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Letter to the Editor

Mental health and stigmata: childhood learning and strabismus

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Check for updates

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Extract

Strabismus (crossed eyes/squint) is a common eye condition among children. Approximately 5 in every 100 children aged five years are likely to suffer from a squint. The stigmatization of a child's psychology by strabismus is significant, as it affects their lives socially and professionally. Children with strabismus may face marginalization and social exclusion due to their physical appearance and may also experience difficulties in learning and socializing. It has become increasingly necessary to fully understand the emotional and psychological impacts of strabismus in children and to address the challenges faced by them.

Keywords

Mental health; Stigmata; Learning disturbance; Strabismus; Stress, psychological

Dear Editor,

Stigmatism profoundly affects several factors in life to create negative stereotypes, leading to discrimination and social exclusion. Individuals exposed to stigma face significant challenges in their overall health and welfare. In a study by Link & Phelan, it was noted that people with mental health conditions who face stigma are more likely to experience difficulties in their social interactions, a significant increase in stress levels and an adverse effect on their mental well-being in the long term [1]. This exclusion perpetuates a cycle of disadvantages, further aggravated by a lack of resources, social support systems, and societal acceptance, ultimately hindering rehabilitation and future social and professional prospects [2,3].

Strabismus is a condition in which the eyes are misaligned, resulting in each eye pointing in a different direction. This condition commonly arises from abnormalities in binocular vision or impairments in the neuromuscular control of eye movements. Strabismus affects physical appearance in addition to disrupting visual development and functionality [4]. The prevalence of strabismus in children worldwide has been reported to vary between 0.14% and 5.65%, i.e., approximately 5 in 100 children aged five years have a squint [5]. In addition to physical challenges, both children and adults with strabismus frequently experience psychosocial distress, which may negatively impact their mental well-being and quality of life [6].

In Pakistan, research on strabismus within a psychosocial framework remains scarce. However, a few studies have highlighted the significant mental health challenges faced by individuals with this condition [7,8]. For instance, congenital strabismus negatively affects children's psychosocial well-being, contributing to poor self-image, reduced confidence, social isolation, and emotional distress. These effects are often worsened by cultural perceptions and stigma, which can further marginalize affected children. Notably, females tend to experience greater difficulties in social integration and

dependency. Despite these insights, there is a critical gap in indigenous research exploring the mental health burden of strabismus.

The negative perception that children with strabismus are less intelligent or underskilled significantly impacts their learning ability, well-being and social interactions. This misconception lowers self-esteem and restricts emotional and cognitive development, leading to increased social anxiety, feelings of despair, and difficulty concentrating in school. Additionally, they often experience bullying by peers and exclusion from activities, which deepens their sense of isolation. A recent study by Loh & Tan revealed that children with strabismus may feel insecure or embarrassed, limiting their engagement with classmates and educational materials and hindering their cognitive and emotional development [9].

A comprehensive and integrated approach is necessary to address both the psychological and social challenges associated with strabismus. Multidisciplinary teams—including ophthalmologists, psychologists, educators, and social workers—can collaboratively address the medical, psychological, and educational aspects of a child's welfare [10]. Early psychological interventions, vision therapy, or corrective surgery can help mitigate both emotional distress and physical symptoms [11].

For this reason, educating healthcare workers, parents, and school staff plays a crucial role in promoting early medical intervention and reducing stigma. Implementing awareness programs and providing structured psychological and social support systems can help create a more inclusive environment for children with strabismus, thereby improving their long-term psychological and social well-being.

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Journal of Basic & Clinical Medical Sciences

Original Article

Prevalence of internet addiction and its associated factors among adolescents in private education institutes in Sargodha, Pakistan

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Abstract

As digital connectivity has become an integral part of daily life, internet addiction has emerged as a significant concern, particularly among adolescents. Therefore, this study aims to estimate the prevalence of internet addiction among adolescents, assess its severity, investigate the associations between sociodemographic factors and internet addiction levels, and examine the correlation between adolescents' age and the severity of internet addiction. This descriptive cross-sectional study involved 200 adolescents from private education institutes in Sargodha, Pakistan. A structured questionnaire was developed to collect data on sociodemographic indicators, and the validated Internet Addiction Test (IAT) questionnaire was adopted to assess the occurrence and severity of internet addiction. The data were analyzed using IBM® SPSS® software. The results revealed that among the 200 participants, 42% were male and 58% female, with nearly half (47.5%) being aged 13–15 years. Most (57.00%) owned a personal mobile device, whereas 47.5% had a laptop. Furthermore, 39.5% of the participants used the internet for one hour or less per day, whereas 30% reported using it for 2–4 hours daily. Only 8 participants stated that they did not use any social media applications. The study highlights significant internet addiction patterns. Many participants stayed online longer than intended (12.5% always, 16.5% often), whereas 34.5% neglected household chores. Internet dependency was evident, with 14.5% preferring online excitement over intimacy and 26.0% receiving complaints about excessive internet use. Sleep disturbances affected 25.0% of the study participants, whereas academic impacts were reported by 14.5% of the participants. The IAT results revealed that 8.5% of the participants had full control, 54.0% had mild, 36.0% had moderate, and 1.5% had severe addiction. Chi-square analysis revealed no significant associations between addiction severity and sex, age, or device ownership ($p > 0.05$), but the duration of internet use per day was significantly associated with addiction severity ($p = 0.030$). Age was weakly but significantly correlated with internet addiction ($p = 0.04$). The study concluded that a significant proportion of adolescents experienced moderate to severe internet addiction. These findings highlight the urgent need to implement measures to promote healthy digital practices among adolescents.

Keywords

Adolescents; Internet addiction; Internet use; Pakistan; Social media; Youth

1. Introduction

The internet has become an integral part of modern life and serves as a rapid gateway to information, a tool for communication, a medium for education, a means to so-

cialize, and a source of entertainment through electronic devices such as mobile phones [1,2]. With over 5 billion users globally, including 111 million in Pakistan, internet usage is particularly high among younger generations, who often begin using it as early as 8 years of age [3,4,5,6]. While the internet supports various educational and social activities, still excessive use can lead to problematic internet use, also known as internet addiction, which is characterized by less focus on other domains of life [7,8]. Globally, the prevalence of internet addiction varies between 3.7% and 26.8%, with even higher rates reported across Asia [9].

Currently, adolescents use the internet to express themselves, build skills, and stay connected with others. The digital world provides them with a sense of inclusion that is not limited to digital engagement, such as exploring hobbies and celebrating gaming achievements but also encompasses seeking approval on social media [10]. For many, internet use transitions from a casual habit to a coping mechanism for handling real-world struggles such as low self-esteem and social anxiety [11]. Moreover, a lack of support in offline environments pushes them toward online spaces as a last resort for validation, social interaction, and identity exploration, making it harder to disconnect later. Furthermore, peer influence further reinforces this confidence, as teenagers often mimic the online habits of their friends [12].

Several studies have reported the excessive use of the internet among adolescents across different regions globally. For example, a study in Bhutan revealed that 34% of adolescents were addicted to the internet, often relying on it to cope with boredom, peer pressure and stress while experiencing high levels of anxiety and depression [13]. In Nigeria, approximately 45% of adolescents exhibit signs of internet addiction, predominantly using Facebook [14]. A Malaysian study reported a 47.9% prevalence, with an average daily smartphone usage of more than three hours, primarily for internet-based activities [15]. In Pakistan, the situation is not very different, and approximately 34% of youth are addicted to moderate or severe internet addiction, with a higher prevalence among males, whereas age does not appear to be a significant determinant [16].

In Pakistan, the rapid proliferation of affordable mobile phones and the widespread use of social media have intensified internet addiction, with many adolescents seeking refuge online from social, familial, and academic pressures. This overdependence can adversely impact their psychosocial development, increasing the risk of anxiety, depression, and declining academic performance [17,18]. Despite these risks, awareness remains low, and support systems for managing internet use are largely insufficient. Addressing this growing issue requires a deeper understanding of adolescent behavior to develop effective interventions. Therefore, this study aims to estimate the prevalence of internet addiction among adolescents in private educational institutes in Sargodha, Pakistan; assess its severity; investigate the associations between sociodemographic factors and internet addiction levels; and examine the correlation between adolescents' age and the severity of internet addiction.

2. Methods

2.1. Study design

This study utilized a descriptive cross-sectional study design and was carried out over a three-month period from April to June 2024.

2.2. Study setting

This study was conducted in private education institutes in Sargodha, a district with a population of 1,537,866 and a literacy rate of 63% [19]. Moreover, the district has 1,923

formal public schools and 12 colleges, reflecting a structured educational environment that supports adolescent learning and development.

2.3. Ethical considerations

The study received approval from the Ethical Committee of Niazi Medical and Dental College, Sargodha, Pakistan (No. NMDC/DRC/07-79/24-ERB). Additionally, permission was obtained from the administration of private education institutes before data collection. Informed consent was obtained from all participants, and for those younger than 18 years of age, consent was provided by their parents or guardians before the interview.

2.4. Inclusion and exclusion criteria

The study included students aged 10–18 years who were enrolled in formal private secondary schools, higher secondary schools, and intermediate colleges and were studying any combination of subjects. However, individuals with cognitive disabilities or those who did not provide informed consent (or whose parents or guardians did not consent in the case of minors) were excluded from the study.

2.5. Sample size and sampling technique

The sample size of 154 was calculated using the OpenEpi calculator (version 3.01) on the basis of a 95% confidence interval, a 5% margin of error, and a reported internet addiction prevalence of 11.3% [20]. However, the sample size was further increased to 200 to improve the statistical power of the study and to cater to potential study dropouts. A nonprobability convenience sampling method was employed to recruit participants from various education institutes, which may limit the generalizability of the findings due to potential sampling bias, a limitation that has been acknowledged to guide cautious interpretation and encourage future studies using probabilistic sampling methods.

2.6. Study questionnaire development

A structured questionnaire was developed to collect data on sociodemographic indicators, and the validated Internet Addiction Test (IAT) was adopted to assess the occurrence and severity of internet addiction among adolescents [21].

2.7. Study measures

The sociodemographic and internet usage patterns section collected information on gender, age, personal ownership of a mobile phone or laptop, duration of internet use per day, purposes of using the internet, and social media applications used by adolescents. The IAT is a 20-item self-report instrument designed to assess internet addiction via a 5-point Likert scale, with response options ranging from 1 (rarely) to 5 (always). The total IAT score is obtained by adding up responses across all 20 items, yielding a final score ranging from 20–100. Scores of 20–30 indicate ‘normal internet usage’, whereas scores of 31–49, 50–79, and 80–100 indicate ‘mild’, ‘moderate’, and ‘severe internet addiction’, respectively. The IAT tool has strong psychometric properties, with a study reporting a Cronbach’s alpha value of 0.91, indicating high internal consistency [21].

2.8. Data collection procedure

Face-to-face interviews were conducted to collect data from the study participants, with each interview lasting between 10 and 12 minutes. For minor participants, a consent form was provided for completion by their parents or guardians. Only those who success-

fully submitted the signed consent form were included in the study, after which the interview was conducted.

2.9. Data analysis

The data collected were analyzed via IBM® SPSS® software (version 25.0). Descriptive statistics, including frequencies and percentages, medians, and interquartile ranges (IQRs), were calculated. Moreover, chi-square tests and Spearman's correlation coefficient were applied, with results considered significant at $p \leq 0.05$.

3. Results

3.1. Sociodemographic characteristics and internet usage patterns of the adolescents

Among the 200 participants, 42% were males and 58% were females. Nearly half of the adolescents (47.5%) were between 13 and 15 years of age (Table 1). A total of 57% of the participants owned a mobile phone, whereas 47.5% had a personal laptop. Furthermore, 39.5% of the participants used the internet for one hour or less per day, whereas 30% reported using it for 2–4 hours daily. In response to the question regarding social media usage, 8% (n = 16) stated that they did not use any social media applications.

Table 1. Sociodemographic characteristics and internet usage patterns of the adolescents.

Variables		Frequency (%)
Gender	Male	84 (42.00)
	Female	116 (58.00)
Age (in years)	10 – 12	17 (8.50)
	13 – 15	95 (47.50)
	16 – 19	88 (44.00)
Mobile phone ownership	Yes	114 (57.00)
	No	86 (43.00)
Laptop ownership	Yes	95 (47.50)
	No	105 (52.50)
Duration of internet use per day (in hours)	≤ 1	79 (39.50)
	2 – 4	60 (30.00)
	5 – 7	44 (22.00)
	8 – 10	10 (5.00)
	≥ 10	7 (3.50)
Purposes of using internet	Gaming	80 (40.00)
	Web browsing	86 (43.00)
	Completing homework	76 (38.00)
	Watching educational videos	73 (36.50)
	Watching YouTube content	111 (55.50)
	Streaming movies/TV shows	84 (42.00)
	Watching sports	37 (18.50)
	Freelancing work	10 (5.00)
	Content creation (making videos)	20 (10.00)
Social media applications used by adolescents	Facebook	60 (30.00)
	Instagram	88 (44.00)
	Twitter	29 (14.50)
	WhatsApp	151 (75.50)
	Snapchat	79 (39.50)
	TikTok	67 (33.50)
	YouTube	11 (5.50)

Variables		Frequency (%)
	Others	18 (9.00)
	Don't use social media	8 (4.00)

3.2. Assessment of internet addiction tendencies among adolescents

Table 2 shows the degree to which the study participants struggled with internet addiction. Many reported staying online longer than intended, with 12.5% always, 16.5% often, and 15.0% frequently engaging in this behavior. Similarly, nearly one-third (34.5%) of the respondents found themselves neglecting household chores due to internet use, with 7.5% always, 15.5% often, and 11.5% frequently prioritizing their online activities over responsibilities. The impact on relationships was also evident, as 14.5% of participants always preferred online excitement over intimacy with their partners, whereas 10.0% often and 12.0% frequently felt the same way. However, forming new relationships online was uncommon, with 76.0% rarely engaging in this behavior. Despite this, more than a quarter of the respondents (14.0% always, 12.0% often) reported that people in their lives complained about their excessive internet use.

The impact on academic performance and work productivity was limited but noticeable, with 3.5% of participants always and 11.0% often admitting that their schoolwork suffered owing to internet use. Similarly, 7.5% always and 14.5% often reported declining productivity, consequently spending much of their time using the internet. Signs of internet dependence were prominent. A total of 12.5% of the participants always used the internet as a way to block out disturbing thoughts about life, whereas more than one-third (21.5% always, 12.5% often) felt that life without the internet would be boring, empty, or joyless. Preoccupation with the internet was also evident, with 13.5% always and 14.0% often anticipating when they could go online again.

Many participants struggled with self-control, with 28.0% always and 19.0% often catching themselves saying, "Just a few more minutes." Similarly, 20.5% always and 16.0% often had unsuccessful attempts to reduce their screen time. Sleep disturbances were another major consequence, as 7.0% always and 18.0% often reported losing sleep due to prolonged internet use. Additionally, 16.0% always and 12.5% often admitted to hiding how long they had been online, possibly due to guilt or fear of judgment.

Table 2. Frequency distribution of Internet Addiction Test responses among adolescents.

Indicators	Rarely	Occasionally	Frequently	Often	Always
	N (%)	N (%)	N (%)	N (%)	N (%)
Stays online longer than intended	54 (27.00)	58 (29.00)	30 (15.00)	33 (16.50)	25 (12.50)
Neglects household chores due to internet use	74 (37.00)	57 (28.50)	23 (11.50)	31 (15.50)	15 (7.50)
Prefers internet excitement over intimacy	85 (42.50)	42 (21.00)	24 (12.00)	20 (10.00)	29 (14.50)
Making new relationships with online users	152 (76.00)	14 (7.00)	13 (6.50)	16 (8.00)	5 (2.50)
Receives complaints about excessive internet use	86 (43.00)	43 (21.50)	19 (9.50)	24 (12.00)	28 (14.00)
Schoolwork suffering due to internet use	107 (53.50)	45 (22.50)	19 (9.50)	22 (11.00)	7 (3.50)
Prioritizing checking emails over other tasks	97 (48.50)	29 (14.50)	28 (14.00)	22 (11.00)	24 (12.00)
Declines in productivity due to internet use	88 (44.00)	54 (27.00)	14 (7.00)	29 (14.50)	15 (7.50)
Becoming defensive about online activities	117 (58.50)	46 (23.00)	12 (6.00)	12 (6.00)	13 (6.50)
Uses the internet to escape disturbing thoughts	61 (30.50)	42 (21.00)	26 (13.00)	46 (23.00)	25 (12.50)
Anticipates the next opportunity to go online	67 (33.50)	54 (27.00)	24 (12.00)	28 (14.00)	27 (13.50)
Fears that life would be boring or empty without the internet	65 (32.50)	42 (21.00)	25 (12.50)	25 (12.50)	43 (21.50)
Gets annoyed when interrupted while online	82 (41.00)	47 (23.50)	19 (9.50)	25 (12.50)	27 (13.50)
Losing sleep due to internet use	73 (36.50)	58 (29.00)	19 (9.50)	36 (18.00)	14 (7.00)
Feelings preoccupied with or fantasized about being online	86 (43.00)	54 (27.00)	17 (8.50)	33 (16.50)	10 (5.00)

Indicators	Rarely	Occasionally	Frequently	Often	Always
	N (%)	N (%)	N (%)	N (%)	N (%)
Says, "Just a few more minutes" while online	45 (22.50)	38 (19.00)	23 (11.50)	38 (19.00)	56 (28.00)
Fails to reduce internet use despite attempts	54 (27.00)	52 (26.00)	21 (10.50)	32 (16.00)	41 (20.50)
Hides the amount of time spent online	83 (41.50)	46 (23.00)	14 (7.00)	25 (12.50)	32 (16.00)
Choosing internet use over social outings	81 (40.50)	47 (23.50)	24 (12.00)	27 (13.50)	21 (10.50)
Feel depressed or anxious when offline but relieved when online	84 (42.00)	50 (25.00)	31 (15.50)	16 (8.00)	19 (9.50)

3.3. Descriptive statistics and reliability analysis of the IAT categories

The IAT scores revealed that 8.5% of the respondents had full control over their internet use. In contrast, more than half of the respondents (54%) indicated mild addiction, followed by 36.00% with moderate addiction and 1.5% with severe addiction. The IAT exhibited good internal consistency, with a Cronbach's alpha value of 0.78.

Table 3. Descriptive statistics and reliability analysis of the Internet Addiction Test categories.

Scale		N (%)	Range	Median (IQR)	Cronbach's α
Internet Addiction Test	Normal	17 (8.50)	0 – 30	45.50 (16.00)	0.78
	Mild addiction	108 (54.00)	31 – 49		
	Moderate addiction	72 (36.00)	50 – 79		
	Severe addiction	3 (1.50)	80 – 100		

3.4. Association between sociodemographic characteristics and internet addiction severity

Table 4 shows that more than half of the respondents (54.0%) had mild internet addiction, with a greater proportion of females (62.0%) than males (38.0%). Moderate addiction was observed in 36.0% of the respondents, nearly half of whom were between 16 and 19 years old. Within this category, approximately 61.1% owned a personal mobile phone, whereas 43.1% owned a personal laptop. Severe internet addiction was rare, with two out of three affected participants using the internet for 5–7 hours per day, while one individual exceeded 10 hours of daily usage. The chi-square test revealed no significant associations between internet addiction severity and sex, age, or personal device ownership ($p > 0.05$). However, the duration of internet use per day was significantly associated with addiction severity ($\chi^2(12) = 22.73$, $p = 0.030$), and the strength of this relationship was moderate, as shown by the effect size ($\phi = 0.34$).

Table 4. Association between sociodemographic characteristics and internet addiction severity.

Variables		Internet Addiction Severity				χ^2	Sig.
		Normal	Mild	Moderate	Severe		
		N (%)	N (%)	N (%)	N (%)		
Gender	Male	4 (23.5)	41 (38.0)	37 (51.4)	2 (66.7)	6.46	0.091
	Female	13 (76.5)	67 (62.0)	35 (48.6)	1 (33.3)		
Age (in years)	10 – 12	2 (11.8)	9 (8.3)	6 (8.3)	0 (0.0)	4.29	0.637
	13 – 15	11 (64.7)	52 (48.1)	31 (43.1)	1 (33.3)		
	16 – 19	4 (23.5)	47 (43.5)	35 (48.6)	2 (66.7)		
Mobile phone ownership	Yes	10 (58.8)	59 (54.6)	44 (61.1)	1 (33.3)	1.45	0.693
	No	7 (41.2)	49 (45.4)	28 (38.9)	2 (66.7)		
Laptop ownership	Yes	8 (47.1)	54 (50.0)	31 (43.1)	2 (66.7)	1.28	0.733
	No	9 (52.9)	54 (50.0)	41 (56.9)	1 (33.3)		
Duration of internet use per day (in hours)	≤ 1	7 (41.2)	46 (42.6)	26 (36.1)	0 (0.0)	22.73	0.030 **
	2 – 4	7 (41.2)	36 (33.3)	17 (23.6)	0 (0.0)		

Variables		Internet Addiction Severity				χ^2	Sig.
		Normal	Mild	Moderate	Severe		
		N (%)	N (%)	N (%)	N (%)		
	5 – 7	1 (5.9)	20 (18.5)	21 (29.2)	2 (66.7)		
	8 – 10	1 (5.9)	5 (4.6)	4 (5.6)	0 (0.0)		
	≥ 10	1 (5.9)	1 (0.9)	4 (5.6)	1 (33.3)		

[*] Associations between variables were assessed using the chi-square test. [**] Significant value ($p \leq 0.05$).

3.5. Assessment of the correlation between the age of adolescents and internet addiction

Table 5 shows a weak positive correlation between age and internet addiction, which was statistically significant ($p = 0.04$).

Table 5. Correlations between age and internet addiction.

Variables	Median	IQR	Age	Internet Addiction
Age	15.00	3.00	-	-
Internet addiction	45.50	16.00	0.04 [*]	-

[*] Significant value ($p < 0.05$).

4. Discussion

The study findings highlight that internet addiction is prevalent among adolescents, with most participants indicating mild to moderate addiction. Many participants struggled to manage their screen time, often prioritizing online activities over household responsibilities and personal relationships. Academic and work performance also suffered for some, whereas sleep disturbances and internet dependency were common. Social media usage was prevalent, with various platforms being actively used, revealing its role in shaping adolescents' online behaviors. The study revealed that the duration of internet use per day was a significant factor in addiction severity, whereas gender, age, and device ownership showed no strong associations. However, a weak but significant association between age and addiction suggests that as adolescents grow older, their internet use patterns may shift slightly.

The study revealed that adolescents mainly use the internet for four activities: watching YouTube, internet searching, and watching movies (television shows and playing games). These findings align with previous research indicating that students use video-streaming platforms such as YouTube for entertainment. Additionally, search engines such as Google serve as valuable tools for gathering information on various topics [22]. A related study in Jordan reported that over 60% of students used the internet for gaming [23]. In the current study, WhatsApp and Instagram were the most commonly used platforms, followed by Facebook. A similar study reported that WhatsApp ranked highest, followed by YouTube, Instagram, and Facebook [24]. The internet has emerged as a primary source of entertainment because it delivers customized content in innovative ways. Social media platforms utilize advanced algorithms to provide tailored feeds that significantly enhance user engagement. Moreover, these websites and applications promote interactive communication, fostering meaningful user connections [25,26]. This fusion of personalized content and interactive entertainment is transforming the way individuals consume media in the digital landscape [27].

The analyses of the current study revealed that a significant number of adolescents were moderately or severely addicted to the internet. This aligns with a study in Bhutan, which reported a 34.4% prevalence of moderate to severe internet addiction among secondary school students [13]. In contrast, a study in Malaysia reported a prevalence of 56.4%, indicating a higher rate than that reported in our study [11]. These findings high-

light the urgent need for Pakistan to address the growing concern of internet addiction [15]. Furthermore, the present study highlighted an impact on performance at school and work, which is supported by another study that highlighted the negative impact of internet addiction on performance among Arab students [28]. Another study highlighted the negative impact of internet addiction on work performance among healthcare professionals [29]. Internet addiction represents a significant public health challenge and is predominantly observed within society because of factors such as boredom, unmet social needs, and difficulties in self-regulation of internet usage [30,31,32].

The results of the present study revealed that sex and age were not significantly correlated with internet addiction, which aligns with the findings of previous studies [33]. However, an American study reported a low prevalence of internet addiction among older adults [34]. This may be attributed to the widespread accessibility of the internet across all age groups and genders, as well as the normalization of internet usage in today's digital environment [35,36].

The results of the current study indicate a link between hours spent online and internet addiction, with longer online times correlating with increased severity of addiction, as supported by European studies conducted to determine mobile phone and internet addiction among adolescents [37,38]. Adolescents benefit from easier internet access via mobile devices, and the key concerns include the individual's personality traits, as low self-control and impulsivity are associated with internet and gaming addiction [39,40]. Kuss et al. highlighted that extroverts use the internet for socialization, whereas introverts seek social compensation. Furthermore, loneliness, shyness, and social anxiety are also connected to internet addiction [41]. Online activities can increase social acceptance and increase self-esteem in low-risk environments, helping individuals manage offline anxiety and practice social skills [42,43].

Neurological factors play a significant role in internet addiction, and this addiction stems from the brain's reaction to internet use, with quick dopamine release leading to an immediate sense of reward. This can result in compulsive behaviors and increased tolerance due to dysregulated reward processing [44]. As a result, individuals who spend excessive time online struggle to manage their usage, leading to chronic addiction, which can negatively impact their social, psychological, and physiological development. Consequently, their lifestyles, attitudes, and behaviors may deteriorate [45,46]. Environmental and technological factors, especially COVID-19, significantly increase internet exposure and addiction among young people [47,48,49]. During lockdowns, social media and the internet became vital for communication, news, and online education, potentially leading to the development of internet addiction among adolescents [50,51,52].

In the context of Pakistan, cultural factors such as strong family hierarchies, limited open communication between parents and children, and restricted recreational opportunities may contribute to the patterns of internet addiction observed among adolescents [53]. In many households, digital devices serve as both a source of entertainment and a means of social connection, particularly when parental supervision is limited or inconsistent. Additionally, academic pressure and the stigma surrounding mental health discussions may push adolescents toward online platforms as a coping mechanism. These sociocultural dynamics require further investigation to inform more contextually appropriate interventions; although not within the scope of the present study, they represent a valuable area for future research to explore deeper insights into the underlying causes of internet addiction.

The strengths of this study include its reasonably large sample size, and the use of a validated tool enhances the reliability of the findings. Additionally, this study provides a comprehensive evaluation of internet addiction by examining its impact on academic

performance, daily responsibilities, sleep patterns, emotional well-being, and social interactions, offering valuable insights into problematic internet use among adolescents. However, the study did not consider factors contributing to internet addiction, such as the family environment, personality traits, and peer influence, which could have deepened the study's insights. Furthermore, the study did not employ multivariate analysis, such as multiple regression, to control for potential confounding factors—this should be considered in future research to strengthen the interpretability of the findings. In addition, the use of a convenience sampling method may limit the generalizability of the results due to potential sampling bias.

5. Conclusions

The study concluded that a significant proportion of adolescents experienced moderate to severe internet addiction, which affected their personal relationships, household responsibilities, and academic or work performance. Sociodemographic variables were not strongly associated with addiction severity or the duration of daily internet use. The weak but significant relationship between age and addiction suggests that internet use patterns may evolve with age. These findings highlight the urgent need to implement measures to promote healthy digital practices among adolescents. Practical steps may include integrating digital literacy and self-regulation modules into school curricula and encouraging parents to set consistent screen time limits and engage in open conversations about responsible internet use.

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Original Article

Nutritional status and postoperative outcomes in patients undergoing major resection for gastrointestinal cancer: a prospective cohort study

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Abstract

Malnutrition is highly prevalent among patients with gastrointestinal (GI) cancers and has a significant effect on surgical outcomes. Despite the growing recognition of this relationship, standardized nutritional assessment and intervention protocols remain inconsistent across healthcare settings. A prospective cohort study was carried out over a one-year period (June 2023–June 2024) to determine the associations between preoperative nutritional status and postoperative outcomes in patients undergoing major resection for GI malignancies. Consecutive patients who underwent elective major GI cancer resection were enrolled. The study utilized validated tools to assess nutritional status, including serum albumin (ALB), body mass index (BMI), and the Patient-Generated Subjective Global Assessment (PG-SGA). The principal outcomes were major postoperative complications (Clavien–Dindo grade ≥ 3), length of hospital stay, and thirty-day mortality. Among 294 patients, 128 (43.5%) were identified as nutritionally at risk preoperatively. Patients classified as malnourished experienced significantly higher 30-day mortality, with a rate of 12.5% versus 4.2% in well-nourished patients ($p = 0.008$). They also had a greater incidence of major postoperative complications, occurring in 35.9% of cases versus 18.1% among their well-nourished counterparts ($p < 0.001$). In addition, the median length of hospital stay was notably longer in malnourished individuals (14 days) than in those with adequate nutritional status (9 days; $p < 0.001$). Multivariate analysis revealed severe malnutrition as an independent risk factor for adverse postoperative outcomes, with an odds ratio (OR) of 2.84, a 95% confidence interval (CI) ranging from 1.52–5.31, and a p value of 0.001. These findings demonstrate that preoperative malnutrition significantly increases perioperative morbidity and mortality among patients undergoing GI cancer surgery. These findings advocate the integration of routine nutritional screening and tailored interventions into the perioperative care pathway.

Keywords

Gastrointestinal neoplasms; Postoperative complications; Malnutrition; Nutritional assessment; Nutritional status; Perioperative care

1. Introduction

Nutritional health is a critical factor influencing surgical outcomes in individuals with gastrointestinal (GI) cancers, yet it is frequently overlooked in the perioperative period. Globally, GI cancers are among the most prevalent and lethal malignancies, contributing to more than 4.8 million new diagnoses and approximately 3.4 million deaths each year [1]. For patients with localized disease, surgical removal of the tumor remains

the primary curative approach. Malnutrition in this population is not only a frequent consequence of the disease but also a modifiable predictor of postoperative outcomes [2]. Malnutrition rates among cancer patients range from 20% to 80% on the basis of the tumor site, disease stage, and assessment methods used [3].

The pathogenesis of cancer-associated malnutrition involves mechanical obstruction, systemic inflammation, altered metabolism, and reduced nutrient intake [4]. GI cancers, in particular, impair digestion, absorption, and nutrient utilization through mechanisms such as cachexia-induced hypermetabolism, nutrient sequestration by tumors, proteolysis, and GI dysfunction [5]. A large multicenter study revealed that 35–45% of patients who underwent major GI cancer surgery were severely malnourished, with the prevalence in certain subgroups reaching 80% [6]. In a global cohort of 5,709 patients, severe malnutrition was linked to a threefold increase in 30-day post-operative mortality, with rates of 8.1% compared with 2.8% [7].

The adverse impact of malnutrition on GI cancer patients extends beyond mortality, leading to an increased likelihood of wound infections, slower healing, prolonged hospital stays, higher healthcare costs, and reduced tolerance to adjuvant therapy [8,9]. Baseline malnutrition in older cancer patients has been significantly associated with an elevated risk of mortality [10]. Several nutritional valuation tools are commonly used in oncology to identify and address these risks, including the Patient-Generated Subjective Global Assessment (PG-SGA), Malnutrition Universal Screening Tool (MUST), and Global Leadership Initiative on Malnutrition (GLIM) criteria [11]. However, the optimal timing, methodology, and cutoff thresholds for defining malnutrition in the perioperative setting remain debated, and traditional laboratory indicators such as albumin (ALB), pre-ALB, and transferrin are limited by their sensitivity to inflammatory states [12]. These uncertainties are particularly relevant in resource-limited healthcare systems, where variability in assessment protocols and perioperative care may further influence patient outcomes [13,14].

Considering the high frequency and modifiable nature of malnourishment, there is a dire need for prospective data from diverse healthcare contexts to guide perioperative nutritional strategies. This prospective cohort study was designed to examine how patients' nutritional conditions before surgery influence postoperative outcomes following major GI cancer resection at a tertiary care center. We hypothesized that individuals with compromised nutritional status prior to surgery would be more prone to adverse postoperative events, require extended hospitalization, and face a greater risk of 30-day mortality than those who are well nourished.

2. Methods

2.1. Study design

This prospective cohort study was carried out between 1 June 2023 and 30 June 2024 at Lady Reading Hospital, MTI Peshawar.

2.2. Study settings

The research took place at Lady Reading Hospital, a public tertiary care facility located in Peshawar that provides specialized GI surgical services to Khyber Pakhtunkhwa Province and surrounding regions.

2.3. Study participants

Consecutive adult patients (≥18 years) scheduled for elective major GI cancer resection were considered for enrollment. The study recruited patients with a histologically

confirmed gastrointestinal malignancy (gastric, colorectal, pancreatic, or hepatobiliary) who were listed for major resection with therapeutic curative intent, had an Eastern Cooperative Oncology Group (ECOG) performance status of 0–2, and were capable of providing written informed consent. However, patients who required emergency surgery, were scheduled for palliative procedures, had concurrent malignancies, presented with severe comorbidities precluding major surgery [American Society of Anesthesiologists (ASA) class IV–V], were unable to undergo nutritional assessment, or declined participation were excluded from the study.

2.4. Ethical considerations

The study was approved by the Institutional Review Board of Lady Reading Hospital, Peshawar (Approval No. 64/LRH/MTI). Prior to enrollment, written informed consent was obtained from all study participants.

2.5. Sample size

The sample size estimation followed the WHO recommendations for comparative study designs, with previously reported complication rates of 40% in malnourished individuals and 20% in those with adequate nutritional status [3,15]. With a type I error probability of 5%, a statistical power of 80%, and an anticipated 10% attrition rate, the final calculated sample size was 294 participants.

2.6. Data collection

Preoperative nutritional assessment was conducted within the first 48 hours of hospital admission using the PG-SGA as the primary evaluation tool. Patients were categorized on the basis of their PG-SGA scores as well nourished (scores up to 3), moderately malnourished (scores between 4 and 8), or severely malnourished (scores of 9 or above) [16]. Anthropometric measurements included height, weight, BMI [classified per the World Health Organization (WHO) criteria], and percentage weight loss over the preceding six months. The laboratory parameters included the serum ALB concentration, total protein concentration, hemoglobin level, and lymphocyte count, which were measured within 72 hours preoperatively.

Demographic data, tumor characteristics, comorbidities, and baseline nutritional parameters were recorded via standardized case report forms. Operative details—including procedure type, duration, estimated blood loss, and intraoperative complications—were documented. Postoperative outcomes were tracked for 30 days and included adverse events (classified according to the Clavien–Dindo system), total duration of hospitalization, unplanned readmissions within 30 days, and short-term postoperative mortality.

2.7. Statistical analysis

The data were analyzed with SPSS version 25. Descriptive statistics were used to summarize patient demographics, tumor characteristics, nutritional parameters, and postoperative outcomes. The means, medians, standard deviations, and interquartile ranges were calculated for age, BMI, weight loss percentage, serum ALB, hemoglobin, lymphocyte count, and hospital stay. Differences in these variables between nutritional status groups (well-nourished vs malnourished) were assessed via t tests or Mann–Whitney U tests, as appropriate. The sex distribution, ASA score (≥ 3 vs < 3), 30-day mortality, major complications, readmission, surgical site infection, anastomotic leakage, and respiratory complications were compared via the chi-square test or Fisher's exact test. Mul-

tivariate logistic regression analysis was performed, including all variables with $p < 0.10$ in univariate analysis and additional clinically meaningful covariates, to determine independent predictors of major surgical complications and 30-day mortality. Finally, odds ratios (ORs) with 95% confidence intervals (CIs) are reported, with significant predictors displayed in a forest plot. The level of significance was set at $p < 0.05$.

3. Results

The malnourished patients were, on average, older than the well-nourished patients were (66.2 ± 11.7 vs. 52.1 ± 11.2 years; $p < 0.001$), had lower BMI values (21.3 ± 3.8 vs. 24.7 ± 4.2 kg/m^2; $p < 0.001$), and experienced greater preoperative weight loss (12.4 ± 6.8% vs. 3.2 ± 2.1%; $p < 0.001$) (Table 1). The laboratory findings demonstrated that the malnourished group had a poorer nutritional and physiological profile, with significantly lower hemoglobin levels, total lymphocyte counts, and serum albumin (ALB) concentrations ($p < 0.001$). Moreover, a greater proportion of malnourished patients had an ASA score of 3 or more, indicating greater operative risk ($p < 0.001$).

Table 1. Baseline characteristics by nutritional status among the study participants.

Variables	Well-nourished (n = 166)	Malnourished (n = 128)	*p* Value
	Mean ± SD	Mean ± SD	
Age (in years)	52.1 ± 11.2	66.2 ± 11.7	< 0.001 ***
Male, n (%)	89 (53.6)	73 (57.0)	0.572
BMI (kg/m^2)	24.7 ± 4.2	21.3 ± 3.8	< 0.001 ***
Weight loss in last 6 months (%)	3.2 ± 2.1	12.4 ± 6.8	< 0.001 ***
Serum ALB (g/dL)	3.8 ± 0.4	2.8 ± 0.6	< 0.001 ***
Hemoglobin (g/dL)	12.1 ± 1.6	10.2 ± 1.8	< 0.001 ***
Lymphocyte count (cells/μL)	1,867 ± 523	1,248 ± 456	< 0.001 ***
ASA physical status ≥ 3, n (%)	34 (20.5)	52 (40.6)	< 0.001 ***

* Data were analyzed via t tests and chi-square tests. ** Nutritional status defined by the PG-SGA: well nourished (0–3) and malnourished (≥ 4). *** Statistically significant at $p < 0.05$.

Table 2 depicts the primary surgical outcomes stratified by nutritional status. Compared with well-nourished patients, those who were undernourished had a significantly increased risk of death during the first 30 postoperative days (12.5% vs 4.2%, $p = 0.008$), along with more frequent major complications (35.9% vs 18.1%, $p < 0.001$). Patients with malnutrition had a median hospital stay of 14 days, whereas those with adequate nutrition had a median hospital stay of only 9 days, which was highly significant ($p < 0.001$). Readmission occurred in 17.2% of the malnourished patients compared with 8.4% of the well-nourished patients ($p = 0.028$). Surgical site infection was observed in 18.4% and 8.4% of the patients, respectively ($p = 0.012$). Anastomotic leakage occurred in 8.6% versus 3.0% ($p = 0.044$), and respiratory complications occurred in 15.6% versus 6.6% ($p = 0.015$), all of which were significantly greater among malnourished patients.

Table 2. Primary surgical outcomes by nutritional status.

Outcomes	Well-nourished (n = 166)	Malnourished (n = 128)	*p* Value
	Frequency (%)	Frequency (%)	
30-day mortality	7 (4.2)	16 (12.5)	0.008 ***
Major complications	30 (18.1)	46 (35.9)	< 0.001 ***
Hospital stay (days), median (IQR)	9 (7-13)	14 (10-21)	< 0.001 ***

Outcomes	Well-nourished (n = 166)	Malnourished (n = 128)	*p* Value
	Frequency (%)	Frequency (%)	
Readmission	14 (8.4)	22 (17.2)	0.028 ***
Surgical site infection	14 (8.4)	23 (18.4)	0.012 ***
Anastomotic leakage	5 (3.0)	11 (8.6)	0.044 ***
Respiratory complications	11 (6.6)	20 (15.6)	0.015 ***

* Data were analyzed via the chi-square test, Fisher's exact test, and the Mann–Whitney U test. ** The Clavien–Dindo criteria were used to define major complications as grade ≥ 3. *** Statistically significant at $p < 0.05$.

Figure 1 delineates the independent predictors of major surgical complications and 30-day mortality after adjusting for confounding variables in a multivariate logistic regression model. Severe malnutrition was strongly associated with major complications, with an OR of 2.84 (95% CI 1.52–5.31, $p = 0.001$), indicating a nearly threefold increase in risk. Advanced age above 70 years was another significant predictor, with an OR of 2.12 (95% CI 1.18–3.81, $p = 0.012$), suggesting that elderly patients were approximately twice as likely to develop complications. An ASA score of ≥ 3 was also linked to increased risk, with an OR of 1.89 (95% CI 1.09–3.28, $p = 0.024$), whereas an operative duration longer than 240 minutes increased the risk by approximately two-thirds (OR 1.67, 95% CI 1.02–2.73, $p = 0.041$). For 30-day mortality, a serum ALB concentration below 3.2 g/dL emerged as the only independent predictor, conferring more than a threefold higher likelihood of death (OR 3.45, 95% CI 1.34–8.87, $p = 0.010$).

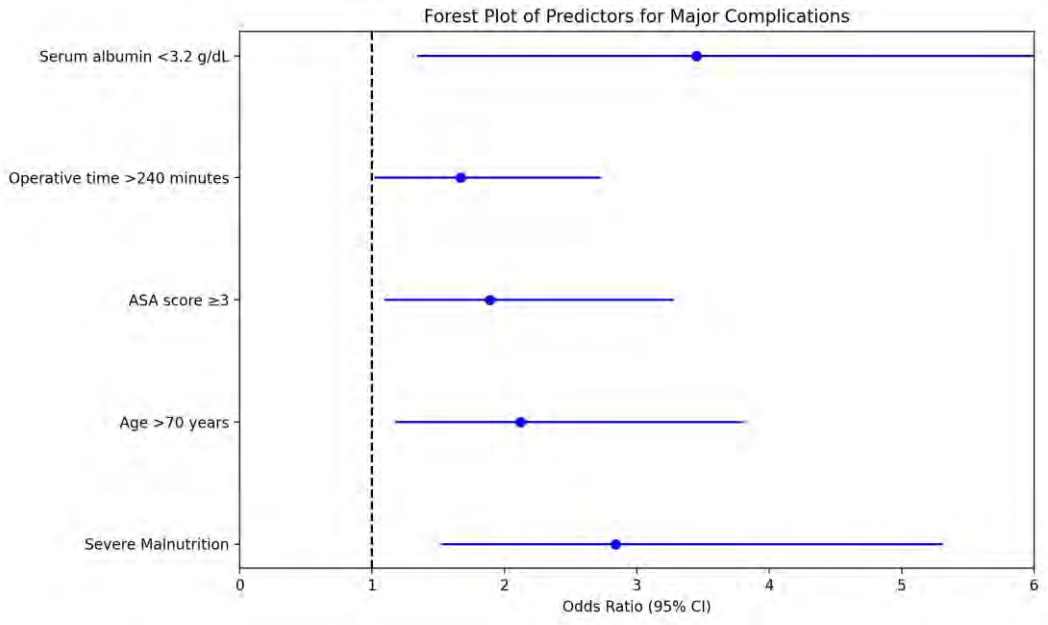

Figure 1. Forest plot of independent predictors of major surgical complications and 30-day mortality identified by multivariate logistic regression.

4. Discussion

This prospective cohort study revealed that preoperative nutritional status was strongly and clinically significantly linked with postoperative outcomes in patients who underwent major GI cancer surgery. Nearly half of our cohort was nutritionally compromised preoperatively, and malnourished patients experienced markedly higher 30-day mortality rates, major complication rates, and prolonged hospital stays than their well-nourished counterparts did. These findings reinforce the key role of nutritional status, a

potentially modifiable determinant of perioperative outcomes in GI cancer surgical procedures, particularly in resource-limited settings.

The malnutrition prevalence recorded by our study is in line with global estimates. Recent multicenter data reported malnutrition or nutritional risk in 35–50% of GI cancer surgery patients, depending on the assessment tool used [17,18]. In a large prospective study, more than one-third of patients (39%) were predisposed to undernourishment at admission (MUST score ≥1), with 17.9% at moderate risk and 21.1% at severe risk [17]. This alignment across diverse healthcare systems suggests that malnutrition is a universal challenge in GI cancer care, transcending geographical and socioeconomic boundaries.

The mortality outcomes in our study further highlight the prognostic impact of malnutrition. The thirty-day mortality rate was 12.5% in undernourished patients in comparison with 4.2% in optimally nourished patients ($p = 0.008$), closely paralleling the landmark international study by Biccard et al., which reported 11.36% versus 2.27% in severely malnourished and well-nourished patients, respectively [19]. Our slightly higher mortality rates may reflect differences in healthcare infrastructure, perioperative protocols, and patient complexity. In the multivariate analysis, severe malnutrition independently predicted major complications, highlighting the importance of preoperative optimization.

The complication rates followed a similar pattern. In malnourished patients, surgical site infections, anastomotic leakage, and respiratory complications occurred at a notably higher incidence, representing major postoperative complications. These findings mirror those of Abrha et al., who reported 3–4 times higher complication and mortality rates in malnourished surgical patients, along with extended hospital stays and approximately 50% greater costs [15]. The increased median length of stay in our malnourished group likely reflects both the greater complication burden and delayed recovery [20].

Nutritional biomarkers also play a prognostic role. A serum ALB concentration <3.2 g/dL was a self-regulating predictor of 30-day mortality, which is consistent with ACS-NSQIP data from over 42,000 colorectal cancer patients [21]. Although the serum ALB concentration is influenced by the inflammatory state and is not a pure nutritional marker, its predictive value in the perioperative setting remains clinically relevant. Our findings support its use as part of a comprehensive valuation strategy rather than as a stand-alone test.

Recent frameworks, such as the GLIM criteria, advocate the integration of phenotypical and etiological criteria to advance diagnostic precision [22]. GLIM-defined malnutrition has been shown to outperform traditional tools in anticipating postoperative medical complications in colorectal cancer patients [23]. In our study, nutritional assessment was conducted via the validated PG-SGA, which remains widely used in oncology. However, integration with the GLIM criteria and body composition analysis may further refine perioperative risk stratification.

Operative factors also differed between groups, with malnourished patients experiencing longer operative times and greater estimated blood loss. Malnutrition is known to impair tissue healing, collagen synthesis, and immune function, all of which can increase surgical complexity and susceptibility to complications [24]. These physiological disadvantages may play a potential role in the prolonged recovery and increased complication rates observed.

Beyond surgical complexity, malnutrition biologically predisposes patients to adverse outcomes by impairing immune defenses, slowing collagen synthesis, and delaying angiogenesis. These mechanisms collectively increase susceptibility to infection, wound

breakdown, and prolonged recovery, helping to explain the complications observed in our cohort.

The adverse outcomes associated with malnutrition may be amenable to targeted intervention. Li et al. reported that timely postoperative enteral nourishment in gastric cancer patients shortened the hospital stay by approximately two days (7.73 vs 9.77 days, $p = 0.002$), although it did not significantly reduce complication rates [25]. Similarly, the NOURISH study highlighted the importance of early intervention and standardized nutritional assessment protocols in upper GI cancer patients [26]. Given our findings, the implementation of structured perioperative nutrition programs could represent a cost-effective strategy for improving outcomes, especially in resource-limited environments. Taken together, these results highlight the clinical importance of early perioperative nutritional care. Routine screening, timely initiation of enteral/oral nutrition, and selective immunonutrition within ERAS protocols may reduce morbidity and enhance recovery in high-risk patients [27].

Sarcopenia, which is characterized by the loss of skeletal muscle mass and function, has been identified as an important component of cancer-associated malnutrition. Several studies have demonstrated that sarcopenia functions as an independent determinant of postoperative outcomes and long-term survival in individuals with GI cancer, even after adjusting for conventional nutritional indicators [28]. Future studies in our setting should consider incorporating CT-based muscle mass assessment to capture this dimension of nutritional status. These observations are consistent with international studies, where sarcopenia and altered body composition independently predicted complications and survival in patients who underwent GI cancer surgery. Similarly, in multicenter cohorts from Europe and Asia, the use of CT-based skeletal muscle indices and the EWGSOP2/AWGS criteria revealed that reduced muscle mass or strength was strongly associated with morbidity and mortality. This finding reinforces the global validity of our findings.

In high-income countries, malnourished surgical patients often incur 30–100% higher healthcare costs than well-nourished patients do, largely due to increased complications and longer hospital stays. [29]. In low-resource settings, cost-effective screening and targeted interventions could yield significant financial and clinical benefits, supporting both patient care and system sustainability.

Our study has various limitations. The relatively small sample size and single-center study design may limit generalizability, predominantly to centers with different case mixtures or perioperative protocols. While we used validated tools for nutritional assessment, the absence of body composition analysis limits the completeness of nutritional profiling. We did not evaluate the impact of specific nutritional interventions, which could provide insight into modifiable outcome determinants. Moreover, the lack of an interventional arm prevents conclusions about whether targeted nutritional therapy could affect outcomes. The observational nature of the study further limits the ability to infer causality. Finally, our 30-day follow-up precludes the assessment of long-term oncologic outcomes and survival.

Future research should prioritize randomized controlled trials evaluating perioperative nutritious interventions in GI cancer patients. The development and validation of simplified, cost-effective screening tools tailored to resource-limited settings would improve the adoption of routine nutritional assessment. Integration of body composition analysis into future studies may increase the accuracy of nutritional risk stratification and its predictive value for clinical outcomes. Studies exploring the relationships between nutritional status and long-term oncologic results are also needed. Finally, eco-

nomic evaluations of nutritional programs could provide an evidence base for policy and resource allocation decisions.

5. Conclusions

This study demonstrated that preoperative malnutrition is a strong determinant of adverse surgical outcomes in GI cancer patients undergoing major resection. Nearly half of the cohort presented with nutritional compromise, and malnourished patients had significantly higher mortality rates, complication rates, and longer hospital stays. Severe malnutrition is recognized as an independent indicator of poor outcomes, highlighting the need for routine preoperative nutritional and dietary screening and targeted perioperative support. These findings advocate incorporating comprehensive nutritional assessment into standard care pathways for GI cancer surgery to improve patient outcomes and optimize healthcare resource use.

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Ethics statement: The study was approved by the Institutional Review Board of Lady Reading Hospital, Peshawar (Approval No. 64/LRH/MTI).

Consent to participate: Not applicable.

Data availability: The data supporting this study's findings are available from the corresponding author, Ihtisham Ul Haq, upon reasonable request.

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Original Article

Knowledge of rheumatoid factor in the diagnosis of rheumatoid arthritis: a survey of family physicians in Punjab, Pakistan

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Abstract

Rheumatoid arthritis (RA) is a chronic autoimmune inflammatory disease that requires timely diagnosis and intervention. As frontline healthcare providers, family physicians must have a clear understanding of the diagnostic utility of rheumatoid factor (RF) and its limitations to ensure early recognition and appropriate referral of RA patients. This descriptive cross-sectional study was conducted over three months to assess the knowledge of family physicians in Punjab, Pakistan, regarding the diagnostic role and interpretation of RF in RA. Stratified random sampling was used, and a structured questionnaire was distributed to 300 physicians, with responses collected via Google Forms. The questionnaire evaluated demographic variables and knowledge of RA diagnostic criteria, RF specificity, and related clinical interpretation. The knowledge scores were classified as good (≥ 75%), moderate (50–74%), or poor (< 50%). Data analysis was performed via SPSS version 24, with chi-square tests used to examine associations ($p < 0.05$). The results revealed that only 27.76% of the participants demonstrated good knowledge. Most respondents had moderate (50.95%) or poor (21.29%) knowledge. Significant associations were observed between knowledge level and factors such as physician age, graduation cohort, experience, type of medical college, involvement in RA patient care, and private practice ($p < 0.05$). This study revealed significant gaps in family physicians' knowledge regarding RF's diagnostic value in RA. Targeted educational interventions and updated clinical training are essential to improve early RA detection, enhance referral practices, and improve patient outcomes at the primary care level.

Keywords

Rheumatoid factor; Rheumatoid arthritis; Knowledge, attitudes, practice; Primary health care; Family physicians

1. Introduction

Rheumatoid arthritis (RA) is a chronic autoimmune inflammatory disorder that primarily affects synovial joints and is characterized by persistent inflammation, progressive joint destruction, and systemic complications, including cardiovascular, pulmonary, and hematologic involvement [1]. Globally, RA has an estimated annual incidence of 3 per 10,000 individuals and a prevalence of approximately 1%, with peak onset between 35 and 50 years of age and a higher prevalence in females [2]. If not diagnosed and treated early, RA can lead to irreversible joint damage, deformities, and significant disability, negatively impacting quality of life and socioeconomic well-being [3,4].

Early diagnosis and the initiation of disease-modifying antirheumatic drugs (DMARDs) are crucial for preventing long-term joint damage [5]. However, diagnosing RA, especially in its early stages, can be difficult because of the nonspecific nature of early symptoms and variable laboratory results [6]. Rheumatoid factor (RF) is an autoan-

tibody directed against the Fc portion of immunoglobulin G (IgG) and has traditionally been used as a key serological marker for RA. However, RF has limitations in diagnostic specificity, as it may be elevated in other autoimmune diseases (e.g., systemic lupus erythematosus, Sjögren's syndrome), infections (e.g., hepatitis C, tuberculosis), chronic lung conditions, and even in up to 4% of healthy people, especially elderly individuals [7]. In contrast, anti-cyclic citrullinated peptide (anti-CCP) antibodies are more specific for RA and have a stronger ability to predict erosive disease [8]. Despite their usefulness, both RF and anti-CCP can be negative in patients with seronegative RA, which makes clinical judgment even more important when they are being diagnosed [9].

To address diagnostic ambiguity and standardize classification, the American College of Rheumatology (ACR) and the European League Against Rheumatism (EULAR) introduced revised RA classification criteria in 2010. These criteria highlight a combination of joint involvement, serological markers (RF and anti-CCP), acute-phase reactants (CRP and ESR), and symptom duration. A score of ≥ 6/10 indicates definite RA [10]. In addition to its diagnostic role, RF also has prognostic significance. High titers of RF are linked to more aggressive disease, increased radiographic progression, extra-articular manifestations, and poorer overall outcomes [11,12,13]. Therefore, accurate interpretation of RF results is essential not only for diagnosis but also for long-term disease management.

In the healthcare system of Pakistan, family physicians serve as the first point of contact for most patients. Their role is central in identifying RA early, ordering relevant diagnostic tests, initiating appropriate patient counseling, and making timely referrals to rheumatologists [14]. However, studies have shown that knowledge gaps among primary care physicians regarding serological markers, especially RF, contribute to delayed diagnoses and inappropriate test utilization, leading to misdiagnosis or missed opportunities for early treatment [15].

Despite the widespread use of RF in clinical practice, limited data exist on the knowledge and clinical reasoning of family physicians in Pakistan regarding its appropriate use, interpretation, and limitations [16]. Understanding these knowledge gaps is critical for improving early diagnosis, referral patterns, and, ultimately, patient outcomes. This study aimed to assess the diagnostic utility and limitations of RF in the treatment of RA among family physicians in Punjab, Pakistan. Specifically, it evaluates the understanding of RA classification criteria, the specificity and prognostic relevance of RF, and factors influencing test interpretation and diagnostic decision-making in primary care.

2. Methodology

2.1. Study design

This was a descriptive, cross-sectional study conducted over a three-month period from February to April 2025.

2.2. Ethical approval

Ethical approval for this study was obtained from the Institutional Review Board of FMH College of Medicine & Dentistry, Lahore (No. FMH-30/09/2024-IRB-1488). Informed consent was obtained from all participants prior to their inclusion in the study, and the confidentiality of the data was maintained throughout the research process.

2.3. Study setting

The study was conducted across primary healthcare settings in Punjab, Pakistan, and targeted family physicians working in both the public and private sectors. Physicians

were recruited from urban and rural areas spanning the 16 administrative districts of Punjab. The study was carried out under the supervision of the Department of Family Medicine, Fatima Memorial Hospital, Lahore, Pakistan.

2.4. Inclusion and exclusion criteria

The inclusion criteria for the study were MBBS-qualified physicians who were actively practicing in primary healthcare facilities, such as basic health units (BHUs), rural health centers (RHCs), and private general practice clinics. Physicians who graduated from foreign institutions or held postgraduate qualifications in internal medicine or rheumatology, as well as those working exclusively in secondary or tertiary care hospitals, were excluded.

2.5. Sample size and sampling technique

A sample size of 233 was calculated via the OpenEpi sample size calculator, assuming a 99.99% confidence level, 5% margin of error, and an estimated knowledge proportion of 4%, on the basis of a previous study that reported that only 4% of primary care physicians felt very confident in diagnosing early RA [17]. To account for potential nonresponses and incomplete data, a total of 300 questionnaires were distributed. The sampling frame was constructed using physician lists provided by the Health and Population Department of the Government of Punjab for public sector facilities, as well as lists from the Association of Family Physicians of Pakistan for private sector clinics. Stratified sampling was used, dividing the physicians into three strata: public, private, and NGO/not-for-profit sectors. The participants were then randomly selected from each stratum to ensure representation across all healthcare sectors.

2.6. Data collection tool

Data were collected via a structured, self-administered questionnaire distributed digitally via Google Forms. The questionnaire was developed on the basis of current clinical guidelines and literature and was reviewed by academic experts in rheumatology and family medicine [18,19,20]. A pilot test was conducted with 15 family physicians to assess clarity and reliability, following which minor revisions were made for comprehensibility.

2.7. Study measures

The questionnaire consisted of two main sections. The first section collected demographic information, including age [≤ 35 years (young), 36–45 years (middle-aged), and ≥ 46 years (senior)], gender (male, female), ethnicity (Punjabi, Saraiki, Urdu-speaking, Balochi, Sindhi, and other), medical college of degree (public, private), year of graduation [recorded as year and later categorized as pre-COVID graduates (≤ 2019) and post-COVID graduates (≥ 2020)], years of clinical experience (1–10 years, >10–20 years, >20–30 years, >30 years), job sector (public, private, NGO/not-for-profit), private practice engagement (yes, no), average number of patients seen per day (1–50, 51–100, >100), and whether the physician routinely managed patients with RA.

The second section assessed physicians' knowledge about RA and the diagnostic utility of RF through multiple-choice questions, each containing one correct answer. The knowledge items covered key clinical concepts, including the nature of RA as a disease, components of the 2010 ACR/EULAR diagnostic criteria, the minimum score required for diagnosis, eligibility criteria for applying the classification system, the use and specificity of RF in diagnosis, the presence of RF in healthy individuals and other diseases, the most

specific serological marker for RA, the possibility of RA diagnosis despite negative RF and anti-CCP results, the biochemical composition of RF, and its prognostic implications. Each correct answer was scored as 1, whereas incorrect and "not sure" responses were scored as 0. A composite knowledge score was calculated for each participant, which was then categorized into three levels: good knowledge (≥75% correct responses), moderate knowledge (50–<75%), and poor knowledge (<50%) [21].

2.8. Data analysis

The data were entered and analyzed via IBM SPSS Statistics version 24 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize participant demographics and knowledge scores. Chi-square tests were applied to assess associations between categorical demographic variables (e.g., gender, job sector) and levels of knowledge. A p value of less than 0.05 was considered statistically significant for all inferential analyses.

3. Results

Table 1 shows that the majority of family physicians were female (58.56%), and most were 35 years of age or younger (45.25%), followed by those aged 36–45 years (33.84%) and senior physicians aged 46 years or above (20.91%). Ethnically, more than half identified as Punjabi (57.03%), whereas the rest belonged to the Urdu-speaking (19.77%), other (11.41%), Saraiki (6.08%), Sindhi (5.32%), and Balochi (0.38%) backgrounds. Slightly more participants had graduated from public medical colleges (52.47%) than from private colleges (47.53%), and a greater proportion were pre-COVID-19 graduates (63.12%) than were post-COVID-19 graduates (36.88%). In terms of experience, 45.25% had been practicing for 1–10 years, 33.84% for 11–20 years, and fewer had more than 20 years of experience. The majority worked in the private sector (59.32%), while 33.84% were in the public sector and 6.84% in NGO or not-for-profit settings. While 36.16% engaged in private practices in addition to their main job, most (60.84%) did not. Most physicians (86.31%) reported seeing 1–50 patients daily, and 75.67% of all respondents reported managing patients with RA in their clinical practice.

Table 1. Demographic and practice characteristics of family physicians (N = 263).

Variables		Frequency (%)
Age (in years)	≤ 35 (young)	119 (45.25)
	36–45 (middle-aged)	89 (33.84)
	≥ 46 (senior)	55 (20.91)
Gender	Male	109 (41.44)
	Female	154 (58.56)
Ethnicity	Punjabi	150 (57.03)
	Saraiki	16 (6.08)
	Urdu-speaking	52 (19.77)
	Balochi	1 (0.38)
	Sindhi	14 (5.32)
	Other	30 (11.41)
Type of medical college graduation	Public	138 (52.47)
	Private	125 (47.53)
Graduation cohort	Pre-COVID (≤ 2019)	166 (63.12)
	Post-COVID (≥ 2020)	97 (36.88)
Clinical experience	1–10 years	119 (45.25)

Variables		Frequency (%)
	> 10–20 years	89 (33.84)
	> 20–30 years	40 (15.21)
	> 30 years	15 (5.70)
Job sector	Public	89 (33.84)
	Private	156 (59.32)
	NGO/not-for-profit	18 (6.84)
Private practice engagement	Yes	103 (36.16)
	No	160 (60.84)
Daily patient volume	1–50	227 (86.31)
	51–100	26 (9.89)
	> 100	10 (3.80)
Manage rheumatoid arthritis	Yes	199 (75.67)
	No	64 (24.33)

Table 2 shows that 27.76% of the physicians demonstrated good knowledge (≥ 75%), 50.95% had moderate knowledge (50–74%), and 21.29% had poor knowledge (< 50%) regarding RA and RF.

Table 2. Knowledge scores and levels of rheumatoid factors in rheumatoid arthritis patients.

Variables		Frequency (%)
Knowledge level regarding rheumatoid arthritis and rheumatoid factor	Poor (< 50%)	56 (21.29)
	Moderate (50–74%)	134 (50.95)
	Good (≥ 75%)	73 (27.76)

Table 3 presents the associations between physician characteristics and knowledge levels regarding RA and RF. Among the physicians aged ≤ 35 years, 62.5% had poor knowledge, whereas only 16.1% of those aged ≥ 46 years had poor knowledge. Conversely, 27.4% of the senior physicians (≥ 46 years) had good knowledge, indicating a statistically significant association between age and knowledge level ($p = 0.032$). The type of medical college also showed a significant relationship; 62.5% of poor scorers graduated from private colleges, whereas 61.6% of good scorers were from public colleges ($p = 0.023$). Knowledge was significantly greater among pre-COVID-19 graduates ($p < 0.001$), with 76.7% of good scorers graduating in or before 2019. Similarly, those with greater clinical experience demonstrated better knowledge ($p = 0.029$), and those engaged in private practices had significantly higher scores ($p = 0.046$). Notably, 98.6% of the participants with good knowledge reported managing RA patients in practice, whereas 66.1% of the poor scorers did not ($p < 0.001$). No statistically significant associations were observed between knowledge level and gender, job sector, or patient volume.

Table 3. Associations between physician characteristics and knowledge level (N = 263).

Variables		Knowledge level regarding RA and RF			Chi-square Value	*p* Value
		Poor (< 50%) n = 56	Moderate (50–74%) n = 134	Good (≥ 75%) n = 73		
Age (in years)	≤ 35 (young)	35 (62.50)	57 (42.54)	27 (36.99)	10.566	0.032 **
	36–45 (middle-aged)	12 (21.43)	51 (38.06)	26 (35.62)		
	≥ 46 (senior)	9 (16.07)	26 (19.40)	20 (27.40)		
Gender	Female	33 (58.93)	84 (62.69)	37 (50.68)	2.809	0.246
	Male	23 (41.07)	50 (37.31)	36 (49.32)		

Variables		Knowledge level regarding RA and RF			Chi-square Value	*p* Value
		Poor (< 50%) n = 56	Moderate (50–74%) n = 134	Good (≥ 75%) n = 73		
Type of medical college graduation	Private	35 (62.50)	62 (46.27)	28 (38.36)	7.581	0.023 **
	Public	21 (37.50)	72 (53.73)	45 (61.64)		
Graduation cohort	Pre-COVID (≤ 2019)	24 (42.86)	86 (64.18)	56 (76.71)	15.735	< 0.001 **
	Post-COVID (≥ 2020)	32 (57.14)	48 (35.82)	17 (23.29)		
Clinical experience	1–10 years	36 (64.29)	58 (43.28)	25 (34.25)	14.023	0.029 **
	> 10–20 years	11 (19.64)	50 (37.31)	28 (38.36)		
	> 20–30 years	6 (10.71)	18 (13.43)	16 (21.92)		
	> 30 years	3 (5.36)	8 (5.97)	4 (5.48)		
Job sector	Private	18 (32.14)	46 (34.33)	25 (34.25)	0.584	0.965
	Public	35 (62.50)	79 (58.96)	42 (57.53)		
	NGO/not-for-profit	3 (5.36)	9 (6.72)	6 (8.22)		
Private practice engagement	No	42 (75.00)	75 (55.97)	43 (58.90)	6.161	0.046 **
	Yes	14 (25.00)	59 (44.03)	30 (41.10)		
Daily patient volume	1–50	50 (89.29)	117 (87.31)	60 (82.19)	3.066	0.547
	51–100	3 (5.36)	13 (9.70)	10 (13.70)		
	> 100	3 (5.36)	4 (2.99)	3 (4.11)		
Manage rheumatoid arthritis	No	37 (66.07)	26 (19.40)	1 (1.37)	75.658	< 0.001 **
	Yes	19 (33.93)	108 (80.60)	72 (98.63)		

* RA = rheumatoid arthritis; RF = rheumatoid factor. ** Significant value ($p < 0.05$).

4. Discussion

This study revealed that a substantial proportion of the physicians reported only moderate or poor knowledge, indicating a gap in the understanding of the diagnostic criteria and serological markers used in clinical evaluation. Statistically significant associations were observed between knowledge levels and multiple demographic and professional characteristics. Younger physicians and those who graduated after the onset of the COVID-19 pandemic tended to have lower knowledge levels, while better knowledge was associated with increasing age and greater clinical experience. Graduates from public sector medical colleges demonstrated higher knowledge scores than those from private institutions did. Additionally, physicians engaged in private practice and those actively managing patients with RA were more likely to possess greater diagnostic knowledge. No significant associations were observed with sex, job sector, or daily patient volume.

These findings are consistent with those of previous studies; a Nigerian study revealed that a majority of general practitioners lacked awareness of the diagnostic role of RF and its limitations, reflecting a similar deficiency in knowledge [22]. Saudi Arabia reported widespread misconceptions about the specificity of RF for the treatment of RA among primary care physicians [23]. Similarly, studies have highlighted poor to moderate levels of knowledge regarding RA diagnostic criteria and the correct interpretation of RF and anti-CCP antibodies [8,24]. Our study revealed that older physicians, public medical college graduates, and those with more than ten years of experience were more likely to have higher knowledge scores. These trends mirror findings from studies in India and Bangladesh, where structured training and clinical exposure in public institutions were associated with better diagnostic proficiency in autoimmune conditions [25,26]. A study by Alzahrani et al. also concluded that clinical experience significantly improved the diagnostic accuracy for RA in general practice [27].

Another noteworthy finding was the significantly lower knowledge scores among physicians who graduated during or after the COVID-19 pandemic. This aligns with evi-

dence suggesting that medical training during the pandemic, which relied heavily on virtual learning, may have compromised clinical exposure and diagnostic reasoning development [28,29]. Graduates from public medical colleges outperform those from private institutions, which is consistent with previous literature indicating that public colleges often offer more rigorous clinical rotations, including exposure to rheumatology departments [30]. Additionally, physicians actively managing RA cases scored higher, corroborating the link between clinical involvement and applied diagnostic knowledge, as seen in other studies [15,31].

Importantly, misconceptions about RF were prevalent. Many physicians incorrectly believe that RF is highly specific to RA, a finding also reported in the scientific literature, where RF is frequently misinterpreted in clinical decision-making [32,33]. A Canadian study similarly noted that primary care physicians often overutilize RF without a clear understanding of its limitations [34]. These inaccuracies may lead to diagnostic delays, overreferrals, or unnecessary anxiety among patients. Contrary to expectations, neither gender nor daily patient volume significantly influenced knowledge levels. This finding supports studies showing that a sheer workload does not ensure better clinical accuracy unless guided by continuing education and institutional support [35].

This study provides a detailed assessment of family physicians' understanding of the diagnostic role and limitations of RF in diagnosing RA in a large, diverse province in Pakistan. One of the strengths of this study is its use of a stratified random sampling method, which ensures a balanced representation of physicians from the public, private, and NGO/not-for-profit sectors, as well as from urban and rural areas and with different levels of experience. The questionnaire was structured on the basis of the literature and validated by experts, enhancing its content validity. Additionally, pretesting the questionnaire improved its reliability. However, despite these steps, the reliance on multiple-choice questions may not fully capture the nuances of clinical decision-making or the contextual understanding needed to interpret RF results. Furthermore, excluding secondary and tertiary care physicians makes it difficult to compare findings across different levels of clinical exposure. Finally, collecting data online may unintentionally exclude physicians with limited access to digital tools or low digital literacy, especially in rural or underserved regions.

5. Conclusions

The study revealed that while some respondents had a good understanding of the topic, most had moderate to poor knowledge, especially among younger and less experienced physicians, as did recent graduates from post-COVID-19 programs. These findings highlight the urgent need for targeted educational interventions, updated clinical training, and improved referral pathways to ensure early and accurate diagnosis of RA in primary care settings.

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Consent to participate: Not applicable.

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Original Article

Maternal awareness and misconceptions about genetic disorders: a cross-sectional study among mothers of affected children at PIMS Hospital, Islamabad

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Abstract

Genetic disorders impose a considerable health burden in low- and middle-income countries, where high consanguinity rates, limited access to services, and low health literacy intensify their impact. This study assessed awareness, knowledge, and misconceptions about genetic disorders among mothers of affected children at the Pakistan Institute of Medical Sciences (PIMS), Islamabad, and examined associated sociodemographic factors. A cross-sectional survey was conducted from April to May 2025 among 100 mothers of children with confirmed genetic disorders via a structured, interviewer-administered questionnaire. The mean participant age was 31.13 ± 6.06 years; 36% were illiterate, and 52% resided in urban areas. While 78% had heard of genetic disorders, only 18% knew of local genetic testing or counseling services, and 24% had received information from healthcare providers. Good awareness was seen in 16% and poor awareness in 78% of the participants; good knowledge was found in 25%, whereas 66% had poor knowledge. Misconceptions persisted, with 21% attributing genetic disorders to bad luck or punishment and 16% believing they were contagious; 38% demonstrated good understanding, and 46% demonstrated poor understanding. Education and socioeconomic class were significantly associated with awareness ($p = 0.011$, $p = 0.001$), knowledge ($p < 0.001$, $p = 0.002$), and beliefs ($p < 0.001$, $p < 0.001$), whereas age and residence were not significantly associated. The findings highlight a gap between general awareness and functional understanding, emphasizing the need for targeted, literacy-sensitive interventions to improve maternal genetic health literacy and support informed healthcare decision-making.

Keywords

Genetic diseases, inborn; Health knowledge, attitudes, practice; Mothers; Socioeconomic factors; Consanguinity

1. Introduction

Genetic disorders contribute significantly to the global burden of disease, affecting millions of children and imposing considerable emotional, medical, and financial strain on families and healthcare systems. Recent estimates suggest that approximately 6% of newborns worldwide are born with serious birth defects, including congenital disorders with structural or functional anomalies [1]. The Global Burden of Disease Study 2021 highlights persistent disparities in disability-adjusted life years (DALYs) attributable to

congenital anomalies, particularly in low-resource settings where access to preventive and diagnostic services remains limited [2]. Global modeling indicates that chromosomal abnormalities and single-gene disorders—together accounting for approximately 8.9% of congenital anomalies—exhibit substantial variation in prevalence between regions, influenced by factors such as maternal age, rates of consanguinity, environmental exposures, and healthcare access [3].

In Pakistan, a low- and middle-income country (LMIC), the burden of genetic disorders is intensified by socioeconomic inequities, high rates of consanguinity, and limited genetic counseling infrastructure [4,5]. Nationally, nearly two-thirds of marriages occur between blood relatives—most commonly first or second cousins—substantially increasing the risk of autosomal recessive disorders [6]. For example, a recent study in Balochistan reported consanguineous unions in half of all congenital anomaly cases, with neurological and limb defects among the most common presentations [5]. The evidence indicates that consanguinity increases the frequency of autosomal recessive disorders by up to twofold compared with nonconsanguineous couples [7].

Maternal awareness plays a pivotal role in early recognition, health-seeking behavior, and the management of genetic disorders. However, in LMICs, awareness levels are often limited due to educational, cultural, and informational barriers. Studies in Pakistan indicate that misconceptions about the causes of genetic disorders are widespread, with a substantial proportion of the population attributing them to infections, nutritional factors, or supernatural beliefs, and awareness of the role of consanguinity in increasing genetic risk is significantly greater among educated individuals than among those with little or no formal schooling [4,8,9]. Comparable patterns have been observed globally. In India, only 36.5% of pregnant women demonstrated an understanding of prenatal genetic screening [10], whereas in Rwanda, 53.8% of women could not name a single genetic condition, although many expressed a willingness to undergo carrier testing if available [11].

Low maternal literacy not only hinders understanding but also delays diagnosis and treatment. A 2022 cohort study linked limited schooling with reduced healthcare utilization for genetic conditions [12]. Misconceptions rooted in cultural beliefs—such as attributing disorders to spiritual punishment or the "evil eye"—further complicate clinical management [8,13]. In Pakistan, diagnostic delays often extend beyond four years, with many families resorting to spiritual healers or discontinuing biomedical treatments when symptoms appear to improve [14,15].

This study seeks to address this gap by evaluating awareness, beliefs, and misconceptions about genetic disorders among mothers of affected children at the Pakistan Institute of Medical Sciences (PIMS) Hospital in Islamabad. The primary objective of this study was to assess the level of awareness among mothers regarding genetic disorders, specifically among those whose children are admitted with such conditions at PIMS Hospital. The study further aims to explore the prevalent misconceptions and myths held by these mothers about the nature, transmission, and management of genetic disorders. Additionally, the research seeks to examine how key demographic factors—particularly maternal age, literacy status, locality, and socioeconomic class—influence both awareness levels and the presence of misconceptions. By identifying these knowledge gaps and demographic patterns, this study aims to provide insights that can guide targeted educational interventions and public health strategies aimed at improving maternal understanding of genetic health issues.

2. Methods

2.1. Study design, setting and duration

This cross-sectional study was conducted at PIMS Hospital, Islamabad, between April and May 2025. The study population included mothers of children diagnosed with genetic disorders who were admitted to the hospital during the study period.

2.2. Ethics consideration

Ethical approval for the study was obtained from the Ethical Research Review Committee (ERRC) of the Islamabad Hospital, PIMS (No. F-5-2/2024(ERRC)/PIMS). In addition, written permission was obtained from the PIMS Hospital administration to conduct data collection within the hospital premises.

2.3. Sample size and sampling method

The sample size was calculated via the single population proportion formula, considering a prevalence rate of 5.9% for genetic disorders, as reported in previous literature, with a 95% confidence level and 5% margin of error, resulting in a minimum required sample size of approximately 86 [16]. To account for potential dropouts, the sample size was increased by 25%, resulting in a final target of 108 participants, who were approached via a purposive sampling technique.

2.4. Selection criteria

Mothers were eligible for inclusion if they had a child with a confirmed diagnosis of a genetic disorder admitted to PIMS Hospital during the study period, were aged 18 years or older, and were willing to provide written informed consent. Mothers who were not the primary caregiver, had severe communication difficulties, or declined to participate were excluded from the study.

2.5. Questionnaire development

A structured, interviewer-administered questionnaire was developed to assess maternal awareness, knowledge, and misconceptions regarding genetic disorders. The tool was adapted from previously validated instruments used in studies assessing genetic literacy and maternal perceptions in LMICs [11,17,18,19,20], with minor modifications to ensure cultural appropriateness and contextual relevance. The questionnaire comprises four sections, including demographic information (age, education, residence, and socioeconomic class); awareness of genetic disorders (three binary yes/no items: having heard of genetic disorders, knowledge of genetic counseling/testing centers in Pakistan, and receiving information from a healthcare provider); and knowledge-based questions (three statements covering prevention through medical interventions, inheritance patterns, and perceived causes; responses: true/false/don't know); and beliefs and misconceptions (eight culturally relevant statements addressing common myths and misconceptions about genetic disorders; responses: true/false/don't know). The instrument was pretested on five mothers of children with confirmed genetic disorders at the same facility to ensure clarity, linguistic suitability, and cultural sensitivity, with minor revisions made before final administration.

2.6. Data collection

Data were collected through face–to-face interviews conducted by a trained female research assistant fluent in Urdu and local languages, held in a private area within PIMS

Hospital, Islamabad, to ensure confidentiality and participant comfort, with each interview lasting approximately 10–15 minutes. Responses were recorded on printed questionnaires and subsequently entered into a secure database for analysis. Written informed consent was obtained from all participants prior to data collection.

2.7. Study measures

The awareness score was derived from three binary (yes/no) items, with one point awarded for each "yes" response (range: 0–3). Scores were classified as good (3 points), moderate (2 points), or poor (0–1 points) [21]. Similarly, the knowledge score was calculated from the three knowledge-based questions, assigning one point for each correct response, with the same classification applied for good (3 points), moderate (2 points), and poor (0–1 points) answers. The misconception score was calculated from the eight belief/misconception items, with one point awarded for each correct response, resulting in a possible range of 0–8 points. For misconceptions, higher scores indicate better understanding and are categorized as low misconceptions (0–4 points), moderate misconceptions (5–6 points), and high misconceptions (7–8 points), with predefined score ranges applied in awareness research [22]. For analysis, age (continuous) was transformed into two categories, ≤30 years and >30 years, reflecting younger and older maternal age groups, respectively. Education was dichotomized into "literate" (able to read/write at any formal education level) and "illiterate" (no formal education).

2.8. Statistical analysis

The data were entered and analyzed via IBM SPSS Statistics (version 27.00, IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize participant characteristics, awareness, knowledge, and misconceptions regarding genetic disorders, with categorical variables presented as frequencies and percentages. The associations between sociodemographic variables and outcome variables, including awareness level, knowledge level, and misconception level, were assessed via the chi-square test. A p value of < 0.05 was considered to indicate statistical significance.

3. Results

Table 1 shows that the mean age of the participants was 31.13 years (SD ± 6.06). Over one-third of the mothers (36%) were illiterate, while 13% had completed graduate-level education or higher. The participants were almost evenly distributed between urban (52%) and rural (48%) areas. With respect to socioeconomic class, both the working and middle classes accounted for 43% each, with 14% belonging to the upper class.

Table 1. Sociodemographic characteristics of the study participants (N = 100).

Variables		Frequency (%)	Mean ± S.D.
Age (in years)		-	31.13 ± 6.06
Education	Illiterate	36 (36.00)	-
	Primary	11 (11.00)	-
	Secondary	18 (18.00)	-
	Higher secondary	22 (22.00)	-
	Graduate and above	13 (13.00)	-
Residence	Urban	52 (52.00)	-
	Rural	48 (48.00)	-
Socioeconomic class	Working class	43 (43.00)	-
	Middle class	43 (43.00)	-

Variables		Frequency (%)	Mean ± S.D.
	Upper class	14 (14.00)	-

Table 2 shows that most participants (78%) reported awareness of genetic disorders; however, only 18% knew about local centers offering genetic testing or counseling, and 24% had received information from healthcare providers. Overall, 16% of mothers demonstrated good awareness, whereas 78% had poor awareness. With respect to knowledge, 44% believed that genetic disorders could be prevented through medical interventions, and 51% thought that they were always inherited. One-fourth (25%) of the participants had good knowledge, whereas 66% had poor knowledge. In terms of beliefs and misconceptions, 62% recognized that cousin marriage increases the risk of genetic disorders, whereas 51% believed that these conditions are always apparent at birth. Misconceptions such as attributing genetic disorders to bad luck or punishment (21%) or considering them contagious (16%) were also noted. Overall, 38% demonstrated good understanding, 16% had moderate misconceptions, and 46% had poor understanding.

Table 2. Awareness, knowledge, and misconceptions about genetic disorders among the study participants (N = 100).

Variables		Frequency (%)
Level of Awareness		
Awareness of genetic disorders	Yes	78 (78.00)
	No	22 (22.00)
Knowledge of local genetic testing/counseling services	Yes	18 (18.00)
	No	82 (82.00)
Information received from healthcare providers	Yes	24 (24.00)
	No	76 (76.00)
Awareness level	Good awareness	16 (16.00)
	Moderate awareness	6 (6.00)
	Poor awareness	78 (78.00)
Level of Knowledge		
Perceived preventability of genetic disorders through medical interventions	True	44 (44.00)
	False	20 (20.00)
	Don't know	36 (36.00)
Belief that genetic disorders are always inherited	True	51 (51.00)
	False	27 (27.00)
	Don't know	22 (22.00)
Belief that maternal lifestyle or diet can cause genetic disorders	True	35 (35.00)
	False	32 (32.00)
	Don't know	32 (32.00)
Knowledge level	Good knowledge	25 (25.00)
	Moderate knowledge	9 (9.00)
	Poor knowledge	66 (66.00)
Beliefs and Misconceptions Level		
Belief that genetic disorders are contagious	True	16 (16.00)
	False	44 (44.00)
	Don't know	40 (40.00)
Belief that genetic disorders are always apparent at birth	True	51 (51.00)
	False	17 (17.00)
	Don't know	32 (32.00)
Belief that cousin marriage increases genetic disorder risk	True	62 (62.00)
	False	26 (26.00)

Variables		Frequency (%)
	Don't know	12 (12.00)
Belief that no intervention is possible after diagnosis	True	30 (30.00)
	False	45 (45.00)
	Don't know	25 (25.00)
Belief that genetic disorders result from bad luck or punishment	True	21 (21.00)
	False	49 (49.00)
	Don't know	30 (30.00)
Belief that genetic testing is only useful postnatally	True	38 (38.00)
	False	43 (43.00)
	Don't know	19 (19.00)
Belief that healthy-looking parents cannot have a child with a genetic disorder	True	10 (10.00)
	False	79 (79.00)
	Don't know	11 (11.00)
Belief that a healthy first child guarantees subsequent healthy children	True	28 (28.00)
	False	48 (48.00)
	Don't know	24 (24.00)
Beliefs and misconceptions level	Good understanding	38 (38.00)
	Moderate misconceptions	16 (16.00)
	Poor understanding	46 (46.00)

Table 3 shows the associations between sociodemographic characteristics and awareness levels regarding genetic disorders. Education and socioeconomic class were significantly associated with awareness ($p = 0.011$ and $p = 0.001$, respectively), with higher awareness observed among literate participants and those from the middle or upper socioeconomic classes. Age and place of residence were not significantly associated with awareness level.

Table 3. Associations between sociodemographic characteristics and level of awareness of genetic disorders among the study participants (N = 100).

Variables		Level of Awareness			*p* Value *
		Good Awareness (n = 16)	Moderate Awareness (n = 6)	Poor Awareness (n = 78)	
		N (%)	N (%)	N (%)	
Age	> 30 years	7 (7.00)	2 (2.00)	45 (45.00)	0.344
	≤ 30 years	9 (9.00)	4 (4.00)	33 (33.00)	
Education	Literate	15 (15.00)	2 (2.00)	47 (47.00)	0.011 *
	Illiterate	1 (1.00)	4 (4.00)	31 (31.00)	
Residence	Urban	9 (9.00)	3 (3.00)	40 (40.00)	0.932
	Rural	7 (7.00)	3 (3.00)	38 (38.00)	
Socioeconomic class	Working class	0 (0.00)	3 (3.00)	40 (40.00)	0.001 *
	Middle class	10 (10.00)	3 (3.00)	30 (30.00)	
	Upper class	6 (6.00)	0 (0.00)	8 (8.00)	

* Data were analyzed by using the chi-square test. ** Significant value ($p < 0.05$).

Table 4 presents the associations between sociodemographic characteristics and knowledge levels. Education ($p < 0.001$) and socioeconomic class ($p = 0.002$) were significantly associated with knowledge, with better knowledge observed among literate participants and those from higher socioeconomic classes. Age and residence were not significantly related to knowledge level.

Table 4. Associations between sociodemographic characteristics and level of knowledge regarding genetic disorders among the study participants (N = 100).

Variables		Level of Knowledge			*p* Value *
		Good Knowledge (n = 25)	Moderate Knowledge (n = 9)	Poor Knowledge (n = 66)	
		N (%)	N (%)	N (%)	
Age	> 30 years	15 (15.00)	3 (3.00)	36 (36.00)	0.383
	≤ 30 years	10 (10.00)	6 (6.00)	30 (30.00)	
Education	Literate	23 (23.00)	9 (9.00)	32 (32.00)	< 0.001 *
	Illiterate	2 (2.00)	0 (0.00)	34 (34.00)	
Residence	Urban	17 (17.00)	6 (6.00)	29 (29.00)	0.080
	Rural	8 (8.00)	3 (3.00)	37 (37.00)	
Socioeconomic class	Working class	6 (6.00)	0 (0.00)	37 (37.00)	0.002 *
	Middle class	13 (13.00)	6 (6.00)	24 (24.00)	
	Upper class	6 (6.00)	3 (3.00)	5 (5.00)	

* Data were analyzed by using the chi-square test. ** Significant value ($p < 0.05$).

Table 5 shows the associations between sociodemographic characteristics and beliefs/misconceptions about genetic disorders. Education ($p < 0.001$) and socioeconomic class ($p < 0.001$) were significantly associated with beliefs and misconceptions, with accurate beliefs and fewer misconceptions being more common among literate participants and those in higher socioeconomic classes. No significant associations were found for age or residence.

Table 5. Associations between sociodemographic characteristics and the level of beliefs and misconceptions about genetic disorders among study participants (N = 100).

Variables		Belief and Misconceptions Level			*p* Value *
		Accurate Beliefs/Low Misconceptions (Good Understanding) (n = 38)	Moderate Misconceptions (n = 16)	High Misconceptions (Poor Understanding) (n = 46)	
		N (%)	N (%)	N (%)	
Age	> 30 years	22 (22.00)	11 (11.00)	21 (21.00)	0.232
	≤ 30 years	16 (16.00)	5 (5.00)	25 (25.00)	
Education	Literate	33 (33.00)	11 (11.00)	20 (20.00)	< 0.001 *
	Illiterate	5 (5.00)	5 (5.00)	26 (26.00)	
Residence	Urban	24 (24.00)	7 (7.00)	21 (21.00)	0.215
	Rural	14 (14.00)	9 (9.00)	25 (25.00)	
Socioeconomic class	Working class	9 (9.00)	6 (6.00)	28 (28.00)	< 0.001 *
	Middle class	21 (21.00)	5 (5.00)	17 (17.00)	
	Upper class	8 (8.00)	5 (5.00)	1 (1.00)	

* Data were analyzed by using the chi-square test. ** Significant value ($p < 0.05$).

4. Discussion

The findings of this study indicate that while a majority of mothers were aware of genetic disorders in general terms, detailed knowledge about their causes, prevention, and available healthcare services was limited, and misconceptions remained prevalent. Educational attainment and socioeconomic status emerged as key factors influencing

awareness, knowledge, and the accuracy of beliefs, whereas age and place of residence appeared to have little impact. The persistence of misconceptions alongside limited awareness of local genetic services suggests a gap between general familiarity with the concept of genetic disorders and a functional understanding that could support informed decision-making and health-seeking behavior.

Our findings align with previous research in Pakistan and other LMICs showing that general awareness of genetic disorders may be relatively common, but detailed knowledge and understanding remain poor [22,23,24,25]. Similar to a Pakistan-based study, where almost 80% of respondents were familiar with the term genetic disorders and 39.3% had heard about genetic testing before the survey, our participants demonstrated high general awareness but limited familiarity with specific services and preventive strategies [22]. A similar trend was observed in an Indian study, where only 36.5% of pregnant women knew about prenatal genetic screening tests, indicating that general awareness often does not translate into a deeper understanding [10]. The persistence of misconceptions—such as the belief that genetic disorders are always inherited or always visible at birth—mirrors findings from Rwanda, where more than half of the women surveyed could not name a single genetic condition despite having heard of the term [11]. These similarities may reflect shared barriers such as low genetic literacy, limited access to counseling, and inadequate integration of genetic health topics into primary care.

The significant associations between higher educational attainment and improved awareness, knowledge, and reduced misconceptions observed in this study align with evidence from various settings. Previous research in Pakistan and other LMICs has consistently shown that literacy equips mothers with the capacity to critically assess health information, leading to more accurate perceptions of genetic disorders [12,16]. Similarly, international studies have indicated that increased years of formal education are often linked to higher genetic literacy and a greater ability to reject misconceptions [26,27,28]. The association between socioeconomic class and better awareness in our findings is also in line with global evidence suggesting that households with greater economic resources are more likely to afford diagnostic services, seek specialist consultations, and participate in health education programs [14,29]. This relationship may be explained by better access to reliable health information, stronger health-seeking behaviors, and more frequent interactions with healthcare providers among educated and higher-income families [30,31].

In contrast, our finding that maternal age and place of residence did not significantly influence awareness, knowledge, or beliefs differs from patterns reported in several earlier studies. Research in certain regions of LMICs has suggested that rural mothers often demonstrate lower awareness of genetic risk factors than their urban counterparts do, whereas studies in other LMICs, such as Rwanda, have also documented rural–urban knowledge gaps [17,32]. The absence of such disparities in our study may be attributable to our hospital-based sampling at a tertiary care facility, where both urban and rural participants had already navigated healthcare referral pathways and may have had prior exposure to genetic health information.

The lack of a significant association between maternal age and genetic health literacy in our results also contrasts with findings from settings where older mothers were expected to possess greater knowledge owing to accumulated life experience [33]. In our context, the absence of an age effect may suggest that experience alone is insufficient to improve understanding without targeted health education [34]. This interpretation is consistent with studies indicating that formal education and structured information delivery are more influential determinants of knowledge than age is [35].

A key strength of our study lies in its focus on mothers of children with confirmed genetic disorders, ensuring that responses were grounded in lived experience rather than hypothetical scenarios. The use of a culturally adapted, pretested questionnaire improved the reliability of the responses in the local context. However, several limitations should be noted. The purposive sampling method and single-institution setting may limit generalizability to broader maternal populations in Pakistan, especially those without access to tertiary care. The cross-sectional design precludes the assessment of causal relationships between sociodemographic variables and knowledge or beliefs. Self-reported awareness and knowledge are also subject to recall and social desirability biases, which may lead to overestimation of understanding. Despite these limitations, this study provides valuable insights into the gaps in maternal genetic literacy in high-risk populations.

5. Conclusions

This study highlights that while a majority of mothers of children with genetic disorders possessed general awareness of these conditions, their detailed knowledge and accurate understanding were notably limited, with several misconceptions still prevalent. Educational attainment and socioeconomic status emerged as significant determinants of awareness, knowledge, and belief accuracy, emphasizing the role of social and educational factors in shaping genetic health literacy. The gap between basic awareness and actionable understanding signals a critical barrier to timely diagnosis, appropriate healthcare utilization, and informed decision-making in the management and prevention of genetic disorders.

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Consent to participate: Not applicable.

Data availability: The data supporting this study's findings are available from the corresponding author, Areesha Rashid, upon reasonable request.

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Conflicts of interest: The authors declare no conflicts of interest.

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Original Article

The impact of passive screen time on early childhood speech and language development: parental perspectives and behavioral correlates

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Abstract

Excessive and early exposure to digital screens has raised growing concerns about its implications for children's speech and language development. This study investigated the associations between passive screen exposure and speech and language delays in children aged 5–8 years, focusing on behavioral and clinical risk factors such as screen-use duration, content type, contextual usage, parental awareness, and screen-time mediation strategies. A descriptive cross-sectional study was conducted with 203 parent–child dyads via a structured questionnaire. Most children were exposed to screens before age two, with more than 57% exceeding two hours of daily screen time. Social media and entertainment content were the most frequently consumed, while only 47.3% engaged with educational content. Parental mediation practices were inconsistent, and only 28.6% reported frequent supervision. Language delay severity was high, with 62.1% classified as having severe delays. Chi-square analysis revealed a significant association between average daily screen time and language delay status ($p = 0.001$). Binary logistic regression revealed that greater screen time increased the odds of delay (AOR = 2.67, $p < 0.001$), whereas greater parental awareness [adjusted odds ratio (AOR) = 0.45, $p = 0.002$], educational content consumption (AOR = 0.40, $p = 0.041$), and active mediation (AOR = 0.35, $p = 0.048$) were protective. A modest but significant negative correlation was observed between parental awareness and language delay severity (r = -0.183, $p = 0.009$). This study revealed that excessive and early screen exposure is strongly linked to speech and language delays in children aged 5–8 years, whereas greater parental awareness, a preference for educational content, and engaged mediation practices are associated with reduced risk. These findings emphasize the pivotal role of parents in shaping digital environments and highlight the need for early, targeted interventions to enhance parental digital engagement, promote content supervision, and guide balanced screen use. Public health efforts and pediatric counseling should collaboratively support families in promoting healthy language development amid evolving digital habits.

Keywords

Speech disorders; Language development disorders; Screen time; Parenting; Child behavior

1. Introduction

The growing integration of digital screens in children's daily routines has raised developmental concerns, particularly regarding speech and language acquisition [1,2]. The widespread availability of smartphones, tablets, televisions, and similar devices has led to extended exposure from an early age [3,4]. Passive screen time refers to noninteractive

engagement—such as watching videos or television—in which children are not actively involved, thus limiting opportunities for language stimulation, cognitive engagement, and social interaction [5,6]. As digital content consumption becomes increasingly common, its developmental implications warrant systematic investigation.

Speech and language development during early childhood is strongly influenced by environmental factors, caregiver interactions, and verbal communication [7,8]. A lack of direct verbal contact, reduced exposure to vocabulary, and limited opportunities for practicing communication may contribute to developmental delays [9]. Several studies have linked excessive screen time to impaired receptive and expressive language skills in children [10,11]. These impairments can have long-term consequences for academic performance and social adjustment.

Although some parents are aware of the risks and impose screen time limitations, others permit excessive or unsupervised screen use, often due to limited awareness or competing responsibilities [12]. When appropriately designed, educational applications may facilitate learning across multiple developmental domains [13,14]. However, the effectiveness of these tools heavily depends on parental involvement and content quality. Therefore, understanding how parents navigate the digital environment is key to shaping effective interventions.

Furthermore, parental education, socioeconomic background, and cultural practices influence children's screen use behaviors [15,16]. Families with greater access to educational resources are more likely to prioritize verbal interaction, whereas others may rely on screens as a means of convenience [17,18,19]. The role of the socioenvironmental context is thus essential in interpreting screen-time practices across diverse populations.

Given the increasing prevalence of speech and language delays and the ubiquity of screens in early childhood, investigating how passive screen time interacts with developmental pathways is clinically relevant. Parental insight and practices are pivotal in mediating screen-related risk, and understanding these dynamics can support the development of targeted health communication, early counseling strategies, and anticipatory guidance in pediatric care.

The primary objective of this study was to explore the associations between passive screen time and speech and language development in early childhood, with particular attention to clinical and behavioral risk factors. Specifically, the study aims to assess parental perceptions of the impact of screen exposure and analyze patterns of screen use—including duration, content type, and contextual usage—that may contribute to developmental delays. It further examines how parental education, parental screen-time mediation practices, and awareness are related to early literacy behaviors and communication outcomes. By identifying potential behavioral predictors of speech and language delay, this study aims to inform pediatric and public health interventions aimed at early identification and clinical guidance for screen-time management in young children. We hypothesized that a greater duration of passive screen time would be associated with an increased risk of speech and language delay, whereas higher parental awareness, educational content use, and active mediation would be associated with reduced risk.

2. Methods

2.1. Study design and duration

This descriptive cross-sectional study was conducted over a period of six months, from November 2023 to April 2024.

2.2. Study setting

Data were collected from multiple pediatric clinical and rehabilitation facilities across Lahore, Pakistan, including the Children's Hospital, Riphah Rehabilitation Clinic, Rehab Care Poly Clinic, Emerging Minds, and the Lahore Residency and Rehabilitation Center. These centers cater to children with developmental delays and provide access to a diverse population of caregivers seeking speech and language therapy services.

2.3. Participants and sampling approach

The sample size was informed by findings from a study conducted at a tertiary care facility on the periphery of Islamabad, which reported a 15.2% prevalence of delayed speech and language disorders among children presenting to a speech-language pathology department [20]. On the basis of the sample of 196 children used in that study, a 10% increase was applied to ensure adequate statistical power and account for potential data loss or incomplete responses. This yielded a final target sample size of 216 participants. Participants were recruited via a nonprobability consecutive sampling technique from pediatric hospitals and rehabilitation centers.

2.4. Eligibility criteria

Parents of children aged 5–8 years who presented to speech-language services for concerns related to speech and language development were included. The participants were required to be primary caregivers and capable of understanding the questions presented during face–to-face interviews. Only those who provided written informed consent were enrolled. In contrast, parents of children with known comorbid conditions such as autism spectrum disorder, neurological disorders (e.g., cerebral palsy, epilepsy), intellectual disabilities, or hearing impairment were excluded. Additionally, children receiving current pharmacological treatment for behavioral or developmental conditions were excluded to avoid confounding factors.

2.5. Questionnaire development

The structured questionnaire consisted of five main sections. The first section collected demographic and socioeconomic information. The second section explored the screen exposure profile, including age at first screen use, daily screen duration, type of content viewed, and contextual usage, such as during meals or before bedtime. The third section assessed parental awareness and attitudes through Likert-scale items, using a five-point scale ranging from "strongly disagree" to "strongly agree," without any reverse or negative scoring. The fourth section examined parental screen-time mediation practices, including coviewing, enforcement of screen-time rules, assistance in content selection, and discussions about screen content. The response options for these items included “always,” “often,” “sometimes,” “rarely,” and “never” for frequency-based behaviors and “yes” or “no” for rule-setting and content supervision. The final section captured parent-reported speech and language development milestones, such as cooing, babbling, vocabulary growth, sentence formation, following instructions, and early literacy abilities. Each milestone was rated as “on time,” “late,” or “not yet achieved,” allowing for categorical assessment of developmental progress.

The questionnaire was developed through an extensive review of the relevant literature and incorporated items adapted from previously validated tools used in studies such as those of Takahashi et al. (2023) [21], Kerai et al. (2022) [22], and Al Hosani et al. (2023) [23]. Language milestone items were aligned with developmental norms used in pediatric clinical assessments to enhance clinical relevance.

Content validity was ensured through expert review by pediatricians, speech-language pathologists, and child development specialists. On the basis of expert feedback, the instrument was refined to improve clarity, cultural appropriateness, and construct alignment. A pilot version of the questionnaire was tested with a small group of parents (not included in the main analysis) to ensure item comprehension and response reliability.

2.6. Parental interview protocol

The finalized questionnaire was administered in paper format through structured, face–to-face interviews with parents. Data collection was conducted at selected study sites where children diagnosed with speech and language delays were receiving care. Each interview lasted approximately 20–25 minutes. The principal investigator and coprincipal investigators, fluent in the local language, conducted the interviews to ensure accurate interpretation of the questions and responses. Prior to participation, parents were briefed on the purpose of the study and provided written informed consent.

2.7. Language delay classification

Parental responses to a series of language development milestones were used to determine speech and language delay status among children. The assessed milestones included cooing by six months, babbling by nine months, imitating sounds by eleven months, saying simple words by twelve months, acquiring a vocabulary of 10–20 words by 18–24 months, combining three to five words into sentences by three years, following two-step instructions, reading simple words or letters, and writing simple words or letters [24,25]. Each developmental milestone was rated by the parent as “on time,” “late,” or “not yet achieved.” For the purpose of analysis, responses marked as either “late” or “not yet” were interpreted as indicative of developmental delay. Children were classified as having a language delay if they were delayed in at least one of the assessed milestones. Additionally, a severity score was calculated by summing the number of delayed milestones across nine key domains, resulting in a total possible score ranging from 0–9. Severity was categorized as follows: a score of 0 indicated no delay; scores of 1–2 were considered mild delay; scores of 3–5 indicated moderate delay; and scores greater than 5 were classified as severe delay. These cutoff points were developed specifically for this study, guided by clinical reasoning and milestone-based approaches, in the absence of standardized scoring thresholds in the literature.

2.8. Operationalization of mediation practices

A composite mediation score was created by summing the number of positive responses across four parental behaviors: coviewing, setting screen-time rules, selecting content, and discussing screen content. Each positive response (yes, always, often, or sometimes) was assigned a score of 1, whereas negative responses (no, rarely, or never) were assigned a score of 0. Participants with scores of 0–1 were categorized as practicing passive mediation, whereas those with scores of 2 or more were classified as active mediators.

2.9. Ethical considerations

Ethical approval for this study was obtained from the Research and Ethics Committee of Riphah College of Rehabilitation and Allied Health Sciences, Lahore, Pakistan (No. REC/RCR&AHS/23/0632). Written informed consent was obtained from all participants prior to data collection. Participation was voluntary, and the confidentiality of all per-

sonal and clinical information was maintained throughout the study in accordance with the ethical principles outlined in the Declaration of Helsinki.

2.10. Statistical analysis

The data were analyzed via IBM SPSS Statistics version 25. Descriptive statistics were computed to summarize the study variables. Chi-square tests were used to examine associations between categorical variables, including screen use behaviors, parental mediation practices, and developmental outcomes. Binary logistic regression was conducted to identify independent predictors of speech and language delay. Spearman's rank correlation was used to assess the associations between parental awareness and literacy-related behaviors. The internal consistency of the Likert scale items was assessed via Cronbach's alpha. A p value of less than 0.05 was considered statistically significant.

3. Results

Among the 216 participants, 203 completed the questionnaire, yielding a response rate of 93.98%. Table 1 presents the sociodemographic profile of the sample. Most of the children were approximately 6 years old (mean = 6.11, SD = 1.04), and two-thirds were male (66.5%). The majority of fathers (35.96%) and mothers (35.96%) held graduate degrees, while approximately 21% of each had intermediate education. Over half of the families (57.6%) fell within the middle-income category.

Table 1. Sociodemographic characteristics of the participating children and their parents.

Variables		Frequency (%)
Age of the child (in years), Mean ± SD		6.108 ± 1.038
Gender of the child	Male	135 (66.50)
	Female	68 (33.50)
Father's education	Illiterate	10 (4.93)
	Primary	42 (20.69)
	Matric	34 (16.75)
	Intermediate	44 (21.67)
	Graduate	73 (35.96)
Mother's education	Illiterate	10 (4.93)
	Primary	42 (20.69)
	Matric	34 (16.75)
	Intermediate	44 (21.67)
	Graduate	73 (35.96)
Family income	Low	24 (11.80)
	Middle	117 (57.60)
	High	62 (30.50)

Table 2 shows the digital exposure and mediation patterns among families. Most children were introduced to screens before the age of 2, with 33% starting before 1 year and another 32% between 1–2 years. The duration of daily screen use exceeded 2 hours for more than half of the samples (57.6%). Social media (74.9%) and entertainment content (33%) were commonly consumed, whereas 47.3% of parents reported that their children viewed educational content. Screen use frequently occurred during calming (76.4%) and meals (60.6%). Only 28.6% of parents reported always or often supervising screen use, and 40.4% did not set screen-time rules. Overall, 62.1% of the children were classified as having severe language delays.

Table 2. Patterns of screen exposure, content type, contextual usage, parental awareness, and parental screen-time mediation practices among participating families.

Variables		Frequency (%)
Age at first screen exposure	< 1 year	67 (33.00)
	1–2 years	65 (32.02)
	2–3 years	29 (14.29)
	3–4 years	19 (9.36)
	> 4 years	23 (11.33)
Average daily screen time	< 1 hour	22 (10.84)
	1–2 hours	64 (31.53)
	2–3 hours	67 (33.00)
	> 3 hours	50 (24.63)
Type of content consumed	Educational	96 (47.29)
	Entertainment	67 (33.00)
	Social media	152 (74.88)
Contexts of screen use	During Meals	123 (60.59)
	Before bed	104 (51.23)
	While playing	61 (30.05)
	To calm/manage	155 (76.35)
	Studying	57 (28.08)
Parental awareness and attitudes, Mean ± SD		3.19 ± 1.03
Coviewing or supervision	Always	22 (10.84)
	Often	36 (17.73)
	Sometimes	45 (22.17)
	Rarely	72 (35.47)
	Never	28 (13.79)
Screen-time rule setting	Yes	121 (59.61)
	No	82 (40.39)
Content selection guidance	Yes	117 (57.64)
	No	86 (42.36)
Discussion of screen content	Always	41 (20.20)
	Often	46 (22.66)
	Sometimes	67 (33.00)
	Rarely	29 (14.29)
	Never	20 (9.85)
Language delay severity	No delay	38 (18.72)
	Mild delay	12 (5.91)
	Moderate delay	27 (12.30)
	Severe delay	126 (62.07)

The binary logistic regression model was statistically significant, $\chi^2(4) = 42.594$, $p < 0.001$ (Omnibus test), indicating that the included predictors reliably differentiated between children with and without language delay (Table 3). The model explained between 18.9% (Cox & Snell R^2) and 30.6% (Nagelkerke R^2) of the variance, with a -2 log likelihood value of 153.149. Table 5 further shows that greater average daily screen time was significantly associated with increased odds of language delay ($p < 0.001$, AOR = 2.67). In contrast, greater parental awareness and attitudes ($p = 0.002$, AOR = 0.45), consumption of primarily educational content ($p = 0.041$, AOR = 0.40), and active screen-time mediation practices ($p = 0.048$, AOR = 0.35) were each associated with reduced odds of delay.

Table 3. Associations of average daily screen time and parental screen-time mediation practices with speech and language delay status among children.

Variables		Language Delay Status		*p* Value
		No Delay (N = 38)	Language Delay (N = 165)	
		Frequency (%)	Frequency (%)	
Average daily screen time	< 1 hour	13 (34.21)	9 (5.45)	0.001 *
	1–2 hours	14 (36.84)	50 (30.30)	
	2–3 hours	7 (18.42)	60 (36.36)	
	> 3 hours	4 (10.53)	46 (27.88)	
Parental screen-time mediation practices	Passive mediation	6 (15.79)	50 (30.30)	0.071
	Active mediation	32 (84.21)	115 (69.70)	

* Variables were compared via the chi-square test. ** Significant value ($p \leq 0.05$).

There was a statistically significant negative correlation between parental awareness and attitudes and the severity of language delay (r = -0.183, $p = 0.009$), indicating that lower awareness is modestly associated with greater delay severity in children (Table 4).

Table 4. Correlation between parental awareness and early literacy-related speech behaviors.

Independent Variables	Pearson Correlation	*p* Value
Parental awareness and attitudes	-0.183	0.009 *
Language delay severity		

* Pearson correlation (2-tailed). ** $p < 0.01$ was considered statistically significant.

The binary logistic regression model was statistically significant, $\chi^2(4) = 42.594$, $p < 0.001$ (Omnibus test), indicating that the included predictors reliably differentiated between children with and without speech and language delays (Table 5). The model explained between 18.9% (Cox & Snell R^2) and 30.6% (Nagelkerke R^2) of the variation in language delay outcomes. Among the predictors, average daily screen time was the strongest risk factor: for each increase in screen time, the odds of a child having a language delay increased by 2.67 times (AOR = 2.67, 95% CI: 1.684–4.240, $p < 0.001$). Conversely, greater parental awareness and positive attitudes significantly reduced risk by approximately 55% (AOR = 0.45, 95% CI: 0.274–0.744, $p = 0.002$). Similarly, children who primarily consumed educational content were approximately 60% less likely to experience a delay (AOR = 0.40, 95% CI: 0.168–0.962, $p = 0.041$). Moreover, active parental screen-time mediation, such as coviewing or enforcing screen-time rules, was associated with a 65% reduction in the odds of delay (AOR = 0.35, 95% CI: 0.124–0.989, $p = 0.048$). Overall, greater average daily screen time was positively associated with increased odds of language delay, whereas parental awareness, educational content consumption, and mediation practices were each negatively associated with delay classification.

Table 5. Binary logistic regression identifying predictors of speech and language delay.

Variables	B	S.E.	Sig.	Exp (B)	95% CI for EXP (B)	
					Lower	Upper
Average daily screen time	0.983	0.236	< 0.001 ***	2.672	1.684	4.240
Parental awareness and attitudes	-0.795	0.255	0.002 ***	0.451	0.274	0.744
Type of digital content primarily consumed	-0.913	0.446	0.041 ***	0.401	0.168	0.962
Parental screen-time mediation practices	-1.050	0.530	0.048 ***	0.350	0.124	0.989

* Exp (B) = odds ratio. ** CI = confidence interval. *** Variables with $p < 0.05$ were considered statistically significant. **** The overall model was statistically significant, $\chi^2(4) = 42.594$, $p < 0.001$. It explained 18.9% (Cox & Snell R^2) to 30.6% (Nagelkerke R^2) of the variance in language delay classification, with a -2 log likelihood of 153.149.

4. Discussion

The current findings highlight trends in early digital exposure and its potential impact on language development. A majority of the children in the sample began screen use before the age of two, with more than 65% introduced to screens by that age and more than half exceeding the recommended two-hour daily limit. The predominant use of screens for social media and entertainment, often during meals and as a calming tool, suggests that screens are deeply integrated into daily routines. However, inconsistent parental mediation may contribute to an increased risk of developmental challenges. A notably high proportion of children were reported to have severe language delays.

These findings are consistent with a growing body of research. Multiple studies have established a significant association between excessive screen time and delays in expressive and receptive language development. Meta-analyses have shown that children with high screen time are more than twice as likely to experience language delays than are those with limited exposure [26,27]. Cross-sectional studies from various settings, including Pakistan, Indonesia, South Africa, and South Korea, have also demonstrated that children with more than 2–3 hours of daily screen time have significantly lower language milestone achievement [28,29,30,31]. For example, children with screen exposure exceeding 9 hours daily are substantially less likely to meet language milestones by the age of five [30].

Moreover, the age at first exposure plays a critical role. Studies confirm that screen use initiated before 24 months is strongly linked to higher odds of speech delay [1,31], especially when the content lacks educational value or when screens are used passively without parent interaction [32,33,34,35]. One case–control study in the UAE revealed that more than 90% of children with language delays were exposed to electronic devices before the age of two, underscoring the timing of exposure as a key risk factor [31].

While some studies suggest that educational screen content and coviewing with caregivers may buffer negative effects [36,37], the overall consensus is that excessive and unsupervised screen use remains detrimental. In fact, children whose screen use was reduced showed significant improvement in vocabulary within just a few months, demonstrating that intervention is possible and effective [38]. Additionally, socioeconomic factors, such as maternal education and the home language environment, further interact with screen exposure to influence language outcomes [39].

In contrast to the findings of the present study, other studies have highlighted that both active and passive screen time, as well as the use of smart screen technologies, are not associated with mental development and may actually enhance interactive abilities [40]. A Malaysian study reported that the screen time of parents and children was associated with monthly family income. Furthermore, there was no association between screen time and developmental quotient (DQ) levels [41]. In children aged 12–16 months, the primary predictor of expressive and receptive vocabulary was the context of screen use, with frequent interactive joint media engagement supporting language development. In contrast, in children aged 17–36 months, greater screen exposure—reflected in higher daily use, background television, and earlier onset—was negatively associated with expressive vocabulary and mean length of utterance, suggesting that increased screen use may impede both lexical growth and syntactic development [42]. Another study highlighted that pragmatic development was positively associated with parental device use during child routines, which may reflect children's adaptation to intermittent attention by employing strategies to re-engage caregivers. Joint media engagement further supported pragmatic skills, which is consistent with evidence that coviewing and discussion facilitate social communication. Additionally, girls outperformed boys, in line with the literature reporting earlier attainment of communicative milestones among females [43].

Our findings show that increased parental awareness and positive attitudes significantly reduce the likelihood of language delays in children. Parents who actively monitor their children's digital consumption can help mitigate negative outcomes, especially when children engage with educational content rather than entertainment or social media [44,45]. This finding supports research emphasizing that content quality, in addition to screen time duration, is critical for developmental outcomes. Active parental mediation strategies, such as coviewing and discussing content, have emerged as important protective factors that support language development [46,47]. Overall, both the quality and quantity of digital engagement, together with parental involvement, are key determinants of language outcomes.

While these findings are robust, the study is not without limitations. First, the cross-sectional design restricts causal inferences. Second, parental reporting may be subject to recall or desirability bias, particularly with respect to screen use behaviors and developmental milestones. Third, the sample was derived from clinical and rehabilitation centers, potentially limiting generalizability. However, the key strengths include a high response rate, the use of validated milestone indicators, and the inclusion of diverse family backgrounds, enriching the contextual understanding. Future research should include more diverse and representative populations, along with longitudinal tracking and objective screen usage measures, to establish causality and assess long-term developmental trajectories.

5. Conclusions

This study revealed that excessive and early screen exposure is significantly associated with speech and language delays in children aged 5–8 years. Conversely, higher parental awareness, engagement with educational content, and active screen-time mediation were linked to reduced odds of delay. These findings emphasize the critical role of parental involvement in shaping digital habits and mitigating developmental risk. Based on the study outcomes, we recommend that early interventions prioritize enhancing parental digital literacy, promoting evidence-based screen-time guidelines, and supporting active content supervision and mediation strategies. Pediatric counseling and public health initiatives should work collaboratively to equip families with the tools and knowledge necessary to support healthier language development in the digital age.

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