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Mapping Spatial Patterns of Child Labor in Sindh: Insights from Regression Analysis of MICS Data

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Abstract: Child labor remains a predominant issue in Pakistan, despite the country's existing policies and frameworks aimed at abolishing it. Through this study, we investigated the child labor distribution across Sindh and examined the factors that shape the regional patterns. We analyzed the data available through the 2018-19 Sindh Multiple Indicator Cluster Surveys, MICS 6, from 20,030 households with 40,633 children in the 5-17 age bracket. By applying prevalence statistics, chi-square tests, and regression modeling to these data, we investigated the trends in child labor prevalence, identified the correlation between child labor and various socioeconomic and geodemographic variables, and finally mapped the geospatial patterns of child labor across districts in Sindh, enabling us to identify and prioritize the districts in need of immediate intervention. The findings revealed that about 20 percent of the children in Sindh are engaged in child labor, with a high prevalence among males and in the 15-17 age bracket. Moreover, poverty and rural dwellings raise this issue. Other socioeconomic and geographic factors reinforcing this issue are lack of education among children, mothers or caretakers, and mothers' or caretakers' functional difficulties. However, children's functional difficulties lower their prevalence in labor. Among the 29 districts across Sindh, Kambar Shahdadkot has the highest prevalence of child labor.

Keywords: child labour; logistic regression; geospatial mapping; MICS; spatial patterns; Sindh; Pakistan

1. Introduction

Child labor is a growing global concern with 160 million children as victims of this predatory practice across the world. According to the International Labour Office and United Nations Children's Fund [1], this figure marks a worrying trend, particularly with the economic aftershocks of the COVID-19 pandemic pushing more children into exploitative work. It exists across the developing as well as the developed nations. Sub-Saharan Africa, being the most significant, has 86.6 million child laborers which is 23.9 percent of the global share in child labor. Central and South Asia follow, with 26.3 million child laborers, representing 5.5 percent of the global share [1].

While child labor definitions vary culturally, generally it is considered as 5-17-year-old children's engagement in work, not classified as permissible light or non-hazardous work [1]. Moreover, child labor does not include household chores or family business-related activities, provided these do not adversely affect the child's health or education. According to the UNICEF MICS 2018-19 report, child laborers are children involved in economic activities or household chores beyond age-specific thresholds.

In 2021, the International Labour Organization reported that child labor is predominant in lower-middle-income and low-income countries, contributing 43 percent and 41 percent respectively to the global share [1]. At the beginning of 2020, there were 63 million girls and 97 million boys among the 160 million child laborers across the world. Figure 1 illustrates the percentage of children aged 5-17 years in 2020, who were engaged in child labor and did not attend school; more than one-third of these children were not attending school. As we move to the right-hand side of the graph, it can be seen that the highest proportion of out-of-school children were 15–17 years old. A higher number of boys were out of school compared to girls, and urban children were more frequently out of school

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than their rural counterparts. Despite the critical importance of the impact of child labor, there remains a paucity of evidence on the causal relationship between child labor and school attendance, particularly whether child labor keeps children out of school or whether school attendance reduces the prevalence of child labor.

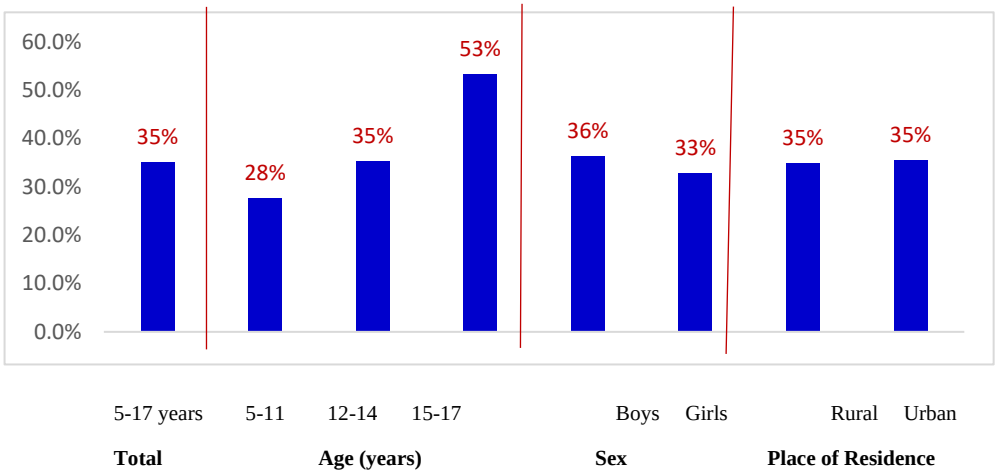

Figure 1. Global Percentage of 5-17 Years Children in Child Labor Not Attending School in 2020, by Age, Sex and Place of Residence. Data Source: ILO (2021).

While eradicating child labor is not explicitly enumerated among the 17 Sustainable Development Goals (SDGs) set by the United Nations in 2015, it is implicitly integrated as Indicator 8.7.1, under Target 8.7, in SDG 8 [2]. It aims to take prompt and effective measures to end child labor by 2025 and create opportunities for conventional work that would drive economic growth. Abolishing child labor will advance progress across other SDGs as well, particularly those related to education and health.

For over two decades, the ILO has been advocating for abolishing child labor. Child labor has gradually decreased up until 2016, shown as a downward trajectory in Figure 2. However, after 2016, this decrease stalled for the first time. International Labour Office and United Nations Children's Fund [1], attributed this stagnation to the COVID-19 pandemic, which also contributed to the poverty surge; increasing families' dependencies on child labor for supplemental income. During this time, school closures worsened the situation, compelling low-income families to send their children to work. Consequently, more children were pushed into child labour.

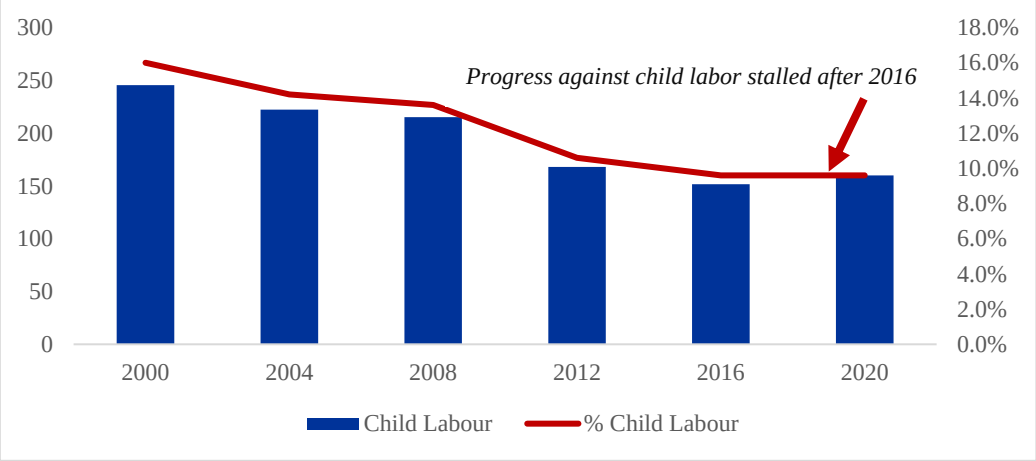

Figure 2. Global Child Labor Trend 2000-2020. Data Source: ILO (2021).

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Researchers have consistently identified poverty as the driving force behind child labor in developing countries [3–9]. However, alternative factors contributing to global child labor are inadequate educational infrastructure [10,11], deep-rooted cultural norms and traditions [12], laxity in law enforcement and general ignorance of pertinent laws [1,12,13], and consistent demand for low-cost labor [14]. Family dynamics [9], insufficient resources and funds for education [15], and migration and displacement [11] further aggravate the situation. Dash, et al. [16] argued that discrimination against certain ethnic and minority groups limits their access to education and employment opportunities, hence perpetuating child labor. Adding a nuanced perspective on child labour, Iqbal, et al. [17] denounced child labor as not only violating human rights; it also has detrimental effects on children's health such as malnutrition and stunted development, depriving children of their rights to education.

Rehman [15] argued that child labor remains a pressing concern in Pakistan with approximately 12 million children trapped in this vicious practice, positioning the country as third in child labor among South Asian countries, following India and Bangladesh [4]. While child labor is pervasive across all four provinces in Pakistan, the concentrated demographic distribution of Sindh, in particular, offers a safe haven for this crime. Ram, et al. [12] and Rehman [15] suggested that the concentrated demographic distribution exerts intense economic pressure in densely populated areas to compete for employment and resources. This bolsters demand for an informal and cheap labor market, which further exploits child labor and consequently compels underprivileged families to send their children to work. Alam [10] affirmed that in Sindh alone there are 1.7 million child laborers. These demographic and socio-economic variations that support child labour prevalence at the provincial and regional level made Sindh a focus for our study.

In 2017, the Government of Sindh enacted "The Sindh Prohibition of Employment of Children Act, 2017" which prohibits minors' employment and regulates adolescents' employment in certain industries [18]. Parallel laws that address child labor in Pakistan are the Employment of Children Act, of 1991, the Bonded Labor System (Abolition) Act, of 1992, and the Minimum Wages Ordinance, of 1961. Violating these laws has severe consequences [18]; however, child labor remains a persistent issue in Sindh [12]. Dash, et al. [16] proposed that sending children to school can break the vicious cycle of child labor. However, this comes with a toll of investing resources and efforts to develop affordable and accessible educational infrastructure. The current statistics on out-of-school children in Pakistan are alarming; on May 9, 2024, Pakistan declared a nationwide education emergency with 26 million children out of school [19]. As mentioned earlier, there is no evidence for the causal relationship between child labor and out-of-school children.

Meeting UNICEF's goal of abolishing child labor by 2025 demands considerable effort. The purpose of our study was to investigate the distribution of child labor across Sindh in association with sociodemographic, economic, and contextual factors. For this, we examined the disparities across genders and socio-economic groups, and the underlying factors contributing to the observed spatial patterns of child labour in Sindh, Pakistan. We analyzed data from the 2018-19 Sindh Multiple Indicator Cluster Surveys, MICS, Series 6 [20] to explain the pattern in the prevalence of child labor within the province. We further employed regression analysis on MICS data and identified correlations between the prevalence of child labor and a range of socio-economic and demographic variables, which enabled us to identify and prioritize the districts most in need of immediate intervention. This study offers a nuance of child labor dynamics and informs targeted interventions. Our study was guided by the research question: "What are the spatial patterns of child labor prevalence in Sindh, Pakistan, and how do socio-economic and demographic factors influence these patterns?

2. Materials and Methods

To address the research question, we conducted a comprehensive analysis of data from Sindh MICS 6, employing Prevalence Statistics, Pearson Chi-Square tests, and Regression Modeling. We systematically mapped the prevalence rates and odds ratios (OR) across the districts in Sindh.

 doi:10.20944/preprints202410.0298.v1

Data

We applied the quantitative research approach to the secondary data from the 2018-19 Sindh MICS 6, provided by the Bureau of Statistics, et al. [20]. The datasets comprised interviews with 20,030 households, encompassing 40,633 children in 5-17 years age bracket, across 1,027 enumeration areas (EAs) in 29 districts of Sindh, with clear distinctions between rural and urban locales. We grounded our analysis in the responses to the child labor questionnaire administered to the mother or primary caretaker of a randomly selected child in the 5-17 years age group within each household.

Next, we reviewed the literature and formulated the research question presented earlier. Subsequently, we employed descriptive statistics (frequency) and prevalence tests for initial data analysis, and used logistic regression for inferential analysis, as suggested by Cohen, et al. [21]. Finally, we interpreted the results and drew conclusions drawn from our analysis.

The MICS data on child labor applied three age-specific thresholds for permissible hours of economic or other activities before being classified as child laborers: (a) 1 hour or more for children aged 5-11 years, (b) 14 hours or more for children aged 12-14 years, and (c) 43 hours or more for those aged 15-17 years.

Both outcome and predictor variables were categorical, represented by distinct categories contrary to numerical values; and dichotomous, having two distinct and mutually exclusive values (yes/ no, male/ female). We constructed the outcome or dependent variable 'child Labor' in SPSS using the 'or' function that assigned value '1' if a child was engaged even for 1 hour as mentioned in the survey questionnaire in any of these activities: working on a farm, household plot, or food garden or caring for animals; assisting in the family business, a relative's business with or without pay, or running their own business; producing or selling articles, handicrafts, clothing, food or agricultural products; or engaging in any other activity for monetary compensation or equivalent.

The predictors or independent variables shortlisted for this research were: demographic factors (sex, age) educational background (child's education, mother's education) health and functional status (child's functional difficulties, mother's functional difficulties), socioeconomic status (wealth index quintile), and contextual factors (area, divisions, and districts). The variable 'sex' had two categories, male and female. Age was divided into three categories: 5-11 years, 12-14 years, and 15-17 years. Child's education and mothers' education each had the same five categories: pre-primary or none, primary, middle, secondary, and higher. The child's functional difficulty and mother's functional difficulty were categorized into 'has functional difficulty' and 'has no functional difficulty'. The wealth index quintile had these five categories: poorest, second, middle, fourth, and richest. In the analysis, key contextual variables were considered to account for the geographical and administrative variations. The 'Area' variable was categorized into rural and urban settings. Additionally, the region was divided into six major administrative divisions: Hyderabad, Karachi, Larkana, Mirpurkhas, Shaheed Benazirabad, and Sukkur. Within these divisions, further granularity was achieved by considering the 29 districts including Badin, Dadu, Hyderabad, Jamshoro, Matiari, Sujawal, Tando Allahyar, Tando Muhammad Khan, and others, to provide a detailed understanding of the spatial distribution across the province.

Data Treatment

As mentioned earlier, the outcome variable and predictor variables were dichotomous, yielding two distinct and mutually exclusive values (yes/ no, male/ female, rural/ urban). The sample weight for children aged 5-17 was applied to the data. We conducted a series of analyses including prevalence tests, cross-tabulation (chi-square tests), and logistic regression. A significance level of $p < 0.05$ was used to determine statistical significance. To ensure the inclusion of all relevant data, we applied a filter and utilized the 'Select Case' function in SPSS. Moreover, geospatial mapping techniques were employed to map the prevalence of child labor and the odds ratios at the district level.

Prevalence

A prevalence test was run to analyze the distribution of values associated with the outcome variable Child Labor. It summarized the frequency of occurrence of each variable which is the

 doi:10.20944/preprints202410.0298.v1

number of child laborers in Sindh. This prevalence test proved instrumental for descriptive statistics, data cleaning, and variable selection. By generating a frequency table, the test facilitated a summary of the distribution of categorical variables. We systematically tallied the cases within each category using MICS data to rectify any missing values before proceeding to the next analysis.

Statistical Analysis

To establish if there was a significant association between the outcome and predictor variables, we applied a Chi-square test with a pre-established significance level of 0.05 and compared the p-values of each predictor variable against this significance level. Subsequently, we considered variables with p-values above this threshold as statistically insignificant and rejected them.

Given that the outcome and several predictor variables were dichotomous or categorical, we applied logistic regression to the data. The rationale for running logistic regression was to model the relationship between the categorical outcome variable, 'Child Labor,' and the predictor variables. In this analysis, we evaluated odds ratios (OR) by designating a reference category for each variable. The effect of all other categories within each variable was then assessed relative to this reference category, allowing us to examine how changes in the predictor variables were associated with variations in the likelihood of the outcome variable, 'Child Labor.'

3. Results

In this section, we present the results of the Prevalence test, Chi-Square Test, and Logistic Regression on the 2018-19 Sindh MICS 6 data.

3.1. Prevalence

As of MICS Sindh 2018-19 survey, the Prevalence test results presented in Table 1a and 1b reveal that 8210 out of 40,633 among 5-17 years old children in Sindh were engaged in child labour, which is more than 20 percent of child labourers. The results indicate that children's engagement in labor progresses with age, with 11 percent for 5-11 years, 24 percent for 12-14 years, and 33 percent for 15-17 years children; the prevalence of child labor being the highest in the 15-17 years and the lowest in the 5-11 years age group.

Table 1a. Socio-economic, Demographic, and Geographic Factors Distribution of Child Labour in Sindh (N=40,633).

Variables	Categories	Responses and Percentage			
		No	%	Yes	%
Sex	Male	16537	78	4733	22
	Female	15886	82	3477	18
Area	Urban	17336	88	2304	12
	Rural	15087	72	5906	28
Age	5-11	16050	89	2052	11
	12-14	11257	76	3629	24
	15-17	5116	67	2529	33
Child's education	Pre-primary or none	15386	77	4701	23
	Primary	10754	83	2191	17
	Middle	3493	82	786	18
	Secondary	2005	85	363	15
	Higher	781	82	167	18
Mother's education	Pre-primary or none	21041	75	7053	25
	Primary	3761	86	595	14
	Middle	1789	93	135	7

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	Secondary	2965	92	266	8
	Higher	2859	95	153	5
	Missing/DK	7	44	9	56
Child's functional difficulty	Has functional difficulty	5102	84	988	16
	Has no functional difficulty	27321	79	7222	21
Mother's functional difficulties	Has functional difficulty	1211	73	455	27
	Has no functional difficulty	31122	80	7679	20
	No information	91	54	76	46
Wealth Index quintile	Poorest	5827	64	3305	36
	Second	6400	71	2594	29
	Middle	7126	84	1393	16
	Fourth	7180	92	584	8
	Richest	5890	95	335	5
Division	Hyderabad	7540	82	1620	18
	Karachi	10532	92	902	8
	Larkana	4072	68	1936	32
	Mirpurkhas	2379	63	1387	37
	Shaheed Benazirabad	3851	77	1126	23
	Sukkur	4049	77	1239	23

Table 1b. Socio-economic, Demographic, and Geographic Factors Distribution of Child Labour in Sindh (N=40,633).

Variables	**Categories**	**Responses and Percentage**			
		No	%	Yes	%
Districts	Badin	1326	78	379	22
	Dadu	1039	82	222	18
	Hyderabad	1517	95	80	5
	Jamshoro	747	89	95	11
	Matiari	579	82	124	18
	Sujawal	674	84	126	16
	Tando Allahyar	592	76	183	24
	Tando Muhmmad Khan	386	76	125	24
	Thatta	681	70	285	30
	Karachi Central	1573	85	278	15
	Karachi East	2059	92	167	8
	Karachi West	2796	93	204	7
	Karachi South	1093	94	75	6
	Korangi	1617	93	116	7
	Malir	1395	96	62	4
	Jacobabad	589	59	401	41
	Kambar Shahdadkot	679	51	642	49
	Kashmore	825	78	237	22
	Larkana	1105	76	358	24

 doi:10.20944/preprints202410.0298.v1

Shikarpur	874	75	299	25
Mirpur Khas	968	74	343	26
Tharparkar	776	55	636	45
Umer kot	635	61	409	39
Naushahro Feroze	1287	86	205	14
Sanghar	1214	63	714	37
Shaheed Benazir Abad	1350	87	207	13
Ghotki	1338	78	379	22
Khairpur	1597	74	569	26
Sukkur	1115	79	291	21

The test further reveals gender disparity in child labor in Sindh with 22.3 percent males compared to 18 percent females engaged in child labour, signaling a higher prevalence of male children in these activities. Moreover, children from rural areas (28 percent) were more susceptible to child labor than those from urban areas.

The results from the variables 'child's education' and 'mother's education' indicate that child labor prevalence decreases with the advancement in the child's or mother's educational level. For children's educational level, 23 percent of children with pre-primary or no education were involved in child labour; the highest proportion among the five categories of educational level. However, there was a noticeable decline in children's involvement in labor as their educational level improved. A similar pattern exists between the mother's education level and the child's engagement in labour; 25 percent of the children were involved in child labour in those cases where the mother had pre-primary or no education. However, this involvement declined with the advancement in the mother's level of education.

The variables on functional difficulties show interesting prevalence. Child labor was more prevalent among functionally capable children compared to those with functional difficulties. 16 percent of children with functional difficulties were engaged in child labour, compared to 21 percent of children who had no functional difficulty. Conversely, children of mothers or caretakers with functional difficulties were seen to be vulnerable to child labor. This suggests that the child's functional difficulty lowers their involvement in labour, whereas the mother's or caretaker's functional difficulty increases this involvement.

The prevalence test results on the wealth index quintile underscore the impact of poverty on child labour. 36 percent of children from underprivileged households were in the labour force, compared to 5 percent of children from affluent households. This suggests child labor prevalence decreases with improved financial conditions.

The results at the division level indicate a pronounced disparity in child labor prevalence among the five divisions in Sindh. Mirpurkhas exhibits the highest rate of child labor in Sindh with 37 percent of children involved, while Karachi shows the lowest rate with 8 percent of children involved in the labor force. The findings from the 29 districts across Sindh reveal that Kambar Shahdadkot has the highest frequency with 49 percent of children involved in child labor, whereas Malir has the lowest frequency of child labor with 4 percent involvement.

3.1.1. Mapping Distribution of Child Labor Prevalence at the District Level

For a visual depiction of child labor prevalence at the district level in Sindh, we mapped the results of the prevalence test on the predictor variable 'Districts' as shown in Figure 3. The provincial child labor prevalence as established from Sindh MICS 6 data is 20.2 percent. The prevalence test yielded a span of 4.25 to 48.6 percent across the districts in Sindh. Based on the standard deviation, we categorized this range into green for child labor prevalence significantly below the provincial average, yellow for districts that have child labor prevalence close to the provincial average of 20 percent, orange for districts with a higher prevalence than the average, and red for districts with an

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alarmingly high prevalence, almost twice the provincial rate. According to Figure 3, Kambar Shahdadkot, Tharparkar, and Jacobabad districts color-coded in red, flag these districts with extremely high child labor rates, followed by districts in orange; Umer Kot, Sanghar, and Thatta.

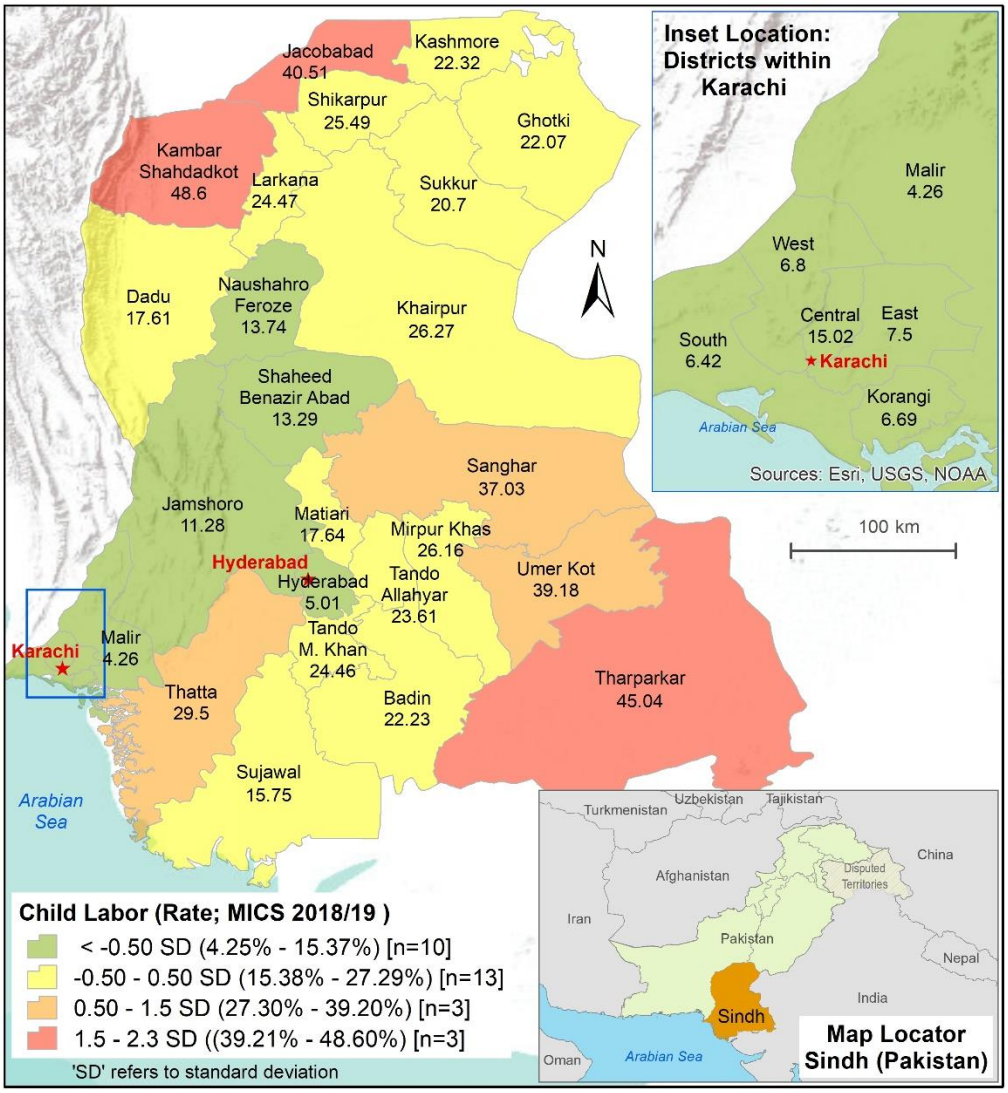

Figure 3. Distribution of prevalence of child labor at district level in Sindh.

3.2. Chi-Square Test

The Pearson Chi-Square test ascertained any association between the outcome variable 'child labor' and the predictor variables, with a pre-established significance level of 0.05. To assess this statistical significance, we compared p-values of each predictor variable to 0.05 significance level, marked the variables with p-values exceeding this threshold as statistically insignificant, and subsequently rejected them. The variables that we finally recorded in Tables 2a and 2b are the ones that we shortlisted based on their p-value below 0.05. We have discussed each of these variables in this section.

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Table 2a. Child Labour in Sindh - Logistic Regression Table.

Variables	categories	Sig.	Exp(B)	95% C.I.	
		p-value	(OR)	Lower	Upper
Sex	Male (Ref)		1		
	Female	<.001	0.688	0.65	0.728
Area	Urban (Ref)		1		
	Rural	<.001	1.194	1.107	1.288
Age	5-11 (Ref)	0	1		
	12-15	<.001	3.097	2.897	3.311
	15-17	0	6.484	5.968	7.045
Child's education	Pre-primary or none (Ref)	<.001	1		
	Primary	<.001	0.862	0.805	0.923
	Middle	<.001	0.791	0.712	0.878
	Secondary	<.001	0.583	0.506	0.673
	Higher	<.001	0.583	0.478	0.711
Mother's education	Pre-primary or none (Ref)	<.001	1		
	Primary	<.001	0.818	0.738	0.906
	Middle	<.001	0.696	0.574	0.844
	Secondary	0.292	0.922	0.792	1.072
	Higher	<.001	0.592	0.489	0.718
	Missing/DK	<.001	7.612	2.435	23.79
Child's functional difficulty	Has functional difficulty (Ref)		1		
	Has no functional difficulty	0.003	1.142	1.047	1.245
Mother's functional disabilities	Has functional difficulty (Ref)	<.001	1		
	Has no functional difficulty	<.001	0.728	0.64	0.829
	No information	0.005	1.714	1.175	2.499
Wealth index quintile	Poorest (Reference)	<.001	1		
	Second	<.001	0.715	0.664	0.77
	Middle	<.001	0.403	0.368	0.441
	Fourth	<.001	0.195	0.17	0.224
	Richest	<.001	0.133	0.111	0.159
Division	Hyderabad (Reference)	<.001	1		
	Karachi	<.001	0.481	0.358	0.646
	Larkana	<.001	1.72	1.426	2.076
	Mirpurkhas	<.001	2.789	2.327	3.344
	Shaheed Benazirabad	0.032	0.805	0.66	0.982
	Sukkur	<.001	1.521	1.261	1.833

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Table 2b. Child Labour in Sindh - Logistic Regression Table.

Variables	categories	Sig.	Exp(B)	95% C.I.	
		p-value	(OR)	Lower	Upper
District	Badin (Reference)	<.001	1		
	Dadu	0.806	1.025	0.841	1.249
	Hyderabad	<.001	0.617	0.471	0.808
	Jamshoro	0.007	0.702	0.543	0.907
	Matiari	0.782	0.967	0.761	1.228
	Sujawal	<.001	0.6	0.475	0.757
	Tando Allahyar	<.001	1.532	1.234	1.902
	Tando Muhmmad Khan	0.64	1.061	0.829	1.357
	Thatta	<.001	1.951	1.599	2.38
	Karachi Central	<.001	9.055	6.675	12.283
	Karachi East	<.001	2.881	2.102	3.949
	Karachi West	<.001	2.455	1.811	3.328
	Karachi South	<.001	2.839	1.978	4.077
	Korangi	<.001	2.7	1.939	3.761
	Malir				
	Jacobabad	<.001	1.614	1.321	1.971
	Kambar Shahdadkot	<.001	3.039	2.528	3.652
	Kashmore	0.007	0.75	0.609	0.924
	Larkana	<.001	1.386	1.143	1.682
	Shikarpur				
	Mirpur Khas	<.001	0.62	0.512	0.751
	Tharparkar	0.097	1.161	0.973	1.385
	Umer kot				
	Naushahro Feroze	0.72	1.041	0.836	1.296
	Sanghar	<.001	3.561	2.958	4.287
	Shaheed Benazir Abad				
	Ghotki	0.348	1.094	0.907	1.321
	Khairpur	0.03	1.211	1.018	1.439
	Sukkur	<.001	0.195		

For the variable 'sex', the Pearson Chi-Square test yielded a p-value of 0.001, which is below the significance level of 0.05, signaling a statistically significant gap in child labor engagement between male and female children in Sindh. A higher percentage of male children are involved in child labor than their female counterparts. Likewise, the p-value for the variable 'area' was less than 0.05, revealing a significant difference in child labor in rural versus urban areas in Sindh. The rural areas exhibited a higher propensity for child labor.

For the variable 'age', the p-value 0.001 indicated a significant variation in child labor across the three age groups of 5-11, 12-14, and 15-17 years. Children's education level also yielded a p-value below 0.05, reflecting a significant correlation between the child's educational level and their susceptibility to child labor; low education level increased the likelihood of the children's involvement in labor. Moreover, there were significant variations across the educational levels: pre-primary or none, primary, middle, secondary, and higher. Mother's educational levels exhibited similar results, with less educated mothers' children being prone to engage in child labor.

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The p-value for children's functional difficulties was below the significance level, establishing a linkage with child labor. Children without functional difficulties are more susceptible to child labor. A contrary trend was observed with mothers' functional difficulties, where children of mothers with such difficulties were more frequently engaged in labor.

The wealth index quintile demonstrated a p-value below the significance threshold, reflecting notable variation among the five wealth index levels in Sindh. The poorest quintile harbors the highest percentage of child laborers in Sindh, whereas the wealthiest quintile exhibits the lowest incidence. The Chi-Square test results for divisions provided a p-value below 0.05, showing significant differences in child labor distribution across the six divisions of Hyderabad, Karachi, Larkana, Mirpurkhas, Shaheed Benazirabad, and Sukkur in Sindh. Similarly, the district-level Chi-Square results also yielded a p-value below the significance level, which confirmed significant variability in child labor incidence across the 29 districts in Sindh.

Pearson's Chi-Square test results indicate that gender, area, age, child's education, mother's education, child's functional difficulties, mother's functional difficulties, wealth index quintile, divisions, and districts, have a p-value less than 0.05, confirming a correlation with child labor.

3.3. Logistic Regression

In this section, we present the findings from logistic regression, as recorded in Table 2. The fourth column of the table shows the odds ratio – OR.

For the variable 'Sex', 'male' being the reference, the odds of a female in child labour are 0.7, with a 95 % confidence interval and 0.65-0.73 as the lower and upper limit, indicating more male children involved in the labor force than their female counterparts.

For the predictor variable 'Area', considering urban as the reference, the odds that children from rural areas will be involved in the labor force are 1.2. With a 95% confidence interval, the lower and upper limits being 1.1 and 1.29 respectively, the results indicate that child labor is more dominant in rural areas compared to those in urban settings.

For the independent variable 'Age', considering the 5-11 years age bracket as the reference, the odds for the 12-15 years old being involved in child labour are almost three times higher, with 2.9 and 3.3 as the lower and upper limits respectively, with 95% confidence interval. In the age bracket of 15-17 years, the odds are more than six times with a 95% confidence interval with 5.9 and 7 as the lower and upper limits respectively, revealing that older children have more chances of being involved in child labour, potentially due to their ability to perform physically demanding and hazardous tasks.

For 'Child's education', with pre-primary or no education as a reference, the odds of a child with primary education being engaged in child labour reduced to 0.86, with lower and upper limits of 0.8 and 0.9 with a 95% confidence interval. These further reduce to 0.79 among children with middle education, with lower and upper limits of 0.71 and 0.88 with a 95% confidence interval. Finally, it plummets to 0.58 as children acquire secondary and higher education, with lower and upper limits being 0.5 and 0.7 with a 95% confidence interval. This indicates that as the level of a child's education rises, the odds of their involvement in child labour steadily decline. A similar trend was observed for 'Mother's education'. With pre-primary or no education as the reference, the odds of a child being engaged in labor decrease to 0.8 for those whose mothers have primary education. The lower and upper limits are 0.7 and 0.9 respectively with a 95% confidence interval. The odds keep on reducing as the mother's education level keeps on improving.

For 'Child's functional difficulties'; with functional difficulty as the reference, the odds of a child with no functional difficulty being in the labor force increase by 1.14, with lower and upper limits being 1.04 and 1.24 respectively with a 95% confidence interval. This reflects that there are more chances that a child with no functional difficulty will be involved in child labour. On the contrary, 'Mother's functional difficulties' increase the odds of a child being in the labor force. The reference is that the mother has functional difficulty, the odds of a child with a mother with no functional disability, being in the labor force are reduced by 0.7, with lower and upper limits of 0.6 and 0.8 with a 95% confidence interval.

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For the 'Wealth index quintile', the 'poorest' household as the reference, the odds of children from the 'second' [poorest] household being involved in work reduce to 0.7, with 0.66 and 0.77 being the lower and upper limits with 95% confidence interval. The odds of children's involvement in labour gradually decline with improved economic household conditions. Children from the richest household have the lowest odds of 0.13 with the lower and upper limits being 0.11 and 0.16 respectively in a 95% confidence interval.

For the variable 'Division', with Hyderabad as the reference, Mirpurkhas stands out with the highest odds for child labour being 2.7, with 2.3 and 3.3 as the lower and upper limits with 95% confidential interval. Karachi, on the other extreme exhibits the lowest odds of 0.48 for child labour, with 0.36 and 0.65 the lower and upper limits with a 95% confidence interval.

For the variable 'District', Badin is the reference. The districts of Dadu, Matiari, Tando Muhammad Khan, Malir, Shikarpur, Umerkot, Naushahro Feroze, Shaheed Benazir Abad, and Ghotki have similar odds of child labour as Badin. While Karachi Central stands out with nine times higher odds of children in labor compared to that of Badin. Sukkur has the lowest odd ratio (0.195). The reason for the high OR in Karachi Central, though it has a low prevalence compared to the provincial average of 20% is the socio-economic conditions in Karachi. Karachi is the most densely populated city in Pakistan, but low in resources that would accommodate even the basic needs of the growing population. It is divided into 6 divisions which are further divided into 29 districts. Karachi Central is one of these 29 districts. The population of Sindh is concentrated in Karachi, particularly in Karachi Central, the rest of the province has a scattered population. Due to the prevailing poverty (also one of the factors for child labor), underprivileged families send their children to work. Therefore, OR of 9 in Karachi Central gives a more accurate representation of a child being involved in labor, compared to the district Badin.

3.3.1. Mapping Distribution of Child Labor Odds Ratio at the District Level

Derived from the Logistic Regression analysis, Figure 4 is a visual representation of the distribution of odds ratio (OR) at the district level across Sindh. Using Badin as the reference, the OR span extends from 0.6 to 9.05. We segmented this span into five intervals and color-coded each interval for clarity. The first interval with OR 0.60-0.70 in dark green shows low OR compared to the reference (Badin, OR = 1), the second interval with OR 0.71-1.00 in light green has districts with OR close to the reference, the third one with OR =1 is the reference in yellow, the fourth interval with OR 1.01-2.00 in orange has districts with higher OR than the reference, and the fifth interval with OR 2.01-9.05 in red shows an alarmingly high odds ratio to the reference. As illustrated in Figure 4, Karachi Central, Kambar Shahdadkot, and Sanghar marked in red show alarmingly high odds ratios, signaling a need for critical intervention to curb child labor in these districts.

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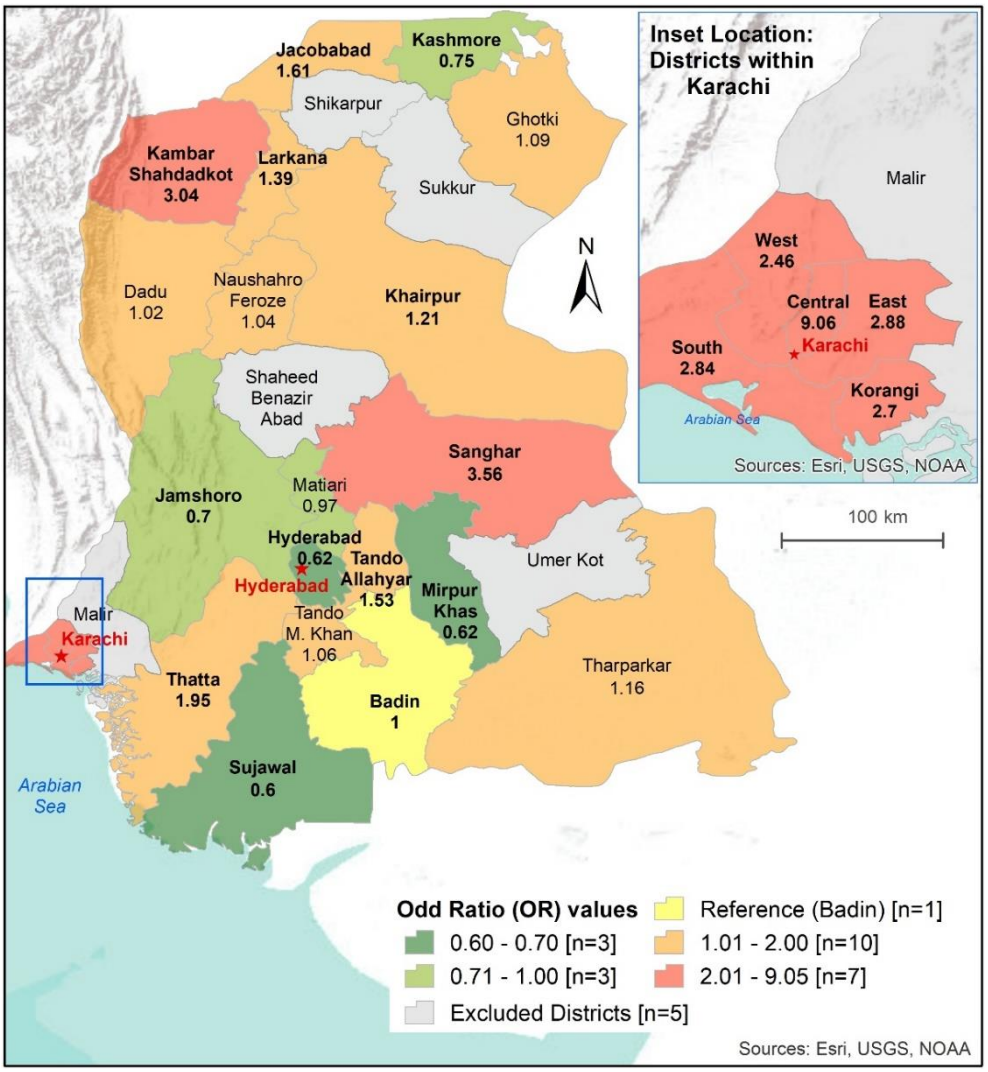

Figure 4. Distribution of odds ratio of child labor at district level in Sindh.

4. Discussion

Through this study, we analyzed the child labor distribution across Sindh in relation to the prevailing sociodemographic, economic, and contextual factors. The rationale behind this study was to refine the analysis of these factors and to explain their association with child labor to precisely delineate the issue.

Applying the prevalence statistics, chi-square tests, and regression modeling on data from the 2018-19 Sindh Multiple Indicator Cluster Survey 'MICS 6', we analyzed the trends in child labor prevalence across the province, explored the correlation between child labor prevalence and various socio-economic and geo-demographic variables, and mapped the geospatial patterns of child labor in 29 districts across Sindh; enabling us to identify and prioritize the districts in need of immediate intervention.

The results from the Sindh MICS 6 data indicate that more than 20 percent of the children in Sindh were engaged in child labor, which is less than the 26 percent reported in the 2014 Sindh MICS 5 report. This suggests that the child labor rate decreased over the reporting period. However, a closer look at the rate of decrease reveals that there was a one percent decrease per year. This is not a substantial decrease in one year to curb such a critical issue, keeping in view that child labor not only impedes the physical growth and education of a child but is also linked to developing mental health issues at a later age [10]. For the same period as our study, ILO Publishing [22] reported Punjab, the largest province of Pakistan, having the highest rate of child labor in the country. Child labor prevalence appears to be a regional issue in South Asia. Das [4] reported that India has the highest

 doi:10.20944/preprints202410.0298.v1

number of child laborers in South Asia (5.8 million), followed by Bangladesh (5 million), and Pakistan (3.4 million).

For this study, we shortlisted the predictor variables from past studies as sex, area, age, child's education, mother's education, child's functional difficulty, mother's functional difficulty, wealth index quintile, division, and district, and categorized them under demographic, socio-economic, and regional factors for this discussion.

4.1. Demographic Factors

The prevalence test results on the demographic variables sex, age, and child's education show a high prevalence of child labor among males, children in the 15-17 age bracket, and children with pre-primary or no education. The Pearson Chi-Square tests on sex, age, and child's education yielded p-values below 0.05, indicating a significant difference among the categories of each of these variables. Finally, Logistic Regression analysis indicates that female children (OR=0.69), young children in the 5-11 years age bracket (OR=1), and children with higher education (OR=0.58) have the lowest odds of being engaged in child labor in their categories.

The results from similar studies vary across the world. Das (2022) reported that 5-14-year-old children as the most vulnerable group (75 percent involvement) in child labor in India. Whereas, Hossain (2023) notified 15-17 years old children as the most susceptible (74 percent involvement) to child labor in Bangladesh. Jephtah, et al. [7] reported similar results of increasing chances of child labor with the increase in age in Nigeria. The highest incidence of child labor in the 15-17 age bracket in Sindh, Bangladesh, and Nigeria is reflective of employers' preference for older children in the workforce, who are perceived as more skilled compared to their younger counterparts. This perception can also be attributed to their ability to perform physically demanding and hazardous tasks. Moreover, older children can easily be admitted into hazardous jobs because the employers feel they can perform the task better than their younger counterparts.

The reports on child labor gender in India [4,16] and Bangladesh (Hossain, 2023) are consistent with our findings on child labor in Sindh, which indicate that male children are more likely to be employed than their female counterparts. The gender disparity in child labor across South Asia can be linked to the cultural norms that hold females responsible for household chores and males responsible for making a living for the family. International Labour Office and United Nations Children's Fund [1] also reinforced the higher rate of child labor among boys compared to girls across all age groups. Though, the pattern indicates more boys involved in child labor than girls; Khan [23] argued that girls are susceptible to the worst forms of child labor including bonded labor and sexual exploitation, which might be a consequence of working in the unregulated and unorganized labor industry of domestic work outside of their home.

The statistical analysis on the variable 'Child's Education' positions education as a dynamic contributor to abolishing child labor. The odds of a child being involved in the labor force in Sindh decrease with the advancement in their educational level (or attainment). However, this is inconsistent at the regional level. Das [4] reported that children with secondary and higher secondary education in India are more likely to be involved in child labor. The risk of child labour in India decreases if the children attend pre-primary and primary schools, and increases with secondary education, and higher secondary education. Studies conducted in West Bengal, India more than two decades ago showed similar results of school drop-outs being more involved in child labour [24]. Jephtah, et al. [7] also reported child labor is more prevalent among children who did not attend school in Nigeria. However, as mentioned earlier in this report, there is no evidence of whether child labor leads to school dropouts or vice versa.

4.2. Socio-Economic Factors

We grouped the mother's education, child's functional difficulty, mother's functional difficulty, and wealth index quintile under socio-economic factors. The prevalence test on these variables shows a high prevalence of child labor among children with less educated mothers, children with no

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functional difficulty, children with mothers or caretakers with functional difficulty, and children from underprivileged families.

The Pearson Chi-Square test yielded p-values below the 0.05 threshold for all socioeconomic variables, which ascertained significant differences among the categories of each of these variables. The Logistic Regression analysis indicates that children whose mothers have higher education (OR=0.59), children with functional disability (OR=1), children whose mothers have no functional difficulty (OR=0.72), and children from the 'richest' wealth index quintile (OR=0.13) have the lowest odds of being engaged in child labor.

A mother's education shows a pattern similar to a child's education, as discussed in the preceding section. This correlation underscores the role of maternal education in mitigating child labor. A similar pattern prevailed at the regional level. Child labor was most prevalent in India among families with non-educated parents [4,16,24]. Hossain, et al. [25] reported a similar pattern in Bangladesh. Jephtah, et al. [7] reported similar results; children with less educated mothers or caretakers were more involved in child labor in Nigeria. The rationale behind a mother's education preventing a child's involvement in labor is based on the fact that education gives access to financial literacy and superior job opportunities. When mothers attain higher education, they have better career prospects, which reduces the necessity of a child's engagement in the workforce.

The child's functional difficulty versus the mother's functional difficulty shows a counter pattern. The former reduces the child's chances of being in the workforce, whereas the latter increases these chances. The rationale behind the first scenario might be that the children with functional difficulty are not able to conduct certain tasks, making them less desirable as employees. In the case of the mother's functional difficulty, the mother's inability to perform certain tasks lowers their options to join the workforce, hence compelling the children to work. Hossain, et al. [25] reported a similar impact of a child's functional difficulty and mother's functional difficulty on child labor in Bangladesh as in Sindh.

Studies indicate poverty is the main driving force of child labour in developing countries. Our study showed similar results of the highest incidence of child labor among the most underprivileged families. As the families' financial conditions improve, the involvement of children in the labour force reduces. Gul, et al. [6] reported a similar trend of poverty leading to child labor in the Mardan district of Khyber Pakhtunkhwa province of Pakistan. Jephtah, et al. [7] also reported that children from poor financial backgrounds are more likely to be engaged in child labour in Nigeria.

4.3. Regional Factors

We considered area, division, and district as regional factors. The prevalence test on these variables indicates a high prevalence of child labor in rural areas of Sindh. Moreover, Mirpurkhas and Kambar Shahdadkot have the highest prevalence of child labor at the division and district levels respectively. The Pearson Chi-Square test on area, division, and district yielded p-values below 0.05, indicating a significant difference among the categories of each of these variables. Finally, Logistic Regression analysis placed rural dwelling (OR=1.19), Mirpurkhas division (OR=2.79), and district Karachi Central (OR=9.05) with the highest odds of being involved in child labor within their categories.

Hossain, et al. [25] and Dash, et al. [16] reported higher rates of prevalence of child labor in rural areas in Bangladesh and India respectively. Jephtah, et al. [7] showed similar patterns for their study in Nigeria; children in rural areas were more involved in labor.

Child labor prevalence in rural settings compared to urban areas can be linked to higher employment opportunities in the agricultural sector in rural settings as reported by [1]. Though Karachi Central does not have a high prevalence rate, which means the frequency of child labor in this division is not alarmingly high; the highest odd ratio, OR places this division in the high-risk zone. The rationale behind this might be Karachi Central is a densely populated division, that offers more job opportunities for children.

The statistical analysis reveals that poverty, area, and age are the three main socioeconomic and geodemographic factors that need attention. We base this interpretation on the incident rate recorded

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in the last column of Table 1. The 'Poorest' in the 'Wealth Index Quintile' shows the highest frequency of child labor, followed by '15-17 years' in the 'age' variable, further followed by 'rural' in the 'area' variable in Table 1.

4.4. Research Limitations and Future Research Options

This study was restricted by some limitations and delimitations. Due to time and financial constraints, we delimited our scope of study to the secondary data available on the UNICEF website, instead of gathering primary data by conducting surveys. We utilized the latest datasets publicly available, which limited our work to 2019, and we were unable to explore the findings of prevailing conditions of child labor in Sindh, considering that an education emergency was recently declared in the country, as mentioned earlier.

Our scope of work also delimited our study to explore the factors and map child labor prevalence at the district level. Hence, we did not delve into the causal relationship among these factors. Moreover, the results of our study suggest a decline in child labor from 26 percent to 20 percent over five years. However, due to the limited scope of our study, we could not identify the variables that might have contributed to this decline.

These limitations and delimitations offer future research opportunities to investigate the causal relationship and multivariate analysis to comprehend the relationship between multiple variables. An independent study can also be conducted to investigate the factors that led to the decline of child labor in Sindh from 2014 to 2019.

5. Conclusions

The purpose of this study was to investigate the child labor distribution across Sindh and examine the factors responsible for the regional patterns. We applied the prevalence statistics, chi-square tests, and regression modeling to the 2018-19 Sindh MICS 6 datasets, and investigated trends in child labor prevalence. We further identified the correlation between child labor and various socioeconomic and geodemographic variables and mapped the geospatial patterns of child labor in districts across Sindh. This enabled us to identify and prioritize the districts in need of immediate intervention.

The findings revealed that about 20 percent of the children in Sindh are engaged in child labor. The three main socioeconomic and geodemographic factors that support child labor are poverty, area, and age. Among the 29 districts across Sindh, Kambar Shahdadkot has the highest prevalence of child labor. Other districts that we identified needing immediate intervention are Tharparker and Jacobabad.

This study informs the policymakers that poverty is the major player in promoting child labor in Sindh. With the prevailing socio-economic conditions in the rural areas of Sindh, 15-17-year-old children from underprivileged families are forced to enter child labor to support their families. These variables need immediate attention.

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