

Using logistic regression to identify the factors affecting child labor in Red Sea State



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ABSTRACT

Sudan, like many countries, suffers from the prevalence of child labor due to the economic conditions it is undergoing in its various states. The study aims to identify the factors affecting child labor in the Red Sea State (Sudan). The study adopted a descriptive-analytical approach and multiple logistic regression. Because of the lack of data and information about child labor in Sudan, the study depended on a questionnaire as a tool for data collection. The study focused on the children in the age group (7-15) years. The sample type was the purposive sample, and the size of the sample was (133) children. Data analyzed using Statistical Package for Solution Services (SPSS). The multiple logistic regression model applied to investigate the relationship between the dependent variable (child labor) and the explanatory variables. The results explained that both males and females entered the labor market, but the number of males who entered the labor market was more than females. Also, the study found that explanatory variables such as age, education of mother, marital status of parents, and the number of family members had significant effects on child labor at a 5% level of significance. However, gender, father job, and parents' encouragement were found to be statistically insignificant. The study recommended that a good database system must be provided and organize accurate information about child labor in order to help policymakers and researchers, and children's education, which may contribute to protecting children from the labor market, must be compulsory.

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1. Introduction

The child labor phenomenon is one of the problems that have emerged in Sudan in the last three decades in a worrying manner, especially since children constitute an estimated percentage of the population of Sudan. Enabling them to obtain a good education is a key factor in the development of society. As a result of these challenges, it has become a hindrance and a strong factor that helps in reviving the national economy and achieving a reasonable limit on human development.

Child labor is a complex development issue, and its causes are varied, the most important of which is the lack of access to education, poverty, and the existence of social customs and traditions. It contributes to the continuation of the social,

economic, and political instability of society. Furthermore, it causes compelling children to work at an early age, either because of the circumstances to which their families are subjected. Thus, they are forced to do work that may cause psychological, physical, and emotional harm to them and deprive them of their childhood. All of these factors combined to cast a shadow over the children in Sudan, who witnessed great fluctuations and changes, whether on the economic or social level.

Child labor is an old phenomenon in some countries of the Arab region, especially in specific sectors such as agriculture, small traditional crafts, and informal industries such as garment and carpet manufacturing, as well as some construction-related activities. Over the past ten years of political turmoil, economic crises, conflicts, and wars, the mass displacement of people, both within and among nations, has changed and aggravated the situation.

Child labor trends in Sudan according to data available in the official 2008 census, the number of working children reached 461,315 for the age group (5-14) years. These statistics date back to the period before the secession of South Sudan. The working

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children in the age category (5-14) had a percentage of 12.6% of the total population, which indicates a bitter and difficult reality of child labor in Sudan.

The phenomenon of child labor is widespread in many poor countries and is not limited to Sudan. It is caused by stifling economic conditions and the resulting unemployment and weakness in household incomes, in addition to many other reasons, including wars, the most important of which is the loss of parents and the displacement of many families from their livelihood. Since all these causes exist in Sudan, this necessarily exacerbates the phenomenon and its widespread.

Sudan suffers from difficult economic conditions and suffers from local tribal conflicts in different States. This situation made all members of the family want to help them with work, and then that situation increased the entering labor market by children. In the area of the study, which is the Red Sea State, there is the main port of Sudan, where the labor market is open for all age groups, especially children in the age group (7-15) years.

Research problem

Child labor is a serious phenomenon that has spread recently in different states of Sudan. It may lead to many problems resulting in harm to the health of the child and loss of the future. The Red Sea State, where the first port of Sudan is located in the city of Port Sudan, child labor is even more widespread than in other States in Sudan. Hence, this situation led to an increase in children suffering. Child labor is increasing every day and at the sight of the parents who do not mind their children working to help them. The phenomenon is widely spreading every day, causing a concern that necessitates studying its causes and knowing the factors that lead to its spread. The objective of this study is to determine the most important factors that affect child labor.

Research questions

The study will answer the questions:

1. Which factors can affect child labor in the Red Sea State?
2. What are the most important factors that influence child labor in the Red Sea State?

Research objectives

The study aims to:

1. Identify the factors affecting child labor in the Red Sea State, Sudan.
2. Determine the most important factors that affect child labor in the Red Sea State.

Research significance

The importance of this research stems from the importance of child labor itself, as the increase in child labor rates leads to depriving children of the most basic rights that they must enjoy, namely to spend a safe childhood period and receive basic,

secondary, and university education. Most international human rights and voluntary organizations advocate for the rights of the child to a decent life free from physical and mental stress and the risks that children may be exposed to if they are absorbed into work.

2. Methodology

The study depended on a descriptive-analytical technique used to describe the phenomenon of child labor in the Red Sea State and the factors affecting it. The analytical aspect used a binary logistic regression to identify the most important factors that may affect the situation of child labor in the Red Sea State, particularly in Port Sudan city.

Source of data

The study was based on preliminary data by means of a questionnaire that was designed based on the questions and objectives of the study. The data for the study were collected in the time period from October 2019 to January 2020, and the process faced many obstacles.

Study population and sample size

The study population included all children working in Port Sudan City in various economic and service sectors in the Red Sea State. The sample of the study was chosen using simple random sampling, and its size was (200) children, 100 of them were not working, and the other 100 were working children.

Research tools

The study depended on a questionnaire as a tool for data collection from the sample of the study, because of the lack of data and information about child labor and official statistics.

Dependent variable

The response variable of our study is whether child labor occurred or not. Hence, the response variable for working can be explained as 1 for those children working, and 0 for those who were not working.

Independent variables

Firstly, we focused on a group of variables such as gender, age, residence type of residence, father education, father job, mother education, number of family, marital status of parents, the living condition of the child, original place, the salary per day, going to school, punishment at school, harassment from the community, reasons for working, parents' encouragement to work, friends are working, aids from organizations and job satisfaction.

2.1. Binary logistic regression

The model of binary logistic could be written as,

$$\{pr(y = 1/x)\} = \beta_0 + \beta x_i \quad (1)$$

where, $pr(y=1/x)$ is the probability of the outcome; x_i is explanatory variables vector; β_0 is the constant of the equation; β is a vector of the parameters to be estimated.

The logistic regression model was used to estimate the coefficients of the model or parameters of the dependent variable (child labor). In the binary logistic regression model, we estimated the probability of a dichotomous response (which, of course, is also its mean) for various values of the independent variables (Agresti, 2018). We fit a following model of the form:

$$E(y) = \frac{e^{\beta_0 + \beta_1 x}}{1 + e^{\beta_0 + \beta_1 x}} \quad (2)$$

The logistic function existed in the right side of the equation. In which, the relationships between p and x are non-linear and can be linearized. Let be the linear predictor where is defined by the transformation. This transformation is called the logit transformation of the probability p , and the ratio called the Odds. Hence, a multiple logistic regression model can be written as:

$$g(x) = \log \text{it}(p(x)) = \ln \frac{p(x)}{1-p(x)} = \beta_0 + \beta_1 x \quad (3)$$

2.1.1. Fitting the logistic model

Logistic regression uses a maximum likelihood estimation technique to estimate the model parameters. In other words, ML finds the best values for,

$$n = \beta_0 + \beta_1 x_1 + \dots + \beta_k x_k \quad (4)$$

Observed values of say, are the n independent random observations corresponding to the random variables (Y_1, Y_2, \dots, Y_n). Since Y_i is a Bernoulli random variable with functional form and hence, the likelihood function is given by:

$$L(\beta) = \prod p_i^{y_i} (1 - p_i)^{1-y_i} \quad (5)$$

The estimation of parameters requires the maximization of the likelihood function or equivalently the maximization of the natural logarithm of the likelihood function.

3. Literature review

3.1. The concept of child labor

Child labor, according to the United Nations System of National Accounts, refers to children who are under 18, producing commodities and services (Edmonds, 2008). It is worth noting that children often assist in agricultural activities that participate in families' economic situation. Contrary to this, the International Labor Organization (ILO), which is in charge of child labor support, sees child labor as any employment preventing children from their childhood and dignity, and it is dangerous to their

bodily and mental improvement. The most harmful types of child labor endanger children's wellbeing by involving them in wars, narcotic trade, slavery, and sex (Islam, 2019; ILO, 2015). Nevertheless, this description is tricky since it relates to child labor to health determinants.

In poor countries, child labor is more popular than in rich ones. Statistics show that 251 million children are in the labor market. It is most common in sub-Saharan African countries where it is estimated that 25.3% of the children and workers. On the other hand, the labor market is low among girls worldwide; it is quickly dropping in Latin American and Caribbean countries.

The most popular approach to the definition of child labor that is adopted by applied research regards it as the involvement of any child in various market activities. This, therefore, includes all kinds of work in the families' ranch or business. Admassie (2002) proposed that "parents who encourage their children to work" indicate a focus on their families' needs more than their children's rights in education. A good education can play an integral part in preventing children from work, which necessitates making education compulsory (Bhat, 2010).

Del Carpio et al. (2016) pointed out that interference reduced children's involvement in families' agricultural activities though it maximized their role in trade. Hoop et al. (2018) argued that it is important to empower women since this increased the effect of the program on children's labor and education.

3.2. Determinants of child labor

There is an agreement that poverty is the main motive that makes parents encourage their children to work. This is supported by poverty theory stating that if a family lives in poverty, child labor is seen as a method to support it in the short term to increase its budget. Thus, income becomes a priority to education that is considered as a luxury. However, Basu (1999) suggested that poverty does not result in child labor.

Other factors contributing to child labor include a child's status, age, gender, and birth order. Moreover, it is also caused by the parents' level of education. The more educated the parents are, the more likely they keep their children away from the labor market. In addition, family structure is a factor that leads to child labor. Families with several members need more income, so they tend to encourage older children to work; they may cater to the last child by sending him to school (Birdsall, 1991).

3.3. Types of child labor in the Red Sea State

Child labor in the Red Sea State is generally represented by work in agriculture, work in grazing, fetching water, and this is found in abundance in the countryside and villages. In Port Sudan, which is the capital of the state, most child labor is concentrated

on the large and small markets, where marginal occupations are paid daily. Examples of child labor include selling water on the market, wiping shoes, tea sellers, housemaids, street vendors, building diaries, porters, working in restaurants, cafeterias, and cold drink stores, collecting money in public transportation cars among others.

3.4. Previous studies

Sturrock and Hodes (2016) found that in third world countries, big numbers of children were working, causing a risk to their wellbeing. It was also found that it was strongly related to bad mental health. Ali (2011) revealed that 73% of children were from small families. This indicates that parents of those children were proportionally living in bad economic conditions. It was also found that 86% of the working children were illiterate. About 52% of working children should work for long hours daily. Hussain and Hussain (2011) concluded that most of the child laborers were in the age group of 11-14 years, and among them, female children labor outnumbered male children labor. Economic compulsion and educational backwardness of parents were the main reasons forcing children to leave school and join the labor market at different points of time. Wellay's (2014) study stated that the existence of a positive and significant association between child work and number of infants and biological relationship to the household head while age and education level of the household head, and household size among others, having a significant but negative effect on child work specialization. Ariyanti (2016) found that factors that significantly affect child labor included children's education and parents' main employment status. Baalawi (2019) showed that child labor in Yemen is due to socio-political and economic factors, and it had disastrous impacts on development and society as it saps the potential and energy of the young generation. Al Zayadi and Al Zayadi (2018) revealed that 27.9% of working children were those who at the age of 9 and under. A large proportion of child workers belong to disjointed families where the percentage of divorce was 24.2%, and the proportion of children orphans who lost one or both parents was 28.7%, which reflects the role of social factors in pushing children into the labor market. Ahmed (2019) found that the most important reasons behind children's work were the deterioration of the economic conditions, loss of the father due to wars, and the deterioration of the security situation. With regard to their geographical distribution, it becomes clear that the vast majority were from outside the city of Ramadi. Karadshah (2014) results; showed that the main analysis of the statistical significance of variables such as "the size of the child's family, the level of the father's education, the mother's age at marriage, the relationship between parents, their place of residence, the monthly family's income, the number of wives in the father's infallibility, and the methods used in raising children" were the reasons behind

children labor. While variables such as "the nature of the relationship between parents, their social conditions, the age difference between them, and the mother's level of education" were found to be weak variables and did not statistically explain the phenomenon under study.

Alfa et al. (2012) examined the impact of child labor on school attendance. A cross-sectional data set was collected from a sample of 399 children between the ages of 5 and 14 in rural areas of Bida Local Government in Niger State. The findings of this study showed that child labor and distance to school hinder school attendance. Also, children of educated parents and those that are biological sons and daughters of the household heads attended school more than others.

4. Data analysis

The study focused on descriptive statistics to describe the characteristics of the study sample, as well as the application of multiple logistic regression.

4.1. Descriptive statistics results

The descriptive statistics for the variables in the current study showed that 101 (75.9%) of the respondents were males, and 32 (24.3%) were females. In terms of the participants' age, it was found that 95 (71.4%) of the participants belong to the age group (13-15) years, followed by 31 (23.3%) of them were (10-12) years, and 7 (5.3%) were (7-9) years. As for father educational level, 45 (33.8%) of the participants' fathers had primary education, 42 (31.6%) had intermediate education, 32 (24.1%) of them were illiterate, 12 (9%) of them were with secondary education, and only 2 (2.5%) were with university education.

Regarding the father job, it was revealed that 60 (45%) of the children fathers labored, 40 (30%) were employed, 28 (21.1%) had free jobs, 3 (2.3%) pensioners, and only 2 (1.5%) of them were unemployed. Mother educational level illustrates that 60 (45.1%) of the children's mothers were with primary education, followed by 31 (23.3%) of them were illiterate, 32 (24.1%) were with intermediate education, and 10 (7.5%) of them were with secondary education. Regarding the number of family members, 57 (42.9%) of the respondents' families had (5-8) people, 46 (34.6%) had (1-4) members, and 30 (22.65) have (9-12) people. The parent marital status showed that 81 (60.9) of children's parents live together, 28 (21.1%) of them were divorced, and 24 (18%) of them had another wife. Statistics showed that 89 (66.95) of the children's parents were alive, 25 (18.8%) of their fathers were dead, 10 (7.5%) of their mothers were dead, and 9 (6.8%) of the children were orphans.

Regarding child labor, the results revealed that 86 (64.7%) of participants were working, and 47 (35.3%) were not working. In terms of punishment at home, 44 (33.1%) of the participants were being beaten at home, while 89 (84.2%) of them were not.

On the other hand, 75 (56.4%) of the respondents regularly went to schools, and 58 (43.6%) of them did not. Regarding punishment at school, 20 (25%) of the children were punished at school, and 113 (85%) of them did not get beaten at school. Reasons for working showed that 71 (53%) of the children chose to work because of pressure from parents, 36 (27%) of them worked to help family, and 26 (23%) worked because they hated school. 78 (69%) of their parents encouraged them to work to help their families. On the other side, there were 78 (58.6%) of children their parent encourages them to work. In terms of job satisfaction, 99 (74.4%) of the respondents expressed satisfaction with their work, and 24 (18%) of them did find their work not satisfied. [Table 1](#) shows respondent characteristics.

Table 1: Respondents characteristics

Variable	classification	Number	Percentage
Gender	Male	101	75.9
	Female	32	24.3
Age	7-9 year	7	5.3
	10-12 year	31	23.3
	13-15 year	95	71.4
Father Education	Illiterate	32	24.1
	Primary	45	33.8
	Intermediate	42	31.6
	Secondary	12	9.0
Father job	University	2	1.5
	labor	60	45
	Employee	40	30.1
	Free job	28	21.1
Mother education	Pension	3	2.3
	Not working	2	1.5
	Illiterate	31	23.3
	Primary	60	45.1
Number of families	Intermediate	32	24.1
	Secondary	10	7.5
	1-4 person	46	34.6
Parent marital status	5-8 person	57	42.9
	9-12 person	30	22.6
	Together	81	60.9
Living condition	Divorced	28	21.1
	Father has another wife	24	18
	Both are a life	89	66.9
	Father is dead	25	18.8
Working	Mother is dead	10	7.5
	Both of them dead	9	6.8
Punishment(home)	Working	86	64.7
	Not working	47	35.3
Go to school	yes	44	33.1
	no	89	84.2
Punishment(school)	Yes	75	56.4
	No	58	43.6
Reasons for working	Yes	20	7.5
	No	113	25
	Help family	36	27
Parent encourage	Hate school	26	20
	Parent pressure	71	53
Job satisfaction	Yes	78	58.6
	No	55	41.4
	Satisfied	90	67.7
	Not satisfied	43	32.3

4.2. Results of chi-square

The chi-square results presented in [Table 2](#), revealed that there is an association between child working and the explanatory variables such as age, father job, mother education, parent marital status,

and parents' desire. Whereas the predictor, gender, father education, and parents' desire found to be insignificant with child labor.

Table 2: Chi-square results

Predictor variable	Response variable	Chi-square	df	p-value	result
Gender	Child labor	2.83	1	0.092	Not significant
age	Child labor	9.55	2	0.008	significant
Father education	Child labor	6.06	4	0.194	insignificant
Father job	Child labor	16.13	4	0.003	insignificant
Mother education	Child labor	12.51	3	0.002	significant
Parent Marital status	Child labor	18.99	2	0.0001	significant
Parents' desire	Child labor	0.929	1	0.588	significant

4.3. Multiple logistic regression results

[Table 3](#) displays the results of the binary logistic regression, which shows the coefficients, standard error, Wald test for the predictors significant, and the odds ratio of the coefficients. It is clear that child labor associated with each of the predictor variables, including the logistic regression model. It is obvious that there was a statistically significant relationship between the explanatory variables: Age, mother education, marital status of parent, number of family members, and child labor. However, gender, father job, and Parent encouragement were found to be statistically insignificant.

4.4. Goodness of fitting the logistic regression model

For the purpose of checking and verified the adequacy of the model, Likelihood ratio (LR) tests, R² statistics, Hosmer-Lemeshow test, and classified table were used. LR test revealed a significant difference between the likelihood ratios for the final model and the likelihood ratio for the model without predictor or reduced model. The results showed -2 Log Likelihood value for the reduced model, and the final model was 172.771 and 114.023, respectively. Chi-square statistics was 58.749 with (p-value=0.0001). This indicates that the final mode fitted well since the predictor variables had a statistically significant effect on child labor at a 5% level of significance. [Table 4](#) shows results of omnibus tests of model coefficients.

4.5. Model summary of binary logistic regression

Nagelkerke square was estimated at (0.491), indicating that the effect of the predictor variables was 49.1% in the dependent variable child work. i.e., 49.1% of the variance in child labor who were investigated were working, or they did not work results were due to change in the explanatory variables. [Table 5](#) shows a summary of the model.

Table 3: Results of the binary logistic model

Variable	B	S.E	Wald test	df	Sig	Odds ratio
Gender (1)	-0.0468	0.924	0.0257	1	0.613	0.626
Age			5.654	2	0.042	
(7-9)	-3.875	1.667	5.403	1	0.020	0.021
(10-12)	-0.590	0.646	0.833	1	0.361	0.555
Father Job			5.676	4	0.225	
Labor	-20.310	28273	0.000	1	0.999	0.0001
Employee	-19.041	28273	0.000	1	0.999	0.0001
Free job	-19.542	28273	0.000	1	0.999	0.00001
pension	-18.554	28273	0.000	1	0.999	0.0001
Mother Education			9.361	3	0.025	
Illiterate	-0.853	1.086	0.616	1	0.433	0.426
Primary	-1.478	1.003	2.170	1	0.141	0.228
secondary	0.591	1.115	0.281	1	0.596	1.807
Marital status of the parent			6.392	2	0.041	
Together	0.247	0.778	0.101	1	0.750	1.281
Divorced	2.512	1.049	5.739	1	0.017	12.332
Parent encourage	-0.513	0.539	0.907	1	0.341	0.599
Number of family members			10.058	2	0.007	
1-4 person	2.296	0.724	10.055	1	0.002	9.931
5-8 person	1.203	0.636	3.570	1	0.059	3.329

Variable(s) in the model: gender, age, father job, mother education, parent marital status, encourage

Table 4: Results of omnibus tests of model coefficients

Model	Chi-square	iteration	p-value
Final model	58.749	15	0.0001

Table 5: Summary of the model

Step	Likelihood	Cox and Snell R Square	Nagelkerke R Square
1	114.023	0.357	0.491

4.6. Model goodness fit

As shown by Hosmer-Lemeshow test results, chi-square test statistics were 13.154 with p-value 0.068. Therefore, the study model was quite a good fit. This fact confirms that the data were fitted well by the estimated model. Table 6 shows the Hosmer-Lemeshow results.

Table 6: Hosmer-Lemeshow results

Step	Chi-square value	df	p-value
1	13.154	7	0.068

The classification table results in Table 7 explains that 2% of the sample members who responded to the questionnaire were correctly predicted. 91.1% of the participants who were working were classified correctly, whereas 63.8% of children, who were not working, were classified correctly as well. 82% correct predictions of the overall children were modeled by using binary logistics regression. Table 7 shows results of the classification table.

Table 7: Results of the classification table

Observed	Predicted		Percentage correct
	Work	Not working	
not working	36	11	63.8
Working	12	56	91.9
Overall percentage	82.0		

5. Discussion and recommendations

Descriptive statistics showed that 1 (75.9%) of the sample member were males, and 32 (24.3%)

were females. This result indicates that male children help their families, and this is in line with the values of Sudanese society that affirm that males bear responsibility and help their parents and their families. The application of binary logistic regression revealed that the explanatory variables, age, mother education, marital status of parents, and a number of family members have significant effects on child labor at a 5% level of significance. However, gender, father job, and parent encouragement were found to be statistically insignificant.

On the other hand, the results revealed that a child working as a dependent variable is significantly associated with the age of those who work in Port Sudan city and males more than females. This result is confirmed by the odds ratio of the age group (10-12), which was (0.555), implying that children in this group were 0.555 times more likely to be working than those in the other age groups. This result indicates that as the age of those children increases, the possibility of being working increases. This finding is consistent with that of Hussain and Hussain (2011), who found that the most age group of child laborers is (11-14). The same feature was also found in the Sudanese States in the west, north, and south. Also, most of the Sudanese communities in rural areas prefer children working in the age group (9-14) in different fields such as agriculture, grazing, bringing food, daily work in order to earn money to save money for the family. In addition, mother education was associated with child labor significantly; this result reflected that the education of mother is a crucial factor that influences child labor, i.e., educated mothers are keen on educating their children so as to prevent them from working. The variable number of family members was found to correlate with child labor, which indicates that when the family members increased, there is a possibility for child labor. This is supported by the odds ratio (3.329), which indicates that families with (5-8) people their children are more likely to work than other families with fewer children. In other

words, the number of family members correlated with child labor, especially if the parents do not meet the requirements of their children. This result is in line with the results of Karadshah (2014) and Welay (2014) studies.

Similarly, the marital status of parents plays an essential role in child labor or their continuation in education, and then completing all levels of education until graduation from university and possibly graduate studies. This is confirmed by the result of the logistic regression, which revealed a statistically and significant association between the marital status of the parents and child labor. The more the parents are together, and the family is stable, the more children will be healthy and stable in its economic and educational conditions. This result was supported by the odd ratio of the divorced parents (12.323), which indicates that the children in the family whose parents were divorced are more likely to work than those whose parents are together.

5.1. Conclusion

Child labor in Sudan has been increasing in recent years, especially in the area of the study, Port Sudan city, the capital of the Red Sea State. The results revealed that there is a relationship between child labor and the explanatory variables such as age, mother education, parent marital status, number of family members, and parents' desire.

5.2. Recommendations

Depending on the results of the study, we propose the following recommendations:

1. A good database system must be provided and organize accurate information about child labor in ordered to help policymakers and researchers.
2. Child education, which may contribute to protecting child labor, must be compulsory.
3. Awareness of problems and the risk of child labor is needed to be raised.
4. More in-depth studies to further investigate factors that affect child labor are needed to be conducted.

5.3. Difficulties

The researcher has faced some difficulties and obstacles in collecting data from the target study sample. This may be because working children do not wish to discuss their situation due to the fear that this information will be used against them. This situation made their response very difficult. This was reflected in the small sample size.

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Compliance with ethical standards

Conflict of interest

The authors declare that they have no conflict of interest.

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