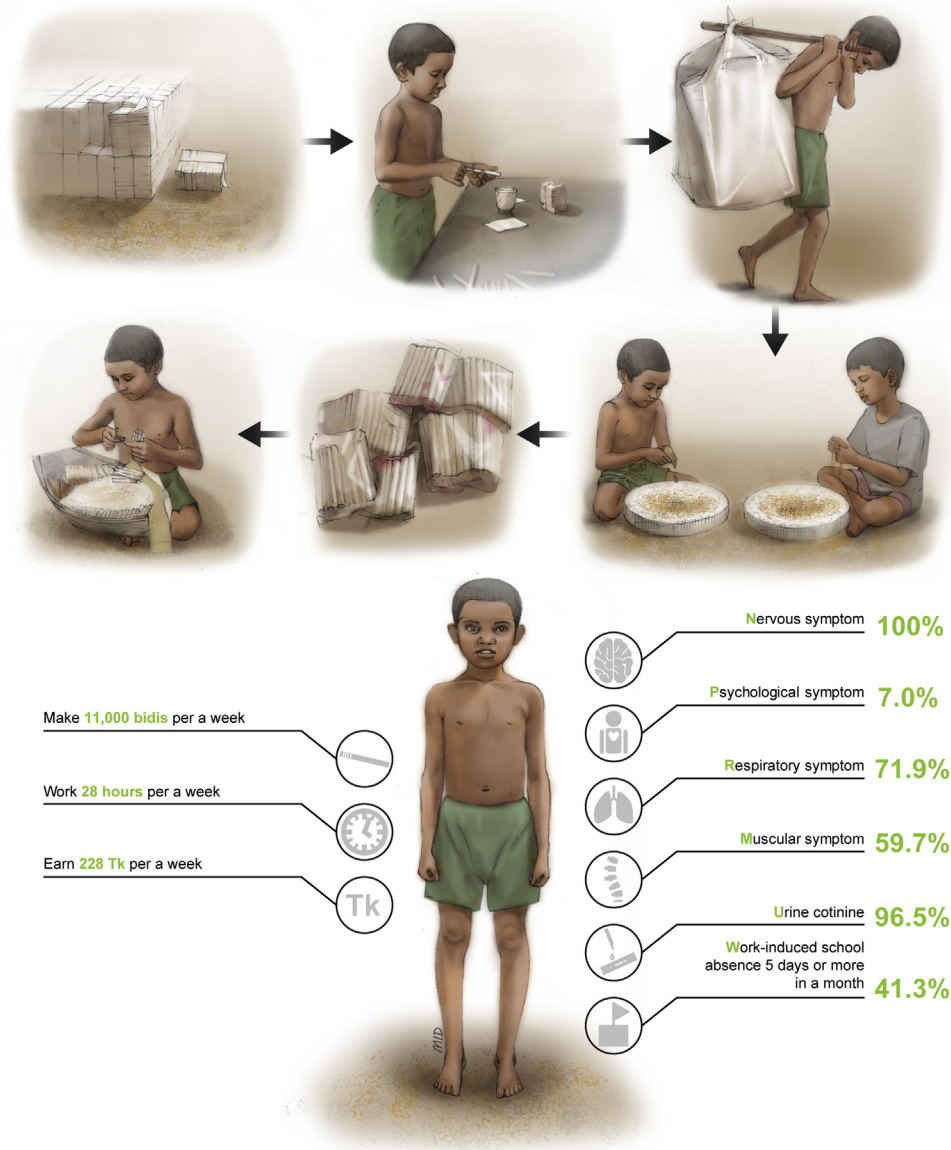


Fig. 4. Schematic pictures explaining the process of bidi-making and related health outcomes in child workers.

carcinogenic effects, and they are also strong vasoactive compounds that can induce vasoconstriction, nerve ending damage, and accelerated atherosclerotic events. Previous studies have shown the effects of these products on the health of bidi rollers with direct exposure to tobacco dust via nasal and cutaneous absorption [24,25]. Nicotine exposure has various health effects, such as tachycardia, vomiting, ataxia, and even seizures [26]. Moreover, in a previous study about the use of nicotine patches in children, transdermal nicotine exposure was observed [27]. Thus, child workers in tobacco factories are exposed to various chemicals, including nicotine, via inhalation and skin contact.

These health burdens are also observed in adult workers in bidi industries. Children are usually sensitive to occupational hazards, and significantly smaller amounts of hazardous materials can induce health manifestations in children. However, studies of workplace exposure to tobacco dust in children have only included those with major exposure from parents, which is referred to as passive smoking.

Residential exposure to environmental tobacco smoking has been assessed frequently. However, studies about occupational exposure to tobacco are limited. Therefore, the health effects of tobacco exposure among child workers must be assessed. In our study, we investigated the symptoms of child workers. Fig. 4 shows the process of bidi making and the health outcomes of child workers.

Despite extensive exposure via respiratory and cutaneous routes, a substantial number of children participated in making tobacco powder and rolling bidis, thereby increasing the negative impact of tobacco exposure on children's health. The bidi making process is considered safe because of the minimal risk of visible injuries, including trauma. However, it still causes long-term effects on children's health, especially when appropriate protective measures are not followed, thereby leading to subjective symptoms. We want to emphasize the importance of children's health, not only physical health (subjective health problems) but also psychological health. Moreover, the basic rights of children are threatened.

Significant exposure to tobacco was defined as the presence of cotinine in the urine, with a cutoff value of 5 ng/mL. In a previous study, children or adolescents who were exposed to even second-hand smoking had a urine cotinine level <5 ng/mL [18–20]. Valsamis et al [28] have investigated changes in pulmonary function among preschool children with asthma, and they observed a significant reduction in pulmonary function among children whose urine cotinine level was >5 ng/mL. Therefore, we used the urine cotinine kit, with a cutoff value of 5 ng/mL, because it is the most sensitive kit and can identify exposure to tobacco levels similar to those encountered via conventional passive smoking. Children who were included in this study did not have family members who smoke, and they were not active smokers. Therefore, the most likely source of cotinine among the participants was bidi making. Third-hand smoking was identified in 96.5% of child workers based on the urine cotinine level test. Therefore, our study showed that child workers in bidi factories were exposed to considerable amounts of tobacco.

Moreover, except for one child, almost all children showed school absence within 1 month because of work. Even if we consider the lack of educational facilities or other supplements, the absence rate will be quite higher than usual. A previous study has reported a higher absence rate, at 14%, among adolescent girls because of menstrual hygiene management, and the average number of days of absence per month was 2.8 days [29]. Compared with this result, the absence rate in our study was significantly higher than 41%. Hence, our quantitative study showed that longer working hours and forced-working significantly affected the rights of child workers in terms of health and adequate education. Children who engage in bidi making cannot frequently go to school. Thus, their future is compromised as they have a lower education level.

The ILO announced that child labor is “a violation of fundamental human rights and has been shown to hinder children’s development, potentially leading to lifelong physical or psychological damage” [30]. The restriction of minimum age at work is an effective measure to prevent deprivation of a child worker’s right to dignity. Moreover, ILO specified that the general minimum age should be 14 years [31]. Even light work should not disrupt the child’s education, vocational orientation, and training. However, in the present study, the child workers experienced physical and psychological problems and were deprived of education.

The government of Bangladesh has emphasized “Convention on the Rights of the Child” [15] in 1990, which declares the children’s rights to life, survival, and development, including receiving adequate education, as the national agenda [32,33]. However, because of outdated legislation, inadequate polices, poor services, implicit connivance, and tacit acceptance, the rights of children remain in jeopardy [32]. Consequently, the bidi industry’s violation of the children’s basic rights, dignity, and future wellness can be considered as violence [30].

Education influences profession and hobbies, which in turn affects the fulfillment of the desire for esteem (desire to be accepted and valued by others). In our study, none of the child workers chose to work in the bidi factory, and most children wanted to become public officers, professionals, engineers, or garment workers. Because education is a pre-requisite for such vocations, attending school, rather than earning money by bidi making, can help achieve personal goals and future wealth [34].

In our study, longer working hours resulted in a frequent absence from school (≥ 5 days/mo). Thus, the future of the study participants was compromised because of the lack of appropriate education. However, although the participants worked for several hours daily, there is a high subjective awareness of the importance of education, and it was not significantly different between the

groups. This result indicates that long working hours were not attributed to the lack of knowledge about the importance of education. Most children agreed that education is important for future wellness. However, approximately 50% of participants had to go to work instead of school because of their parents’ desire. Approximately, 30% of child workers provide money for their household, and their families will not tolerate reduction in the household income because of the lack of employment. Thus, to alleviate poverty, child labor is required. However, this in turn leads to injuries, abuse, emotional or physical neglect, and lack of education among children, thereby perpetuating a life of poverty [35,36].

Hence, encouraging education without socioeconomic support might be ineffective. Goldstein [37] has shown that “education is important, but it must come after the family is fed, housed, clothed, and enough is put by to see them through unemployment”. Maslow’s hierarchy of needs includes physiological, safety, belonging and love, esteem, and self-actualization levels through which humans generally move for motivation to occur at a particular level. For one to move to the next level, the previous level must be satisfied. Therefore, without fulfilling the previous levels of needs, esteem or self-actualization cannot be achieved.

Occupation and occupational health approaches can contribute to breaking the vicious cycle that comprises poverty, child labor, unhealthiness, and undereducation and can turn it into a virtuous circle. Occupation is a socially accepted legal activity used to earn money for maintaining the quality of life [38]. Paradoxically, work dissatisfaction can disrupt the quality of life, and a balance between work and quality of life must be maintained, which can be accomplished through improving occupational safety and health in the case of bidi makers. This key principle can be applied to guarantee the health of child workers if child labor cannot be eradicated immediately [39]. In this study, the participants worked in tobacco factories for economic benefit even if they experienced health-related symptoms and loss of education. Therefore, improvement in occupational health among bidi factory workers can help protect the rights of children and preserve the economic benefits of working.

Although the children’s health and right to education are important, immediate eradication of child labor can result in severe poverty. Moreover, the causes of child labor in this study included parental compulsion, lack of social support, and childhood avocations, which cannot be overcome by individual effort. Therefore, in the future, comprehensive approaches must be used to resolve these issues. Ensuring occupational safety and health can be the first step in maintaining the basic rights of child workers.

Our study had few limitations. First, it did not cover the whole population of bidi factory workers, and random sampling was not performed. Moreover, only cooperative enterprises and individuals were included. Thus, the representativeness of bidi factories and study participants could not be guaranteed. Second, objective information about the concentration of tobacco dust in bidi factories was not available. Third, the urine cotinine tests were performed using only one type of stick, and further analysis or a dose–response analysis of participants with >5 ng/mL of urinary cotinine could not be performed. In addition, a single urinary cotinine examination could be affected by the point of exposure and half-life of cotinine. Therefore, to test our hypothesis more appropriately, future studies with structured random sampling using quantification methods must be conducted.

Child workers in bidi industries were exposed to unsafe workplace environments, and they presented with health-related symptoms and loss of education because of work. The role of family in poverty was a driving force for child labor, thereby indicating that immediate eradication without economic support will be ineffective. Therefore, interventions must focus on the

occupational health of child workers in bidi factories. In a developing country, children who experience poverty succumb to the demands of the bidi industry and work for cheap labor even if their health, future wealth, and fundamental rights are compromised. Thus, cooperation among homes, factories, and other social capitals can result in less dangerous and health-threatening conditions.

Ethical approval and consent to participate

This study was reviewed and approved by the IRB from Rajshahi University (IRB number: 89/320/IAMEBBC/IBSC, 2017), and all participants provided informed consent.

Authors' contribution

JHY and SEH have designed the research methods and study structure. SR and SEH arranged a walk-through study, and collected data. JK and WL analyzed data and interpreted the results. First manuscript was written mainly by JK, WL, and SR. Manuscript has been reviewed by JHY, and JHY decided to submit the article. All the authors read and approved the final manuscript.

Funding

Yonsei University College of Medicine funded this study held in Bangladesh with special concerns to investigate child labor.

Conflicts of interest

All authors have no conflicts of interest to declare.

Acknowledgments

The authors acknowledge Medical Illustration & Design (MID), a part of the Medical Research Support Services of Yonsei University College of Medicine, for all artistic support related to this work.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.shaw.2020.02.002>.

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