

Breastfeeding Associated with Intestinal Parasitic Infections among Children Up to Two Years of Age at Selected Health Facilities in Karachi, Pakistan

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ABSTRACT

Background: Intestinal parasitic infections have been a worldwide public health issue. The most vulnerable population is children due to their immature immune systems and nutritional requirements. IPIs are associated with improper sanitation, no access to safe water and improper hygiene, economic uncertainty, and social marginalization.

Objective: This study aimed to determine the association of breastfeeding with IPIs among children up to two years of age at selected health facilities in Karachi, Pakistan.

Methods: The study was conducted among 160 children up to two years of age, out of which 80 were breastfed and 80 were non-breastfed. The study was carried out in selected health facilities in Karachi, Pakistan, from October 2022 to January 2023. The study design was analytical cross-sectional, and the data was collected through a structured questionnaire. The questionnaire included questions related to the demographics of the children and their mothers, feeding practices, hygiene practices, and the health status of the children.

Results: The overall prevalence of IPIs among children up to two years of age was 36.9%, with *Entamoeba histolytica* and *Giardia Lamblia* being the most common parasites identified. Breastfeeding was significantly associated with a lower risk of IPIs (OR: 2.02, 95% CI: 1.05-3.90). Other factors associated with IPIs included age 0 to 12 months (OR: 0.30, 95% CI: 0.12-0.74), the habit of fingernails trimming (OR: 0.35, 95% CI: 0.17-0.72), mother's hand washing before preparing food (OR: 0.44, 95% CI: 0.22-0.85), method of purifying drinking water (OR: 0.45, 95% CI: 0.21-0.86) and history of diarrhea, abdominal pain, excessive crying, and perianal itching (OR: 1.96, 95% CI: 1.02-3.76), (OR: 1.96, 95% CI: 1.02-3.76), (OR: 2.88, 95% CI: 1.47-5.64) and (OR: 3.15, 95% CI: 1.50-6.60), respectively.

Conclusion: Our study highlights the prevalence of IPIs among children up to two years of age in Karachi, Pakistan. Breastfeeding was found to be protective against IPIs, while other factors such as age, the habit of fingernail trimming, hand washing, water purification, and symptoms of infection were found to be associated with a higher risk of IPIs.

Keywords: Breastfeeding, intestinal parasitic infections, children, Children, Karachi.

INTRODUCTION

Intestinal parasitic infections have been a worldwide public health issue, 3.5 billion people suffered, and 450 million are still suffering due to IPI [1-4]. Children are the most vulnerable population due to immature immune systems and nutritional requirements [3, 5, 6]. The literature revealed that economic and social situations are significant causes of IPIs with improper sanitation, no access to safe water and improper hygiene are other factors [2, 7-9]. Breastfeeding prevents infant mortality and defends against diarrheal illness during the early stages as it builds the child's immune system, and acts as a protective factor against infections [10-12]. This is attributable to the fact that breast milk is a rich source of nutrition and provides infants with immunity, [10, 11, 13-16]. In Pakistan, the recommended exclusive breastfeeding for infants up to 6 months of life is seen for only 38% without any significant changes whereas bottle-

feeding in children below two years is highly prevalent. According to Pakistan Demographic and Health Survey 2012-13, one in five babies less than two months of age is on bottle with a nipple, increasing to 46% of children aged 9-11 months; the highest percentage (51%) found in the age group 20-23 months. As per the National Nutrition Survey 2018, the prevalence of breastfeeding in children up to 2 years of age is 48.4% [17].

Literature suggested most women are working mothers, and others are involved in household chores; therefore, EBF is not practiced; another major factor is the lack of information about the benefits of breastfeeding [17].

Several studies have been conducted in Pakistan regarding Breastfeeding and IPIs and other associated factors; few of them have highlighted the association between breastfeeding and IPIs but still, a gap exists in raising awareness about the protective role of breastfeeding against IPIs that are prevalent in our region as a significant public health problem. Hence, research is required to identify and promote Breastfeeding practices as protection against IPIs.

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The study aimed to determine the association of breastfeeding with IPIs among children up to two years of age.

MATERIALS AND METHODS

An analytical cross-sectional study was conducted from October 2022 to January 2023 in the selected health facilities of Karachi. The sample size was calculated by using percentages of parasitic infections among Breastfeeding children as 38.5% and 75.2% among non-Breastfed children [13]. The power of the test is 90% and 99% confidence level; the estimated sample size came out as a minimum of 55 in each group; for non-respondents, which was inflated and included 80 samples in each group.

The participants were recruited by non-probability purposive sampling technique based on eligibility criteria. Children with their mothers were approached after informed consent from the mother, permanent residents of Karachi, and who did not take any anti-parasitic treatments within one month were included. Children who were not accompanied by mothers, mothers with chronic diseases unable to feed infants, and children who were severely ill were excluded.

Mothers were interviewed, and children were examined on their laps. Laboratory reports of the selected children were recorded. The data collection was done by the principal investigator using a structured questionnaire. The selected mothers were interviewed to get socio-demographic data, hygiene data, and breastfeeding practices. After the interview, the mothers were given a clean, dry, leak-proof plastic container for stool sample collection of the children. Standard procedures were followed for the stool examination. The wet mount and formalin ethyl acetate sedimentation techniques were used. Data were tested for comprehensiveness and consistency and entered into the SPSS version 21. Descriptive analysis was computed to calculate the mean and SD for continuous variables and the percentage for categorical variables was computed. Associations of the outcome with each independent variable were estimated by Independent t-test or chi-square test. The level of statistical significance was put as p-value ≤ 0.05 . The odds ratio and 95% CI were computed to measure the association between the dependent variable and the independent variable.

Confidentiality and privacy are being maintained by keeping the data, including laboratory results of the child, in lock and key with access only for the principal investigator.

RESULTS

The results show information collected from 160 participants from selected health facilities in Karachi, 46% of respondents were from Rafah-e-Aam Medical Centre, 40% from Imran Pediatric Clinic & Vaccination Centre, and 13% from Khidmat-e-Alam.

Socio-demographics

A total of 160 children were grouped into two categories, namely 0 to 12 months and 13 to 24 months. The majority of participants in this study, 76.3% (n=122), belonged to the 13 to 24 months age group. The odds ratio (OR) for Child Age was 0.30 (95% CI = 0.12-0.74), indicating a statistically significant association between younger age (0 to 12 months) and reduced odds of developing IPIs. The p-value for this association was 0.007. Additionally, the majority of participants, 39.4% (n = 63), had a monthly household income of PKR 20,000-40,000 (**Table 1**).

Hygienic Habits

The majority of 71.3% (n = 114) participants who had their fingernails trimmed regularly had half the odds of developing IPIs (OR = 0.35, 95% CI = 0.17-0.72).

The majority of 53.1% (n = 85) of the mothers wash their hands before preparing food, and the method of purifying drinking water was associated with half the odds of developing IPIs (OR = 0.35, 95% CI = 0.18-0.69; OR = 0.45, 95% CI = 0.21-0.86) (**Table 2**).

Related History & Symptoms

The majority of participants who had parasitic infections had a history related to specific symptoms, including diarrhea (43.8%, n = 70), abdominal pain (43.8%, n = 70), excessive crying (36.9%, n = 59), and perianal itching (25.0%, n = 40) (**Table 2**).

Breastfeeding and Associated Factors

Among the 160 participants, 80 (50.0%) were breastfed, and 44 (27.5%) were exclusively breastfed (EBF). The data suggests that breastfeeding, particularly exclusive breastfeeding (EBF), was associated with lower odds of developing intestinal parasitic infections (IPIs).

Table 1: Analysis of Socio-demographic factors of children and their parents associated with IPIs.

Variables	Positive n(%)	Negative n(%)	OR (95% CI)	p-value
Child Age				
0 to 12 months	7 (18.4)	31 (81.6)	Reference category	0.007
13 to 24 months	52 (42.6)	57 (57.4)	0.30 (0.12-0.74)	
Gender				
Male	14 (31.1)	31 (68.9)	Reference category	0.340
Female	45 (39.1)	70 (60.9)	0.70 (0.33-1.46)	
Residence				
Rural	16 (30.2)	37 (69.8)	Reference category	0.214
Urban	43 (40.2)	64 (59.8)	1.55 (0.77-3.13)	
Number of Family Members				
≤ 5	19 (42.2)	26(57.8)	Reference category	0.383
>5	40(34.8)	75(65.2)	1.37(0.67-2.77)	
SES				
Upper class	3 (50.0)	3 (50.0)	Reference category	0.652
Middle class	52 (36.9)	89 (63.1)	1.71(0.2-2.16)	
Lower class	4 (30.8)	9 (69.2)	2.25(0.8-3.1)	

Variables	Positive n(%)	Negative n(%)	OR (95% CI)	p-value
Mother Education Level				
No Education	8 (44.4)	10 (55.6)	Reference category	0.641
Primary	3 (42.9)	4 (57.1)	1.07(0.18-6.21)	
Secondary	2 (14.3)	12 (85.7)	4.80(0.82-27.96)	
Matriculation	6 (40)	9 (60)	1.20(0.29-4.81)	
Intermediate	17 (43.6)	22 (56.4)	1.03(0.34-3.18)	
Higher Education	22 (34.3)	44 (65.7)	1.60(0.55-4.62)	
Father Education Level				
No Education	3 (37.5)	5 (62.5)	Reference category	0.813
Primary	3 (37.5)	5 (62.5)	1(0.13-7.57)	
Secondary	1 (16.7)	5 (83.3)	3.0(0.22-39.60)	
Matriculation	11 (45.8)	13 (54.2)	0.71(0.14-3.66)	
Intermediate	18 (33.3)	36 (66.7)	1.20(0.25-5.59)	
Higher Education	23 (38.3)	37 (61.7)	0.96(0.21-4.42)	
Mother's Working Status				
Working	9 (39.1)	14 (60.9)	Reference category	0.802
Not working	50 (36.5)	87 (63.5)	1.11 (0.45-2.77)	
Father's Occupation				
Private job	46 (36.5)	80 (63.5)	Reference category	0.856
Own Business	13 (38.2)	21 (61.8)	0.92 (0.42-2.02)	
Monthly Income				
< 20,000	6 (17.1)	29 (82.9)	Reference category	0.016
20,000-40,000	29 (46.0)	34 (54.0)	0.24 (0.17-2.12)	
>40,000	24 (38.7)	38 (61.3)	0.32 (0.92-2.89)	
Housing Type				
Non cemented	10 (30.3)	23 (69.7)	Reference category	0.380
Cemented	49 (38.6)	78 (61.4)	1.44 (0.63-3.29)	

CI: Confidence interval, OR: Odds ratio

Table 2: Analysis of Hygienic habits & parasitic infection manifestation factors of children associated with IPIs.

Variables	Positive n(%)	Negative n(%)	OR (95% CI)	p-value
The habit of fingernail trimming				
Yes	34 (29.8)	80 (70.2)	Reference category	0.004
No	25 (54.3)	21 (45.7)	0.35 (0.17-0.72)	
Taking a bath				
Once a day or Three times a week	47 (35.1)	87 (64.9)	Reference category	0.284
Once a week or less	12 (46.2)	14 (53.8)	0.63 (0.27-1.47)	
Mothers wash hands before preparing food.				
Wash Hands	22 (25.9)	63 (74.1)	Reference category	0.002
Did not wash hands	37 (49.3)	38 (50.7)	0.35 (0.18-0.69)	
Method of Purifying Drinking water				
Do not Purify at all	4 (14.8)	23 (85.2)	Reference category	0.009
By Boiling Water or Filtering Before Use	55 (41.4)	78 (58.6)	4.05 (1.32-12.38)	

Variables	Positive n(%)	Negative n(%)	OR (95% CI)	p-value
Latrine care				
Mother	42 (40.4)	62 (59.6)	Reference category	0.057
Others	12 (25.0)	36 (75.0)	2.03(0.94-4.35)	
Self	5 (62.5)	3 (37.5)	0.41(0.09-1.79)	
Child eating Mud.				
No	41 (39.4)	63 (60.6)	Reference category	0.363
Yes	18 (32.1)	38 (67.9)	0.72(0.36-1.44)	
Eat undercooked or unwashed vegetables.				
No	45 (38.5)	72 (61.5)	Reference category	0.492
Yes	14 (32.6)	29 (67.4)	0.77 (0.36-1.61)	
Diarrhoea in the past month				
Yes	32(45.7)	38 (54.3)	Reference category	0.041
No	27 (30.0)	63 (70.0)	1.96 (1.02-3.76)	
History of abdominal pain				
Yes	32 (45.7)	38 (54.3)	Reference category	0.044
No	27 (30.0)	63 (70.0)	1.96 (1.02-3.76)	
History of excessive crying				
Yes	31(52.5)	28 (47.5)	Reference category	0.002
No	28 (27.7)	73 (72.3)	2.88 (1.47-5.64)	
Lack of appetite				
Yes	19 (45.2)	23 (54.8)	Reference category	0.191
No	40 (33.9)	78 (66.1)	1.61 (0.78-3.30)	
Perianal itching				
Yes	23 (57.5)	17 (42.5)	Reference category	0.002
No	36 (30.0)	84 (70.0)	3.15 (1.50-6.60)	
Irritability in sleeping				
Yes	14 (41.2)	20 (58.8)	Reference category	0.558
No	45 (35.7)	81 (64.3)	1.26 (0.58-2.73)	
History of parasitic infections				
Yes	7 (43.8)	9 (56.3)	1.37 (0.48-3.91)	0.548
No	52 (36.1)	92 (63.9)	Reference category	

CI: Confidence interval, OR: Odds ratio

Table 3: Analysis of Breastfeeding Status and other associated factors with IPIs among children.

Variables	Positive n(%)	Negative n(%)	OR (95% CI)	p-value
Breastfeeding				
No	23 (28.8)	57 (71.3)	Reference category	0.033
Yes	36 (45.0)	44 (55.0)	2.02(1.05-3.90)	
EBF				
Yes	13 (29.5)	31 (70.5)	Reference category	0.237
No	46 (39.7)	70 (60.3)	0.63 (0.30-1.34)	
Partial Breastfeeding				
Yes	22 (59.5)	15 (40.5)	Reference category	0.001
No	37 (30.1)	86 (69.9)	3.40(1.59-7.29)	

Variables	Positive n(%)	Negative n(%)	OR (95% CI)	p-value
Duration of Breastfeeding				
<6 months	46 (39.7)	70 (60.3)	Reference category	0.237
≥6 months	13 (29.5)	31 (70.5)	1.56 (0.74-3.30)	
Knowledge about the benefits of Breastfeeding				
Yes	33 (32.4)	69 (67.6)	Reference category	0.116
No	26 (44.8)	32 (55.2)	0.58 (0.30-1.14)	
Knowledge about the disadvantages of bottle breastfeeding				
Yes	37 (37.4)	62 (62.6)	Reference category	0.868
No	22 (36.1)	39 (63.9)	1.05 (0.54-2.05)	
Reason for not breastfeeding in <6 months				
Insufficient milk supply	17 (25.8)	49 (74.2)	Reference category	0.049
Working Mother	7 (53.8)	6 (46.2)	0.29(0.08-1.01)	
Mother expecting next pregnancy	0 (0.0)	1 (100)	-	

CI: Confidence interval, OR: Odds ratio

Table 4: Distribution of IPIs and their species among children.

Variable	N	%
Presence of Parasite		
Yes	59	36.9
No	101	63.1
Parasite Species		
<i>Entamoeba histolytica</i>	28	47.5
<i>Giardia Lamblia</i>	20	33.9
<i>Ascaris Lumbricoides</i>	10	16.9
<i>Hymenolepis Nana</i>	1	1.7

The odds ratio (OR) for EBF was 0.63 (95% CI = 0.30-1.34), indicating a trend towards reduced odds of IPIs, although statistical significance was not reached at the conventional threshold ($p > 0.05$) (Table 3).

Conversely, children who were not breastfed had higher odds of developing IPIs, with an OR of 2.02 (95% CI = 1.05-3.90), indicating a statistically significant association ($p > 0.05$) (Table 3).

Partial breastfeeding, among the positive cases, 22 (59.5%) had partial breastfeeding, while 15 (40.5%) did not. The odds ratio for partial breastfeeding was 3.40 (95% CI = 1.59-7.29), indicating a statistically significant association between partial breastfeeding and increased odds of developing IPIs ($p < 0.05$) (Table 3). Parasite was present among 36.9% children (Table 4).

DISCUSSION

The present study estimated the prevalence of intestinal parasitic infections (IPIs) among children up to two years of age. The study included 160 children, and the estimated prevalence of IPIs was 36.9%. Among the infected children, the majority (47.5%) were infected with *Entamoeba histolytica*, which was the predominant parasite. In comparison with a study conducted in Ethiopia that included children under 5 years of age,

a lower prevalence (15.5%) of IPIs was estimated [18]. However, a study performed in Karachi, Pakistan reported a prevalence of 12.4% with the frequently observed parasite being *Entamoeba histolytica* (66.1%). In comparison the IPIs were 42.9% from Ethiopia [19], while a study from rural areas of district Lower Dir, Pakistan reported a high prevalence of 82% of IPIs [20]. The variability in IPIs prevalence across studies could be attributed to various factors, such as geographical location, population, hygiene practices, sanitation, health practices, undernourishment, accessibility of safe drinking water, socio-economic differences, and environmental conditions [21].

The study categorized the participants into two age groups, 0 to 12 months and 13 to 24 months. The majority of the participants (76.3%, $n=122$) belonged to the latter age group, with a statistically significant p-value of 0.007 when compared to other studies [3]. Age has been identified as a potential risk factor for IPIs, with children aged 7-24 months being more vulnerable to infection than younger children. This is due to increased exposure to faecal-contaminated soil, as they engage in more mobile activities in unhygienic environments. Further prospective studies are necessary to investigate the association of age within this range [22].

The main reason for the IPIs among children is poor sanitation, poor hygiene, and malnutrition children may have weakened immune systems, and overcrowded conditions, which can increase the risk of transmission of infections and exposure to contaminated food or water. One effective strategy for reducing the risk of intestinal parasite infections is the use of proper methods to purify drinking water. Our findings showed that children who used proper water purification methods had 0.45 times lower odds of IPIs compared to those who did not use any method of water purification, with a p-value of 0.016. These results are consistent with similar findings reported in other studies [23, 24]. In our study, we found that certain hygiene practices were also associated with a reduced risk of IPIs. Specifically, the habit of regular nail trimming and mothers washing hands before food preparation were found to be associated with lower risk, with p-values of 0.004 and 0.002, respectively [5, 6].

Our study also identified several symptoms that were positively associated with IPIs, including a history of diarrhea, abdominal pain, excessive crying, and perianal itching, with p-values of 0.041, 0.041, 0.002, and 0.002, respectively. These symptoms can cause significant distress for children, underscoring the importance of preventing and treating IPIs to improve their overall health and well-being [25].

Children, who were not breastfeeding were found to be associated with increased odds of developing intestinal parasitic infections (IPIs), as indicated by an OR of 2.02 (95% CI = 1.05-3.90), signifying a statistically significant association ($p < 0.05$).

Moreover, the prevalence of IPIs was significantly lower among children who were breastfed, particularly those who were exclusively breastfed (EBF), in comparison to those who were not. Specifically, among the positive cases, 36 (45.0%) were children who were not breastfed and were found to have IPIs. Conversely, 13 (29.5%) of the EBF children exhibited IPIs, while 46 (39.7%) of the non-EBF children were infected. These findings provide evidence that BF is associated with a reduced risk of IPIs, thereby aligning with the consistent findings of previous studies [13].

Our study also found that insufficient milk supply and working mothers were the main reasons for non-breastfeeding among the participants. Furthermore, our analysis revealed that children up to two years of age who were not breastfeeding had a higher probability of having IPIs, with a p-value of 0.049. These findings underscore the importance of promoting and supporting BF as a preventative measure against IPIs in young children.

Several studies have found that BF during the first 6 months of life protects against gastrointestinal infections, compared to children formula fed or those who were breastfed for a limited period [26]. The protective effect of breastfeeding was earlier demonstrated with IPIs in a study conducted in Mexico, BF has been shown a 5-fold protective effect than non-breast-feeding children aged 0–18 months [27].

It is worth noting that breastfeeding appears to significantly reduce the prevalence and severity of IPIs by limiting exposure to contaminated food, water, and hygiene practices. However, several limitations to this study should be acknowledged. Firstly, the diagnostic sensitivity of the stool test may have been improved if three consecutive samples were taken, but this was not performed. Secondly, sampling was difficult for the 0–6 month age group, and not all susceptible children were referred for stool testing. Finally, since this is a cross-sectional study, it is not possible to establish a causal relationship between various factors and their association with IPIs.

CONCLUSION

Our study highlights the prevalence of IPIs among children up to two years of age in Karachi, Pakistan. Breastfeeding was found to be protective against IPIs, while other factors such as age, the habit of fingernail trimming, hand washing, and water purification were found to be associated with a higher risk of IPIs with a history of diarrhoea, abdominal pain, excessive crying, and perianal itching.

The study highlights the critical need for developing pragmatic approaches and strategies for enhancing and maintaining BF during the first 6 months of life. There is a need to promote large-scale deworming and

health promotion campaigns to raise awareness among parents about their child's health and hygiene.

LIST OF ABBREVIATIONS

WHO	World Health Organization
IPIs	Intestinal parasitic infections
PDHS	Pakistan Demographic and Health Survey
SPSS	Statistical Package for Social Sciences
CI	Confidence Interval
EBF	Exclusive Breastfeeding

ETHICAL APPROVAL

Ethical approval of the study has been granted by the Institute of Ethical Review Board IERB(13)/SZABIST-KHI(PH)21104184/220155 at SZABIST. Written approval for data collection was obtained from the concerned authorities of selected health facilities. All procedures performed in studies involving human participants were following the ethical standards of the institutional and/or national research committee and with the Helsinki Declaration.

CONSENT FOR PUBLICATION

An informed consent form was signed by the mothers of the child before they were enrolled in the study with the right given to the mothers for leaving the study at any moment during the interview.

AVAILABILITY OF DATA

The data set may be acquired from the corresponding author upon a reasonable request.

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Declared none.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORS' CONTRIBUTION

All the authors contributed equally to the publication of this article

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