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Table of Contents	i
Journal of Health and Medical Sciences Editorial Board	ii
Capacity Building to Address the 10/90 Gap: Evaluation of a 2015 Global Health and Development Summer Institute in India Raywat Deonandan	1
Patient Attitudes Regarding Physician Accessibility via Social Media: A Cross-Sectional Survey Raywat Deonandan, Priscilla Karnabi	5
Depression, Anxiety and Stress in Parents of Children with Disabilities in Bangladesh Nahid Parvez, Mehedi Hasan Mizu, Fabiha Alam	10
Potential Expression of HER2 Protein According to the Macroscopic Type of Tumor in Gastric Cancer: Original Scientific Paper Amir Spahić	35

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Capacity Building to Address the 10/90 Gap: Evaluation of a 2015 Global Health and Development Summer Institute in India

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Abstract

Ninety percent of global medical research expenditure is targeted at problems affecting only 10 percent of the world's population (the so-called 10/90 research gap). One strategy to address the gap is capacity building among global health scholars in low-income countries. In 2015, Canadian scholars, in partnership with Indian academics, conducted a series of training workshops in Ahmedabad, Gujarat, India, targeted to graduate students and junior faculty from across India. This study is a brief evaluation of those workshops, based on participants' perceptions collected via an end-of-program survey, to refine future interventions aimed at bridging the 10/90 gap. Methods: The 49 participants in the workshop completed a survey consisting of 23 questions: 6 open-ended, 13 multiple-choice, and 4 Likert-type. Questions concerned participant demographics, initial and concluding skills and capacities, and perceived relevance of the workshops' content. Responses were analyzed using a mixed methods approach. Textual survey responses were analyzed using thematic phenomenological analysis, while quantitative survey data were analyzed using descriptive and bivariate analyses. Results: Participants felt most knowledgeable in identifying ethical issues in research and felt more enthusiasm to build a career in global public health. A majority wanted more instruction in social justice issues, research design, and quantitative analyses. No significant differences in experiences or in desired outcomes were found with respect to gender, geographical location, or education level. These results are instructive for the design of subsequent workshops delivered to a similar audience.

Keywords: Global Health Capacity Building, 10/90 Gap, Research Training Evaluation; Health Workforce Development, India

1. Introduction

Ninety per cent of global medical research expenditure is directed toward health problems that affect only 10 percent of the world's population: a disparity commonly referred to as the 10/90 research gap. ("Western medical journals and the 10/90 problem," 2004) This imbalance has profound consequences for low- and middle-income countries (LMICs), where the burden of preventable, non-communicable, and infectious diseases is disproportionately high. The World Health Organization estimates that millions of deaths each year are preventable, with approximately 8 million individuals dying prematurely from treatable conditions. (World Health, 2004) Noncommunicable diseases (such as cancer, cardiovascular disease, and diabetes) now account for roughly

three-quarters of global deaths, with more than 80% of premature deaths from these conditions occurring in low- and middle-income countries. (World Health, 2025)

Capacity building has emerged as a promising strategy for narrowing the 10/90 gap. Broadly defined, capacity building is a conceptual approach to development that seeks to understand the obstacles impeding progress toward developmental goals and to strengthen the skills, infrastructure, and institutions needed to overcome them. ("Capacity Building for Urban Management: Defining the Concept," 2026) In the context of global health research, this includes developing the competencies of researchers in LMICs so that these individuals may meaningfully compete for and contribute to the global research enterprise. Without deliberate investment in such capacity, the research agenda for the majority of the world's population will continue to be shaped primarily by scholars based in high-income countries, further entrenching the 10/90 disparity.

India presents a particularly important context for this work. As one of the world's most rapidly developing economies, with a young and growing population of scholars, India offers considerable potential for the expansion of a domestic global health research workforce. In 2015, a collaboration between Canadian academics from the University of Ottawa and the University of Saskatchewan, together with Indian colleagues at the Indian Institute of Technology Gandhinagar, resulted in a month-long Summer Institute on Global Health and Development held in Ahmedabad, Gujarat. The institute was designed to provide graduate students and junior faculty from across India with foundational and advanced training in global health research, deliberately situated within an Indian cultural and political context rather than framed through an exclusively Western lens.

The present study is an evaluation of this summer institute, based upon participants' self-reported perceptions of knowledge, skills, and attitudes collected through an end-of-program survey. The primary aims of this evaluation were: (1) to assess participants' baseline and post-workshop levels of knowledge and competency across key global health domains; (2) to identify content areas in which participants sought additional training; and (3) to examine whether experiences and outcomes varied by gender, educational level, or geographic origin. The results are intended to inform the design of future iterations of the workshop and similar capacity-building interventions aimed at addressing the 10/90 gap through an educational lens.

2. Method

The participants of the workshop were invited to complete an online survey consisting of 23 questions: 6 open-ended, 13 multiple choice, and 4 Likert-type scale. Questions concerned participant demographics, initial and concluding skills and capacities, and perceived relevance of workshops' content. Responses were analyzed using a mixed methods approach. Textual survey responses were analyzed thematically and phenomenologically, while quantitative survey data were analyzed using descriptive and bivariate analyses, performed using SPSS version 20.

Permission for this study was granted by the University of Ottawa's Office of Research Ethics and Integrity, file number H12-16-02.

3. Results

Of 73 participants, 49 completed the questionnaire, rendering a response rate of 67%. Their mean age was 27 years. Most came to the institute from parts of Gujarat (33%) and Maharashtra (20%), and most were male (59%). Only 12 respondents (24.5%) were undergraduate students, while 16 (33%) were Master's students and 21 (43%) were completing their doctorates. Slightly more than 12% considered themselves to be students of health care or health sciences, while 31% studied natural sciences, and 33% social sciences.

In terms of baseline skills, respondents rated the ability to write a grant application as the skill in which they were most lacking. Knowledge of public health matters and the ability to conduct qualitative analyses were also lowly ranked, though not as low as grantsmanship. The most commonly mentioned topics of greatest interest were research design and statistical analysis (57%).

Respondents indicated the most positive change in knowledge and abilities with respect to identifying ethical issues in research and in understanding the role of social sciences in public health.

4. Discussion

The findings of this evaluation are, on the whole, encouraging for capacity-building efforts aimed at bridging the 10/90 research gap through educational means. Participants' self-reported gains in knowledge regarding the identification of ethical issues in research, and their increased enthusiasm for careers in global public health, represent precisely the kinds of attitudinal and competency outcomes that such a workshop aims to produce. The identification of ethical issues is a foundational research skill, and participants' confidence in this area likely reflects the sustained attention given to research ethics within the curriculum.

Similarly, heightened career enthusiasm is an important precursor to sustained engagement with global health, suggesting that the institute may have successfully cultivated a sense of purpose and professional identity among its participants.

Participants' expressed desire for more training in research design, statistical analysis, and social justice issues is instructive for the refinement of future programming. The high baseline interest in research design and statistical analysis (57%) is consistent with the practical demands of graduate-level scholarship, and the post-workshop recognition that further training was needed likely reflects a deepened appreciation for these skills rather than a failure of the curriculum. The call for more instruction in social justice issues is particularly noteworthy, as it suggests participants are attuned to the broader structural determinants of health inequity.

The absence of significant differences in outcomes across gender, geographic origin, and educational level is a meaningful finding that warrants reflection. It suggests that the institute was broadly accessible and relevant to a diverse cross-section of Indian scholars, and that the curriculum was neither so specialized as to advantage certain groups nor so elementary as to fail others.

There are several limitations to this study that must be acknowledged. Most importantly, the evaluation relies entirely on participants' self-reported perceptions, which are subject to social desirability bias and may not accurately reflect objective gains in knowledge or competency. The end-of-program survey captures immediate impressions rather than longer-term changes in research behaviour or career outcomes, which would be more meaningful indicators of capacity-building success.

5. Conclusion

The 2015 Global Health and Development Summer Institute in Ahmedabad represents a meaningful effort to address the 10/90 research gap through capacity building. Participants reported positive gains in knowledge and professional orientation, and identified clear areas in which future programming could be strengthened. The equitable distribution of outcomes across demographic subgroups speaks to the inclusivity of the design. Taken together, these results provide a useful foundation for the ongoing refinement of this workshop series and for the broader project of developing a robust global health research workforce in India and in comparable LMIC settings.

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Patient Attitudes Regarding Physician Accessibility via Social Media: A Cross-Sectional Survey

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Abstract

This study examines patient attitudes toward physician accessibility and engagement via social media. A voluntary, cross-sectional online survey was conducted in 2013 among 227 adult participants recruited through social media platforms. Respondents were predominantly young, female, and Canadian, with high levels of social media use. While most participants reported neutrality regarding the impact of physician–patient interaction on social media, a substantial proportion expressed concern about potential harm to the professional relationship. The majority preferred traditional, in-person care and could not envision scenarios in which social media would be an appropriate substitute for clinical interaction. Privacy emerged as a dominant concern, with over half of respondents reporting high discomfort with online communication with physicians. LinkedIn was identified as the most appropriate platform for professional engagement. Overall, findings suggest cautious patient acceptance of physician social media presence, with strong expectations for maintaining professional boundaries, confidentiality, and separation between personal and professional identities.

Keywords: Social Media, Physician–Patient Relationship, Online Professionalism, Patient Attitudes, Digital Health

1. Introduction

The rapid growth of social media has fundamentally transformed communication patterns worldwide. Facebook has approximately 3.07 billion monthly active users globally, with about 2 billion logging in daily. (Meta Platforms, 2024) This digital shift has penetrated nearly every domain of daily life, prompting questions about its applicability to healthcare.

Social media platforms, including Facebook, X (formerly Twitter), LinkedIn, and others, offer unprecedented potential to facilitate health communication, patient education, and provider–patient interaction. Yet the medical community has been ambivalent in adopting these tools, citing concerns about confidentiality, professional boundaries, and the absence of established guidelines. (Chretien & Kind, 2013) Recent national survey data indicate that 58.5% of adults used the internet to look for health or medical information in the past year, compared with 41.5% who used the internet to communicate with a healthcare provider. (Wang, 2023) Earlier work similarly

found that around 70% of Canadians search online for health-related information, often turning to the internet before consulting physicians (Tonsaker et al., 2014).

Both the Canadian Medical Association (CMA) and the American Medical Association (AMA) have recognized these developments and began addressing physicians' online conduct a decade ago. (Canadian Medical, 2013a; Farnan et al., 2013) Formal was slow to arise, but is slowly manifesting (American Medical, 2023; Australian Medical, 2020; Canadian Medical, 2013b).

Today, evidence suggests that patients see value in online medical content shared via social media, (Sun et al., 2024) while 15.5% of patients reported using social media to select a physician (Greif et al., 2022). But patients are cautious about direct interaction with physicians online. (Markham et al.) Has this sentiment changed over time? The present study aimed to measure patient attitudes and expectations regarding physician presence and accessibility on social media platforms several years ago. The findings, while dated, provide a historical snapshot of the general public's attitudes toward physician social media use.

2. Method

2.1 Study Design and Participants

A voluntary, cross-sectional online survey was conducted in 2013. Eligibility criteria included being 18 years of age or older and English-speaking. Participants were recruited through Facebook and Twitter.

2.2 Survey Instrument

A 36-item questionnaire was developed and administered via SurveyMonkey (approximately 10 minutes to complete). The survey comprised closed-ended questions covering: (1) demographic information; (2) social media usage patterns; (3) healthcare access and utilization; and (4) attitudes and expectations regarding physician social media activity. One optional open-ended question was included. Participants were assigned randomly generated ID numbers to maintain anonymity. All data were stored in a secure, password-protected account accessible only to the research team.

2.3 Analysis

Descriptive statistics were computed for all closed-ended items using SurveyMonkey's analytic tools. The researchers analyzed open-ended responses thematically. Results are reported across five domains: demographics, social media usage, healthcare access, physician social media engagement, and patient opinions on physician online presence.

3. Results

3.1 Participant Characteristics

A total of 227 individuals completed the survey. The sample was predominantly female (74%), young (46% aged 18–25), and urban (88%). Nearly all respondents (94%) resided in Canada, with 92% from Ontario. Most (89%) had a family physician, and 96% visited their physician fewer than 10 times per year.

3.2 Social Media Usage

Facebook was the most widely used platform (95%), followed by Twitter (56%), LinkedIn (50%), Instagram (36%), and Google+ (31%). Among Facebook users, 71% spent 1–10 hours per week on the platform. Only 6 respondents (2.6%) were aware that their physician was active on Facebook, and only 2 had friended or contacted their physician through social media.

3.3 Attitudes Toward Physician–Patient Interaction on Social Media

When asked whether they would accept a friend request from their physician on Facebook, 37% said they would, while 44% would decline. Only 20% agreed that physicians should be available to answer questions on Facebook; a similar proportion (14%) agreed with physician availability via Twitter. Seven respondents (3%) reported they would take offence if their physician declined their friend request, and six of these would change physicians as a result.

Regarding preferred platforms for physician–patient communication, respondents ranked Facebook first (55%), followed by LinkedIn (39%), Google+ (29%), Twitter (22%), and Instagram (3%). However, when asked which platform physicians should use for a professional profile, LinkedIn ranked highest (60%), ahead of Facebook (52%), Twitter (38%), Google+ (25%), and Instagram (13%).

Table 1: Perceived impact of a social media relationship with one’s family physician on the professional relationship (n = 209).

Response	n	%
Beneficial	28	13.4
Harmful	65	31.1
Neither beneficial nor harmful	116	55.5

Table 2: Respondents who could envision scenarios preferring social media over in-person care for health matters (n = 209).

Response	n	%
Yes	58	27.8
No	151	72.2

Table 3: Level of privacy concern if communicating with a physician via social media (n = 209).

Level of Concern	n	%
Not concerned at all	22	10.5
A little concerned	73	34.9
Very concerned	114	54.5

Table 4: Effect on patient–physician relationship if physician expressed a disagreeable political view on social media (n = 209).

Response	n	%
Less inclined to remain their patient	61	29.2
More inclined to remain their patient	2	1.0
No effect	146	69.9

Table 5. Respondent opinion on whether family physicians should limit their public social media visibility (n = 209).

Response	n	%
Yes	97	46.4
No	46	22.0
No opinion	66	31.6

As shown in Tables 1–5, the majority of respondents held a neutral or cautious view of physician social media engagement. Most (55.5%) felt such interaction would be neither beneficial nor harmful to the physician–patient relationship, while 31.1% considered it potentially harmful (Table 1). The majority (72.2%) could not envision circumstances in which they would prefer social media over in-person consultations (Table 2). Privacy was a salient concern, with 54.5% reporting they would be very concerned about privacy when communicating with their physician online (Table 3). While most respondents (69.9%) felt a physician’s expressed political views would not affect their relationship, 29.2% indicated they would be less inclined to remain the physician’s patient (Table 4). Finally, 46.4% of respondents believed physicians should limit their public social media visibility (Table 5).

Open-ended responses clustered around four themes: (1) physicians’ right to use social media as private citizens; (2) privacy and confidentiality concerns; (3) the importance of maintaining professional physician–patient boundaries; and (4) the appropriateness of social media use with restrictions (e.g., separate personal and professional accounts).

4. Discussion

This study found that patients generally favoured in-person medical consultation over social media–based interaction, and most hold neutral or cautious views about physicians’ social media presence. Privacy and professional boundaries were the most consistently raised concerns, echoing findings in existing literature (Chretien & Kind, 2013; Fisher & Clayton, 2012).

These results diverged somewhat from prior research. Fisher and colleagues found that 56% of socially active patients wanted their physicians to use social media, motivated by preferences for appointment management, prescription notifications, and access to general health information. (Fisher & Clayton, 2012) In contrast, only 20% of our respondents agreed that physicians should field questions via Facebook. This discrepancy may reflect the predominantly younger, Canadian urban demographic of our sample, or differences in survey framing and context. Bosslet et al. similarly found that a notable proportion of physicians had received patient-initiated friend requests, suggesting that some patients are comfortable initiating online social connections with their physicians. (Bosslet et al., 2011) Our data confirm that a small subset of patients (roughly 37%) would accept a physician’s friend request, yet the majority would not, suggesting cautious openness rather than widespread enthusiasm.

A key finding is that patients strongly prefer LinkedIn over Facebook or Twitter as an appropriate physician platform. This reflects a desire for professional rather than personal engagement: a distinction central to many respondents’ open-ended comments. Nearly half of the participants felt physicians should limit their public visibility, indicating concern that personal disclosures (e.g., political views) may erode patient trust and damage the therapeutic relationship.

Several limitations should be noted. First, the convenience sampling strategy introduces substantial selection bias and limits generalizability. The sample was concentrated in Ontario, skewed toward younger women, and limited to English speakers, restricting applicability to broader Canadian or international populations. Second, the sample size (n = 227), while adequate for descriptive analysis, limits statistical power and increases the risk of imprecise

estimates. Third, important confounding variables such as educational attainment were not captured. Finally, the novelty of the research area in 2013 precluded robust comparison with prior patient-focused literature.

5. Conclusion

Most respondents preferred that physicians limit their social media visibility and favoured LinkedIn as the most appropriate professional platform. Privacy and professional boundary maintenance were the dominant concerns.

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Depression, Anxiety and Stress in Parents of Children with Disabilities in Bangladesh

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Abstract

The overall well-being of children with disabilities is greatly influenced by parental mental health. The purpose of this study was to assess the prevalence and the severity of depression, anxiety and stress among the parents of children with disabilities in Bangladesh, and to investigate the socio-demographic factors associated with them. A cross-sectional study design was used to collect data from 220 parents at CRP-Savar using the Depression, Anxiety, and Stress Scale (DASS-21). Results indicated that 43.6% of parents had extremely severe anxiety, 43.2% extremely severe depression, and 61.8% severe stress. Significantly more extreme anxiety (62.3%) and extreme depression (63.1%) were observed among female parents as compared to males. The greatest prevalence of extremely severe anxiety (52.9%) and depression (48.6%) was found among families in the lowest income range (10,000–20,000 BDT), which emerged as a major factor of financial strain. The results indicate an urgent requirement for targeted mental health interventions, financial support systems, and culturally appropriate family-centered care programs. Addressing these multisystem challenges necessitated joint efforts of healthcare professionals, policymakers and community organizations to engineer resilience and longer-lasting support structures for affected families.

Keywords: Bangladesh, Depression, Anxiety, Stress, Parents, Children with Disabilities

1 Introduction

1.1 Introduction

“Disability is defined by the World Health Organization (WHO) as an umbrella term encompassing impairments, activity limitations, and participation restrictions.” (Saleem, 2020). About 15% of the overall population is

estimated to have a disability globally, with considerable variation across age and geographic regions. UNICEF reports that approximately 10.1% of individuals aged 0-17 years (ages 0-17 years) amongst children and adolescents experience moderate-to-severe disabilities, which amounts to nearly 266 million individuals worldwide (Olusanya et al., 2022). Disability prevalence in Asia, especially in the South Asian countries, is high, with estimates suggesting an average disability prevalence of 8.7% in children 2–4 years old (Alam et al., 2024). Child disability in Bangladesh is a significant public health issue, as studies indicate 3% of children. Studies have shown that functional difficulties exist in children of 2–4 years of age, with more males requiring assistance than females (Rahman et al., 2024). A child's disability affects the family, particularly the parents. Because caregiving presents a unique set of challenges, parents of children with disabilities tend to have much higher levels of depression, anxiety, and stress. For these mothers, the demands of having a child with special needs become a 24/7 occupation, creating continuous psychological strain and often making it hard to find relief from the daily burden of their responsibilities (Turda, 2023).

According to the literature, the global prevalence of depression, anxiety, and stress is remarkably high among parents of children with disabilities, which is significantly higher than that of parents of typically developing children. Reports indicate that significant depressive symptoms can be found in about 66.3% of mothers and 35.4% of fathers of children with intellectual disabilities, while anxiety symptoms can be seen in 91.8% of mothers and 57.6% of fathers (Sharma et al., 2023). The high prevalence of depression, anxiety, and stress among parents of children with disabilities in Asia highlights the challenges they face. Research suggests that many parents are psychologically distressed. In Kazakhstan, for example, 39% of parents suffered from severe depression and 42% reported high anxiety levels (Ahmad et al., 2022). In Tunisia, anxiety affected 70.7% and depression 52% of mothers were more affected (Thabet et al., 2013). Likewise, a study conducted in Sri Lanka found that although primary caregivers of children with invisible disabilities experienced similar levels of distress to parents of typically developing children, they were younger and concerned with their high levels of anxiety (Mohamed & De Silva, 2022).

In Bangladesh, the prevalence of depression, anxiety, and stress among parents of children with disabilities is highly recognized, which represents a huge psychosocial burden. A study among parents of a child with autism found that about 60.35% had a diagnosis of depression or anxiety disorder; 31.7% men had depression and 28.6% men had anxiety (Sajib et al., 2022). It is an important study, another was conducted in Bangladesh, indicating that a large number of mothers have mental health issues 62% of them are under stress, 58% have anxiety and around 63% are under depression (Islam et al., 2024). Different factors lead to certain reasons for parental stress. One of the greatest stressors is the child's health issues, which take considerable time, energy and emotional investment to keep under control. Health issues can mean regular visits to doctors, medication and checking up on the kid constantly to make sure they are okay. This is backbreaking for the parents, who are already exhausted in every sense of the word. Financial stress also adds to the weight of stress, especially for families at the margins. Unlimited access to e-Papers, Websites, and Apps. When money is tight, they are making it is even difficult to afford necessary treatment, medications, and even daily essentials for their children, putting more stress on the shoulders of parents. The demands of day-to-day caregiving can be an added strain, since parents need to manage routine tasks, such as feeding, bathing, administering medications, in addition to providing emotional comfort. For single parents, these challenges are compounded as they shoulder all caregiving without an available partner. Moreover, kids with those unusual behaviors - tantrums, resistance to following directions - can create public embarrassment and stress for the parent. I know how judgment or disapproval of others can make you feel guilty and frustrated (Fong & Ali, 2023). Studies show that mental health (depression, anxiety and stress) has a strong multifactorial impact on parents of children with disabilities. Parents, especially mothers, of children with disabilities such as cerebral palsy, intellectual disabilities or more invisible diagnoses, such as autism spectrum disorder are more likely to have mental health issues. Children with cerebral palsy have multiple medical needs and hospitalizations, which worsen levels of depression, anxiety and stress, leading to moderate to severe degrees of these mental health problems in their caregivers. The parents of children with 4 intellectual disabilities also have high levels of depressive and anxiety symptoms, especially mothers versus fathers, highlighting the gender difference in the burden of caregiving (Sharma et al., 2023). Apart from the demands of caregiving, stress in these parents arises from a lack of social support, which is the same significant predictor of mental health issue with disability mothers (Almheiri et al., 2023). Moreover, the type of disability also influenced the mental health of the

parents; for instance, mothers of children with autism spectrum disorder are more stressed than mothers of children with Down syndrome, which has a significant impact on their quality of life and can lead to social isolation. In an unexpected finding, studies reporting no statistically significant differences in mental health outcomes among caregivers of children with invisible disabilities compared to caregivers of typically developing children found parental age as a predictor of anxiety, indicating that experience may buffer some stressors (Mohamed & De Silva, 2022). 90% of parents of children with disabilities call for targeted interventions and support systems aimed at alleviating the psychological burden on these people and at increasing their quality of life, given that the mental health of parents of children with disabilities is seriously undermined. The psychological impact on parents of people with disabilities, particularly those who are also parents of children with disabilities, is well documented across a spectrum of studies and the profound, multifaceted psychological effect we see reflected in such studies. The stress and anxiety, and depression is even more so for parents who go through the unique challenges. For instance, mothers of children with intellectual disability were shown to report greater levels of stress compared with their peers, with numerous factors including socioeconomic status and the length their child has experienced disability predicting the level of reported stress (Kumari et al., 2025). It brings additional stress and contributes to feelings of isolation and depression coupled with social stigma and absence of social support. Moreover, the continuous treatment of children with disabilities is mentally and physically exhaustive and reduces the mental health status, where parents put their child's needs above themselves and sacrifice their personal and work-related ambitions (Das & Joseph, 2022). If emotional, the psychological burden is also reflected in physical symptoms, with parents also reporting fairly high levels of anxiety and depression, a large percentage of which can be moderately or even severely depressed. But there are ways to counter them. It has been established that psychoeducational programs reduce parental anxiety, and improve parents' knowledge and attitudes related to the management of their children's needs. Moreover, the reduction in anxiety and depression also impacts a balanced mental state and personal development. (Valeriya, 2022). Coping strategies play a significant role too; in general, problem-focused and emotion-focused coping strategies correlate with lower stress and better mental well-being whilst avoidant coping correlates with higher stress (Pachița & Gherguț, 2023).

In conclusion, parents of children with impairments, particularly mothers, experience considerable emotional and psychological burdens as a result of demanding, frequently rumbling caregiving responsibilities. This infrequently studied population is often faced with increased stress, anxiety and depression, exacerbated by financial strain, social stigma, and low social support. The type of disability and the unique situations of the family determine how serious these mental health disorders are. Research shows parents of children with disabilities such as cerebral palsy, autism spectrum disorder and intellectual disabilities are especially at risk. Yet targeted interventions such as psychoeducational initiatives, coping strategies, and a strong support network are clearly important in reducing these difficulties. These interventions can bolster resilience and provide resources that enhance mental health, ultimately improving parents' well-being to better manage their caregiving responsibilities, and enhancing their overall quality of life. Bailin believes parents need to be prepared for their own mental and emotional health needs – along with their children's - at a time like this, something that needs to be addressed.

1.2 Research Question

What is the level of depression, anxiety and stress in parents of children with disabilities in Bangladesh?

1.3 Objectives

1.3.1 General Objective

- To find out depression, anxiety and stress in parents of children with disabilities in Bangladesh

1.3.2 Specific Objective

- To determine the socio-demographic information of patients.
- To determine the prevalence of depression, anxiety and stress in parents of children with disabilities.

- To find out associated factors of depression, anxiety and stress in parents of children with disabilities.

1.4 Literature Review

Mental health conditions such as depression, anxiety and stress are related, and affect individuals and communities around the world. Persistent sadness, loss of interest, and a number of other emotional and physical problems that interfere with normal functioning characterize depression (Delgado et al., 2024). Anxiety means too much worry and fear and also has physical symptoms, for example, a faster heartbeat and sweating (Frolova, 2022).

Depression affects over 264 million people globally and the lifetime prevalence of depression, anxiety, and stress among the young adult population ranges from 5 percent to 70% (Nageswaran & Devi, 2021). Compared with parents of typical children, parents of children with disabilities have significantly higher levels of depression, anxiety, and stress. The psychological distress resulting from the special challenges of raising a child with disabilities, including emotional, financial, educational, social and health issues (Poptean & Popovici, 2022). In terms of the amount of this burden that is carried by mothers, who are often the primary caregiver, as well as those with higher anxiety and depression than fathers (Sharma et al., 2023). These parents suffer from a great psychological impact, with many of them remaining under long-term stress that negatively affects their quality of life and health (Turda, 2023). The effects of acute stress on clinical accuracy are moderated by social support. To diminish anxiety and depression symptoms, improve the state of mental health, participants can attend support groups and get psychological assistance (Xia et al., 2023).

As reported in a study that about 66.3% of mothers and 35.4% of fathers engaging with children with intellectual disabilities presented a statistically significant level of depressive symptoms and about 91.8% of mothers and 57.6% of fathers exhibited statistically significant levels of anxiety symptoms (Sharma et al., 2023). In addition, the lack of sufficient social support aggravates those challenges, since 63% of the variance in mental health problems among mothers of children with special needs is by social support (Almheiri et al., 2023). One in three parents of children with IDD will reach the cut-off for moderate depression, compared to 7% of parents of children without IDD. We also learn from the research that anxiety levels are high among parents as much because they worry about their children's future and their own aging. Parents with disabilities and other parents from low-income households have higher levels of depression and anxiety (Scherer et al., 2019).

Parenting stress showed significant differences across different diagnostic categories: Childhood Diagnoses related to behaviour issues, sleep problems and feeding difficulties. The research revealed that 65% of parents who responded to the Parenting Stress Index (PSI) said they had stress in the child domain, and these particular problems make a significant contribution to the extra stress parents of children with disabilities experience. The neurobiological etiology, stress and family reactance linked to continuous caregiving needs and changes in family dynamics noted by parents of children with developmental disabilities can result in negative outcomes, for example parental depression and family malfunction (Scheibner et al., 2024). Although the child's condition contributes to the stress of the parents, the parents' social support, coping strategy and economic status are also contributing factors (Shin & Kim, 2009). The presence of a child's clinical conditions such as a developmental disorder, behavior issue or chronic illness, is a strong predictor of parental stress (Kwon et al., 2022).

Parents of children with developmental disabilities, such as Down syndrome and motor impairment, are under more stress, a study showed. Longitudinal research suggests that stress among these parents typically rises from early to middle childhood, largely out of the high level of caregiving demands and challenges associated with their child's condition. Transition to adolescence can also intensify stress for these individuals because of social isolation and the requirement of adult services, which can further damage parental wellbeing (Woodman, 2014). A study also showed that the parents of intellectually challenged children, multi deficiency children or who are autistic had higher levels of depression than the parents of non-disabled children. Therefore, parents of children with disabilities report higher levels of stress, which are associated with age of child and parent education level, as higher stress corresponds to older age among the children and lower level of education among parent (Pocinho & Fernandes, 2018).

From Isfahan, Iran, 70% of parents and caregivers of children with disability suffer from mild to severe depressive symptoms according to this study (Ebrahimi et al., 2021). A study at Bangabandhu Sheikh Mujib Medical University in Dhaka found that 60.35 percent of parents of children with autism had either depressive or anxiety disorders. The most common diagnosis was major depressive disorder, with 31.7% having depressive disorders and 28.6% having anxiety disorders (Sajib et al., 2022). A similar study on caregivers of adolescents with cerebral palsy in rural Bangladesh reported similar mental health problems, but did not provide prevalence rates in the abstract provided (Muhit et al., 2022). The quality of life (QoL) of parents of children with cerebral palsy (CP) in Bangladesh is decreased and depression levels are increased. In the study there was found a strong correlation between the QoL of parents and their physical, psychological, social and environmental health and spastic CP was found to have a relatively better QoL for mild depression than different types of CP (Doly et al., 2024). Caregivers of children with neurodevelopmental disabilities are very significantly affected in their mental health; most of them experience moderate stress levels. Their QoL is negatively influenced by factors like caregiver and their age, perceived stress, and socioeconomic status (Tasnim et al., 2024).

Parental stress levels are also driven by the educational setting of the child concerning mainstream or special schools. According to the research parents of children in special schools have higher stress levels compared to parents in mainstream settings (Pachița & Gherguț, 2023). Longitudinal studies substantiate that mother of children with disabilities are more likely to experience ill health, including musculoskeletal disorders, depression, anxiety, and sleep disorders, including after controlling for pre-existing ill health (Brekke & Alecu, 2023). It also affects parents' professional life. In fact, many parents report quitting their jobs to be able to give full time care to their child with disabilities, increasing the financial strain and decreasing personal fulfillment (Popțean & Popovici, 2022). Depression, anxiety, and stress prevalence among these parents clearly necessitates targeted intervention and support systems that improve their mental health and quality of life (Ahmad et al., 2022). These parents are burdened with caregiving stress, financial burdens and social stigma psychological distress (Dhamodharan, 2024). Many of the stressors and mental health problems faced by parents are multiplied by their financial incapacity and housing and transportation problems. Furthermore, discrimination and societal stigma further add to their already steep mental anxiety, preventing them from taking the right and essential effect for their and their children's wellbeing (Hussain & Raihan, 2022). Especially, financial constraints are directly associated with higher depression levels (because) families with lower incomes are more susceptible to having major mental health difficulties (Millaku & Kraja-Bardhi, 2022). The problem is compounded by poorly designed family and social support systems. Caregivers with increased rates of depression and anxiety are associated with insufficient financial and psychological assistance (Xia et al., 2023).

However, resilience and contextual factors, e.g. having a trusted person to talk to, attending support groups and receiving professional psychological support, has been demonstrated to lessen these effects, and to favor a positive mental health outcome (Flores-Buils et al., 2023). Also, parents with lower rates of depression live in family environments with harmonious relationships and barrier-free settings (Xia et al., 2023). Certainly, social support is one of the key factors that predict and reduce mental health problems, thus the need for targeted intervention and resources in support of those families. Children with disabilities are significantly influenced in terms of depression and anxiety and family dynamics and child development by parental mental health. In studies, (Claudia & Sandu, 2020) show that parents of children with disabilities, especially their mothers demonstrate higher rates of anxiety and depression as compared to parents of typically developing children.

Typically, additional caregiving responsibilities and a lack of good support systems aggravate this psychological distress (Xia et al., 2023). Especially, maternal depression can affect child development negatively and result in impaired bonding, insecure attachment and developmental delay (Rohanachandra, 2021). Interventions like the Healthy Mothers Healthy Families program have been shown to reduce maternal anxiety and depression, and thereby improve maternal well-being as well as child outcomes. They are expensive and often have low uptake. For better family dynamics and child development, the impact study focuses on dealing with both maternal and paternal mental health (Dennis et al., 2023). Parents also greatly need social support to reduce parental stress and associated mental ill health. In resource-limited settings, informal social support provides a critical form of psychological and economic relief (Lakhani et al., 2025). In addition, social support acts as a buffer against

depression, meaning that having more social support by mothers can lower depression even under high stress (Park & Lee, 2022). Psychosocial adjustment in children with disabilities is also improved by social support which reduces parental stress (Adigun et al., 2022). As its mediating role in promoting resilience among parents shows, it is important for better coping mechanisms and overall mental health (Zhao et al., 2021). Raising children with disabilities negatively affects parental mental health outcomes, and specifically depression and anxiety, and these outcomes are different for parents of each gender. There is research to suggest that parents of children with disabilities have higher levels of depression than do parents of non-disabled children. According to an example, a study showed that 54% of mothers of disabled children had mild to severe depression and 18% had moderate to severe depression (Hamamreh et al., 2016).

Mothers in general tend to have greater amounts of stress, anxiety and depression than fathers, as mothers are typically the primary caregivers (Sharma et al., 2023). Not all emotional and social coping strategies, including seeking support and verbalizing problems, reduce maternal stress (Hallberg, 2014). Clearly, severity and age of the child's disability also matter here: Maternal depression and anxiety is higher if demands on the caregiver are more severe and prolonged (Gnanavel, 2019).

Although fathers are less affected than mothers, they too suffer great stress and mental health stresses, which are typically associated with caregiver burden and financial pressures. Lower-income families also report higher parental depression levels (Millaku & Kraja-Bardhi, 2022). These challenges compound the problem and render them even stronger when they are taken in conjunction with inadequate family and financial powers (Xia et al., 2023). The way in which disability is perceived culturally and socially has a great impact on parent experiences. Some culture sees disability positively, for example in the Tswana's tradition, disabilities are regarded as divine gifts (Zhang, 2020). However, in areas such as Southern India, cultural stigmas continue to prevent people from accessing the resources and support services due to which perceptions are slowly fluctuating (Dickinson, 2018). Another study revealed that in Malaysia, cultural beliefs, resource availability and social support affect parental coping strategies, therefore, family-centered medical approaches are needed (Marshall et al., 2019). In urban India, as well, parents commonly explain disabilities in terms of religious or biological causes and toggle between mainstream medicine and alternative therapies (John et al., 2017). Higher social inequalities exacerbate this issue when families in low-income settings are already under social stress and lack of access to social support groups (Ansari & Jahan, 2016). Family-centered interventions in Ireland have helped to increase parental confidence and social connections but uptake is lower in areas of deprivation (McConkey et al., 2023). Besides, their findings show that culturally sensitive interventions ought to be formulated in a manner that targets the distinctive family needs (Sanchez & Wood, 2016). Parental stress needs to be tackled in a multi-pronged way. For example, mindful parenting programs are effective in reducing stress by improving parent-child interactions in an academically demanding culture such as China (Tan et al., 2024).

Multiple evidences from various studies show that the disability of a child in a family leads to poor income and economic stability of the family. In particular, mothers experience a pronounced reduction in labor market participation and earnings, and the effect of the severity of the child's disability is to intensify these effects. Across different contexts, such as Taiwan, Denmark, Norway, where mothers are more likely to cut work hours or leave the labour market to care for their disabled child, this reduction in maternal employment holds (Lin et al., 2023). Earnings also decline for fathers, although generally less so than for mothers. Add to the overall financial burden the extra cost of caring for a disabled child, which can mean a family has a lower standard and raises greater economic hardship (Roddy, 2022). However, there are some families that succeed at maintaining or even increasing their long-run net worth, perhaps because of government support or because they have fewer children and therefore lower costs. However, the presence of a disabled child alters not just the experience of being a parent to a disabled child, but also changes family dynamics, facilitating an increased chance of divorce with reduced fertility, reducing the yield for the next generation. Findings show these policy interventions are needed, like flexible employment options and better disability support payments to ease the financial and emotional pressure faced by families with children with a disability (Roddy, 2022).

Traditional types of therapy such as CBT are less effective than schema therapy which focuses on emotion management and parenting skills (Kim & Kadyrov, 2022). Paternal caregivers suffer from financial stress, social

stigma, and caregiving burdens of which show the needs for holistic support systems (Paster, 2024). Socioeconomic status, parental fatigue and child health problems are the major stress contributors in Malaysia that need psychological and social support from both governmental and non-governmental organizations. Parental stress due to behavioral issues associated with disabilities is often underestimated by healthcare providers, and necessitates family-centered consultations (Scheibner et al., 2024). Also showed that positive self-talk interventions have been successful in reducing parental stress through acceptance and gratitude and are therefore suitable for community-based programs.

Overall, we find that parents of children with disabilities experience much greater levels of stress, anxiety, and depression, and mothers often bear a disproportionate share of the burden. The incidence of these issues is affected by financial strain, lack of social support, perceived cultural stigma, and severity of the child's disability. Parent mental health outcomes may improve with mindful parenting, schema therapy, and family-centered medical approaches. These problems are multi-dimensional and would require healthcare providers, policy makers and community organizations to work together to provide long-term support and resilience for families.

2. Method

2.1 Participants Characteristics

Parents of children with disabilities aged between 2-12 years were used as the sample in this study.

2.2 Sampling Procedure

Purposive sampling was used by the investigator from a population that met the specified inclusion and exclusion criteria

2.2.1 Inclusion Criteria

- Both male and female participants.
- Parents of the children with disabilities
- Age range of children: 2-12 years.

2.2.2 Exclusion Criteria

- Parents of children without disabilities.
- Children whose age range is not between 2-12 years
- Subjects who are unwilling to participate in this study were excluded.

2.3 Sample size

In survey studies, larger samples better represent the population, but typically, researchers were constrained by practical or financial considerations from obtaining them (Hicks, 1999). The equation was according to the sample size –

We know that-

$$\text{Sample size: } n = \frac{z^2 p(1-p)}{d^2}$$

$$\frac{(1.96)^2 \times 0.5 \times (1-0.5)}{(0.05)^2}$$

$$= 384$$

So, Sample size 384.

Where,

n= Required sample size,

z = confidence level at 95% (standard value of 1.96),

P= estimated prevalence of subject (0.5)

d = margin of error at 5% (standard value 0.05)

Due to insufficient time and budget, this study was conducted with only 220 participants instead of the planned 384.

2.4 Measures

A structured questionnaire- Depression, Anxiety and Stress Scale (DASS-21) was used as a data collection instrument. The Depression, Anxiety and Stress Scale consists of 21 sets of questions. DASS-21 questionnaire is divided into 3 domains, Anxiety, Depression and Stress. This questionnaire used a Likert scale, and scoring is calculated for each domain. Normal scoring ranged for depression (0-9), anxiety (0-7) and stress (0-14), mild scoring ranged for depression (10-13), anxiety (8-9) and stress (15-18), moderate scoring ranged for depression (14-20), anxiety (10-14) and stress (19-25), severe scoring ranged for depression (21-27), anxiety (15-19) and stress (26-33) and extremely severe ranged for depression (28+), anxiety (20+) and stress (34+). This scoring method was used.

2.5 Study Design

The investigator conducted this study to find out depression, anxiety, and stress in parents of children with disabilities in Bangladesh. The investigator used a quantitative cross-sectional prospective research methodology. Quantitative research is a technique of research that collects numerical information from subjects (Hicks, 1999; Fraenkel & Wallen, 1996).

3 Results

3.1 Gender of the participants

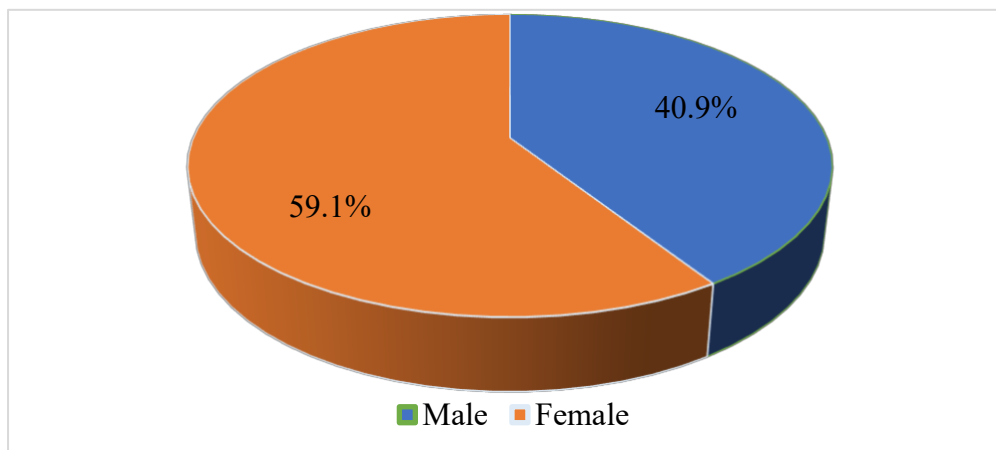


Figure 1: Gender of the Participants

Among 220 participants, the majority of the participants were female 59.1% (130) and male participants were 40.9% (90).

3.2 Age of the Parents

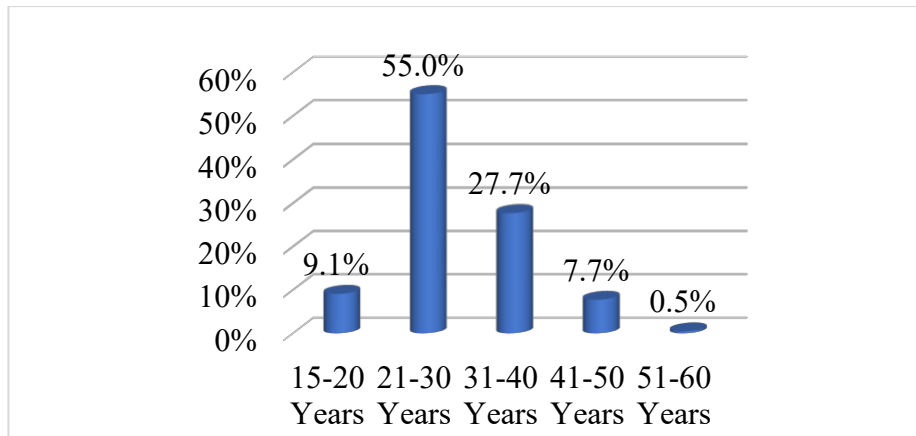


Figure 2: Age of the Parents

In the middle of the 220 participants, the maximum number of participants, age range from (21 to 30) years were 55% (121). It was found that 27.7% (61) were in the age range from (31 to 40) years. Age range from (15 to 20) years were 9.1% (20). It was also found that 7.7% (17) were in the age range from 41 to 50) years and few numbers of participants were 0.5% (1) age ranged from 51-60 years.

3.3 Gender of the Child

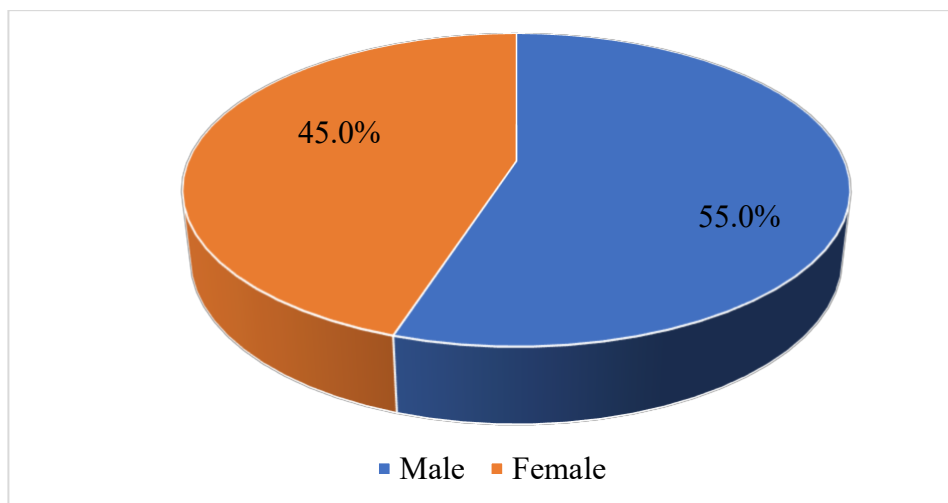


Figure 3: Gender of the Child

Among the child with Disabilities of 220 participants, the majority of the children were male 55% (121) and female were 45% (99).

3.4 Age of the Child

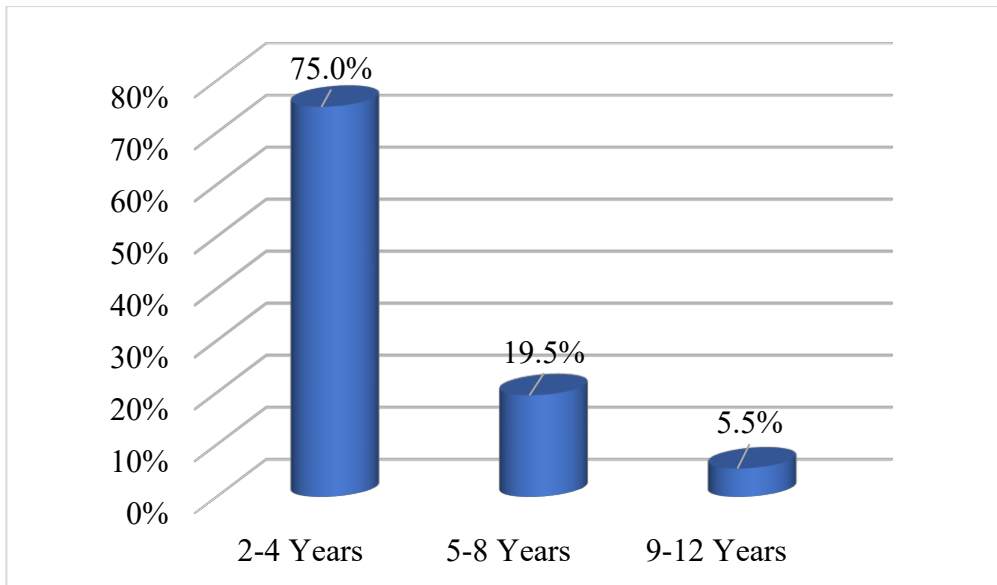


Figure 4: Age of the Child

In the middle of the Child with Disabilities of 220 participants, the maximum number of the child, age range from (2-4) years were 75% (165). It was found that 19.5% (43) were in the age range from (5-8) years and very few numbers of participants were 5.5% (12) age ranged from (9-12) years.

3.5 Diagnosis of the child

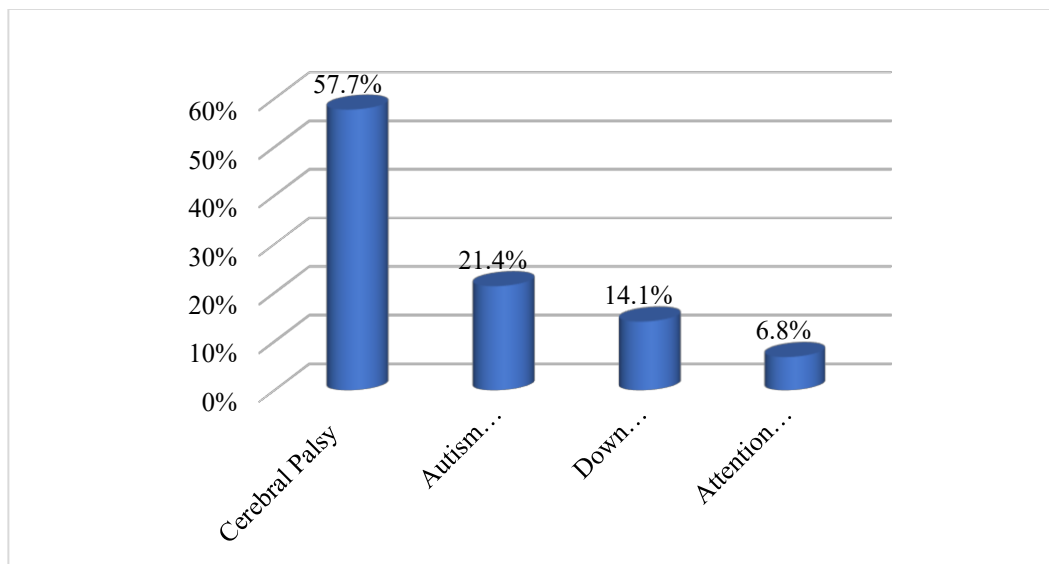


Figure 5: Diagnosis of the child

Among 220 child, 57.7% (127) of children are diagnosed with cerebral palsy and 21.4% (47) of children are diagnosed with Autism Spectrum Disorder, 14.1% (31) of children are diagnosed with down syndrome while only 6.8% (15) of children are diagnosed with Attention Hyperactivity Disorder.

3.6 Educational Qualification

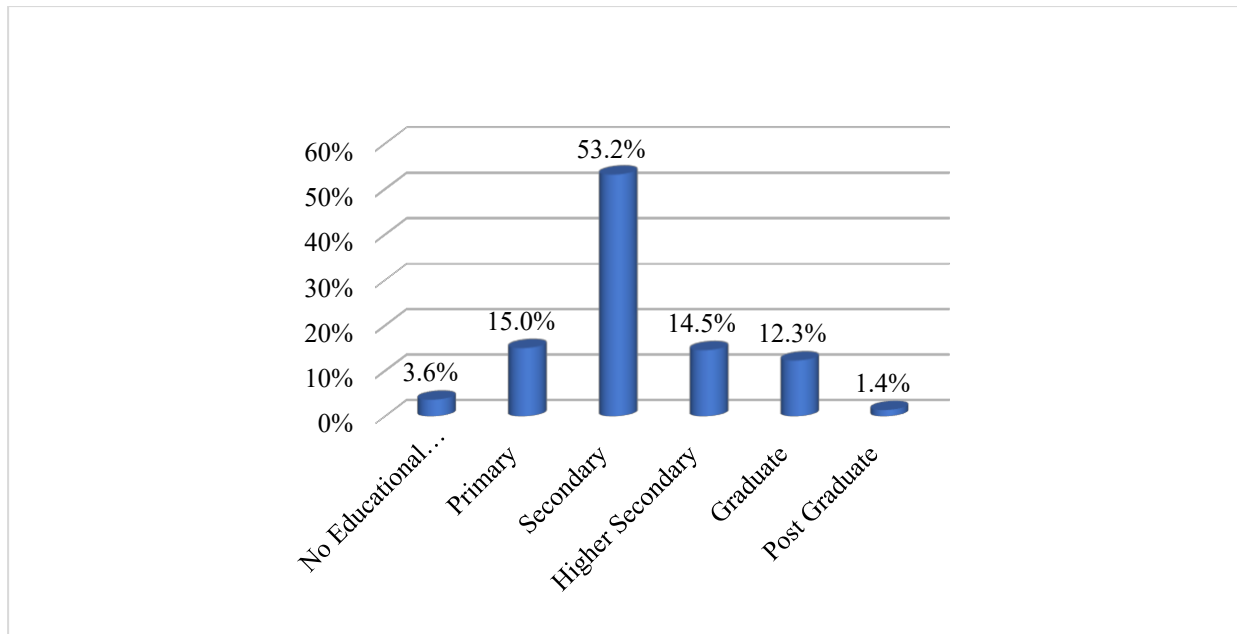


Figure 6: Educational qualification

From 220 participants, the maximum number participants were 53.2% (117) Were secondary. 15.0% (33) of participants education level were primary. Among them only 14.5% (32) participants education level were Higher secondary. 12.3% of the participants (27) have completed graduate level. 3.6% of them (8) have no educational qualification. 1.4% (3) of them have post graduate educational qualifications

3.7 Occupation of the participants

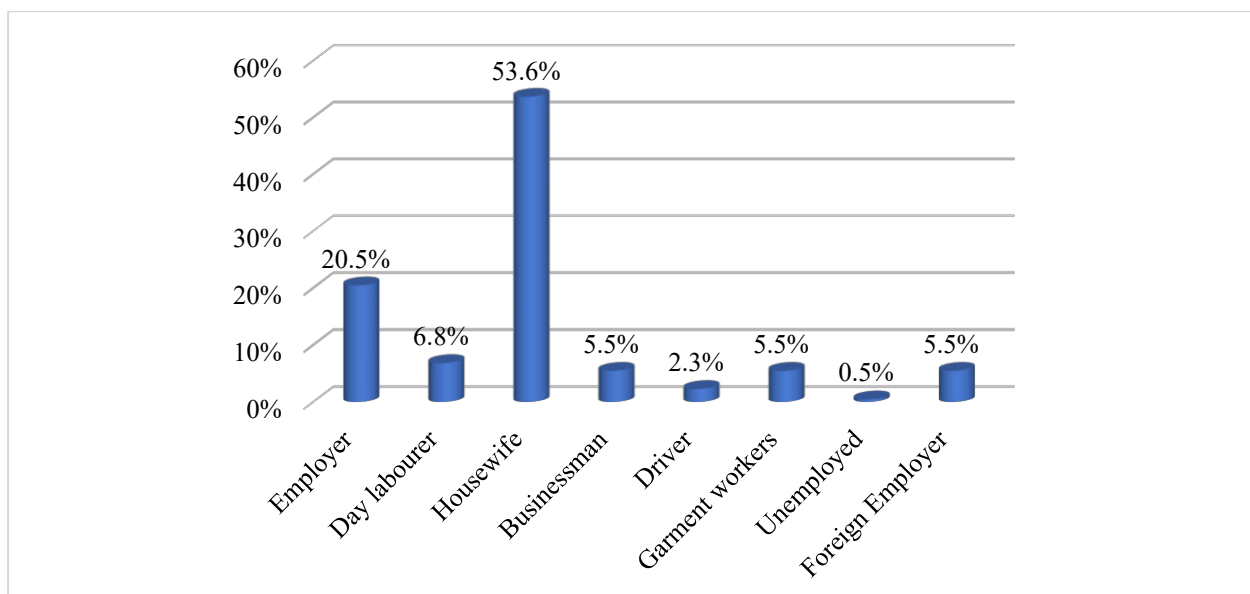


Figure 7: Occupation of the participants

In the group of participants, 20.5% (n=45) were employer. The maximum number participants were 53.6% (n=118) participants were housewife. 5.5% of them were businessman (n=12), Garment workers were 5.5% (n=12), Day labourer were 6.8% (n=15), Driver were 2.3% (n=5), Foreign Employer were 5.5% (n=12). The minimum number participants were 0.5% (n=1) participants were unemployed.

3.8 Monthly income of the family

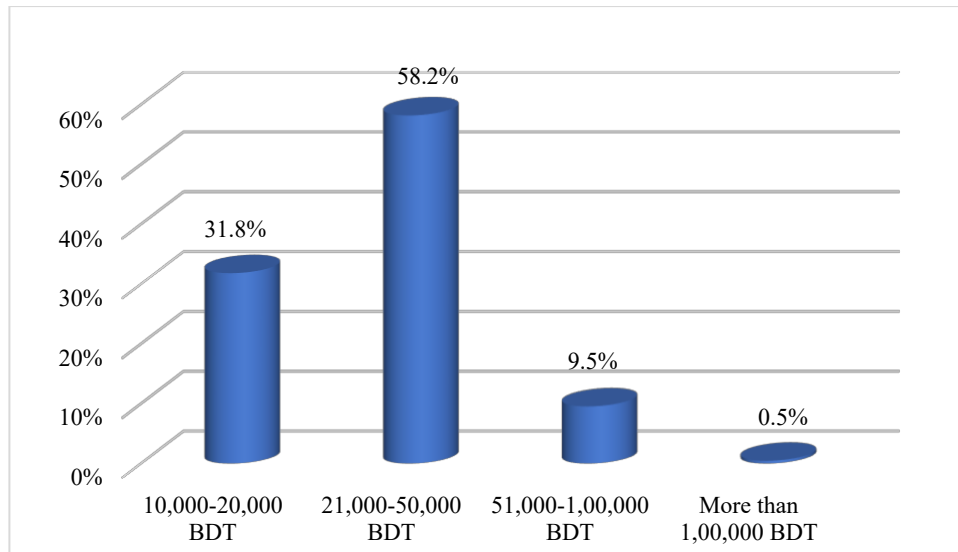


Figure 8: Monthly income of family

The chart demonstrates the distribution of monthly income. The most extensive income range, including 58.2% (128), was between (21000 to 50000) Tk, indicating the most common income category. Subsequently, 9.5% (21) earned between (51000 to 100000) Tk, while 0.5% (1) earned more than 100000 Tk. 31.8% (70) earned between (10000-20000) Tk.

3.9 Number of Family Members of the child

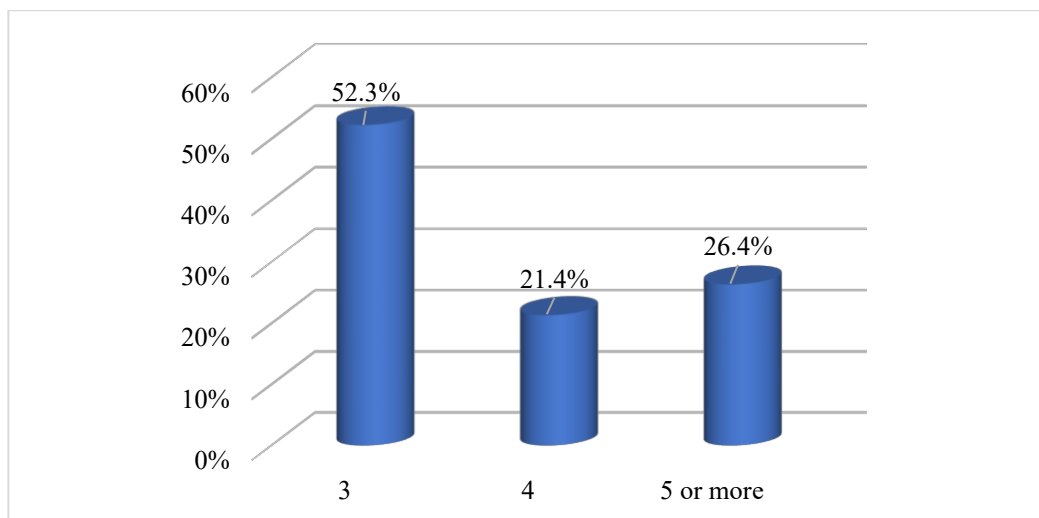


Figure 9: Number of family members of the child

Among 220 child, 52.3% (115) of children have three family members, including themselves, 21.4% (47) of children have four family members including themselves and his/her siblings while 26.4% (58) of children have 5 or more family members including themselves.

3.10 Position of the Child in Siblings

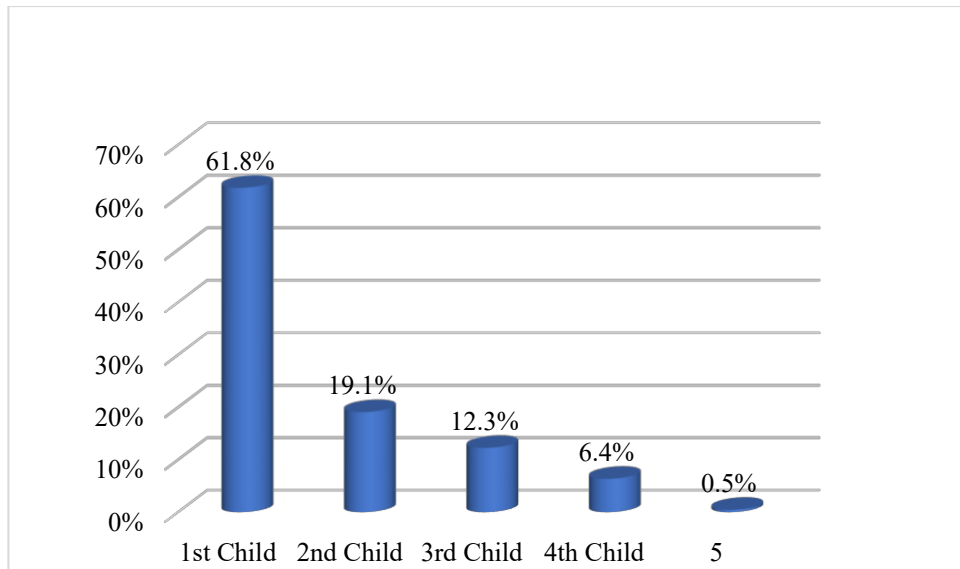


Figure 10: Position of the child in siblings

Among the children with Disabilities of 220 participants, 61.8% (136) parents have their 1st child affected with Disabilities. 19.1% (42) parents have their 2nd child affected with Disabilities and 12.3% (27) parents have their 3rd child affected with Disabilities. 6.4% (14) parents have their 4th child affected with Disabilities and 0.5%(1) parents have their 5th child affected with Disabilities

3.11 Number of disabled children

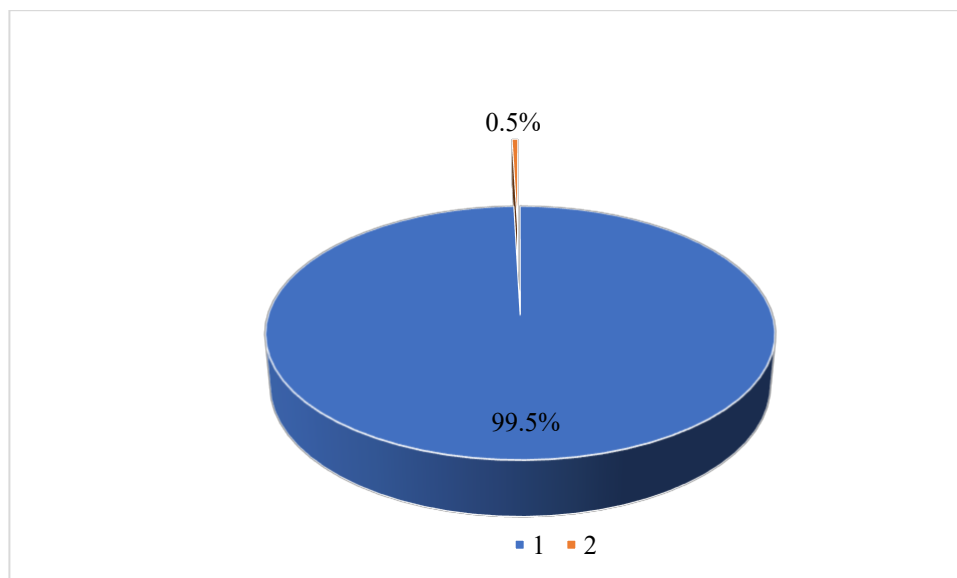


Figure 11: Number of disabled children

Among 220 participants, 99.5% (219) parents have one disabled child where 0.5% (1) parents have two disabled child.

3.12 Carer of the child

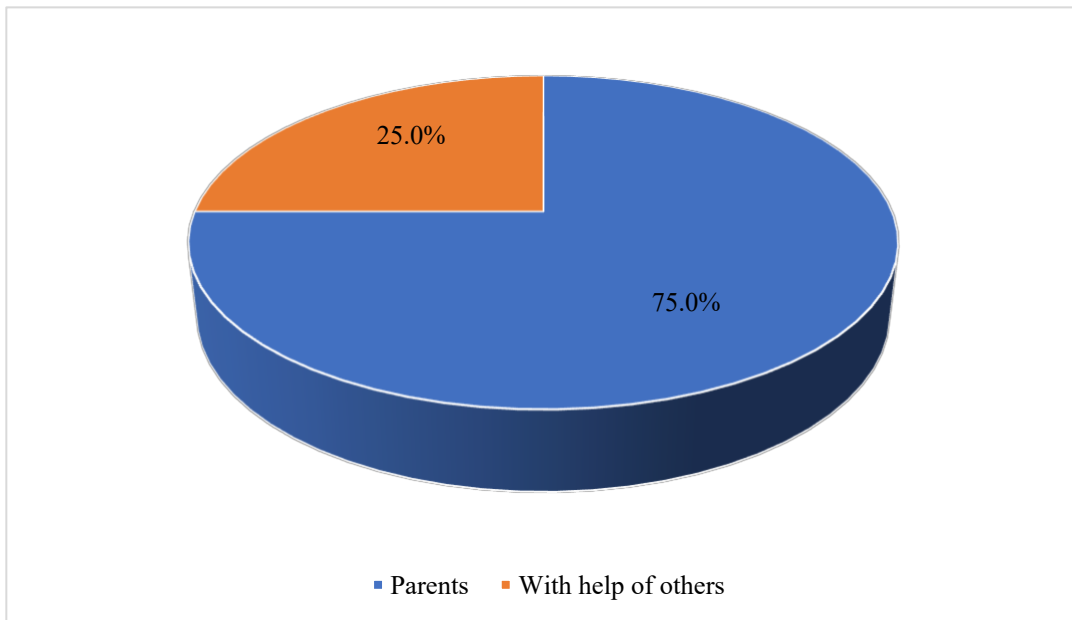


Figure 12: carer of the child

Among 220 participants, 75% (165) of children receive care only from their parents while 25% (55) receive care from both their parents and other family members.

3.13 The severity of anxiety level

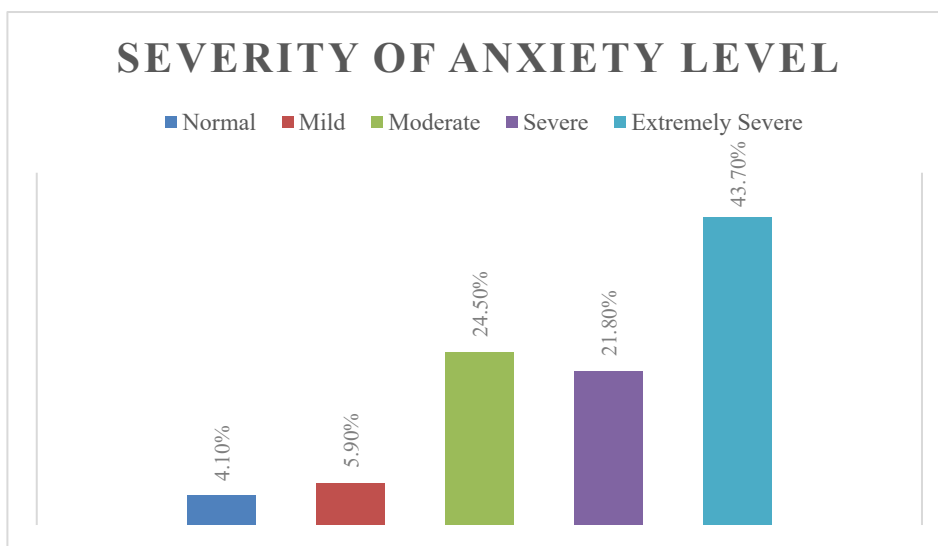


Figure 13: Severity of anxiety level

The majority of participants (61.8%) fall into the severe stress category, indicating that high stress levels are very common in the sample. About 21.4% of participants experience moderate stress. A smaller portion, 12.2%, is experiencing extremely severe stress, suggesting that a notable number of individuals are under very critical stress conditions.

3.14 The severity of depression level

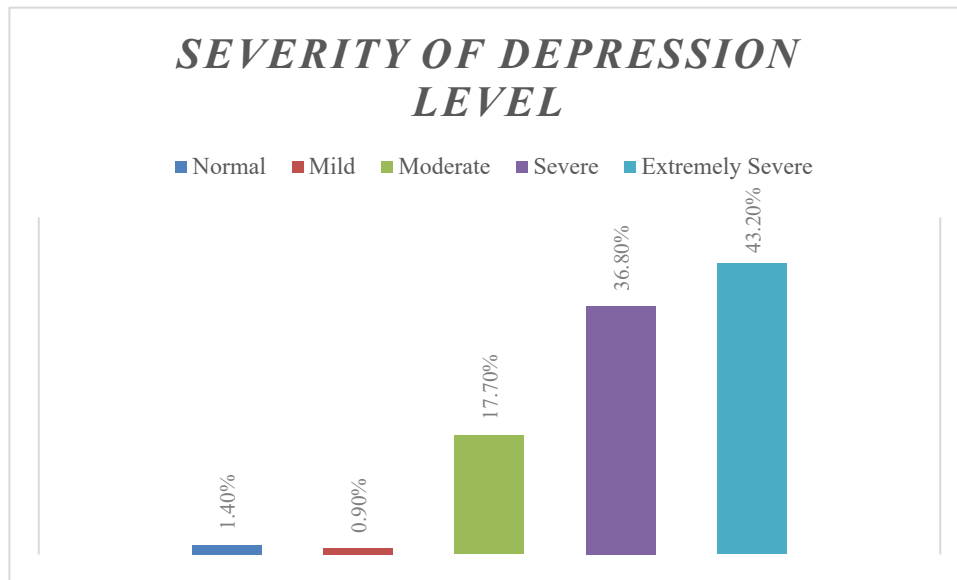


Figure 14: Severity of depression level

The largest proportion (43.2%) of participants fall into the extremely severe depression category, indicating a very high level of depressive symptoms in a significant portion of the sample. 36.8% of participants experience severe depression, which is the second largest group. About 17.7% of participants have moderate depression.

3.15 The severity of the stress level

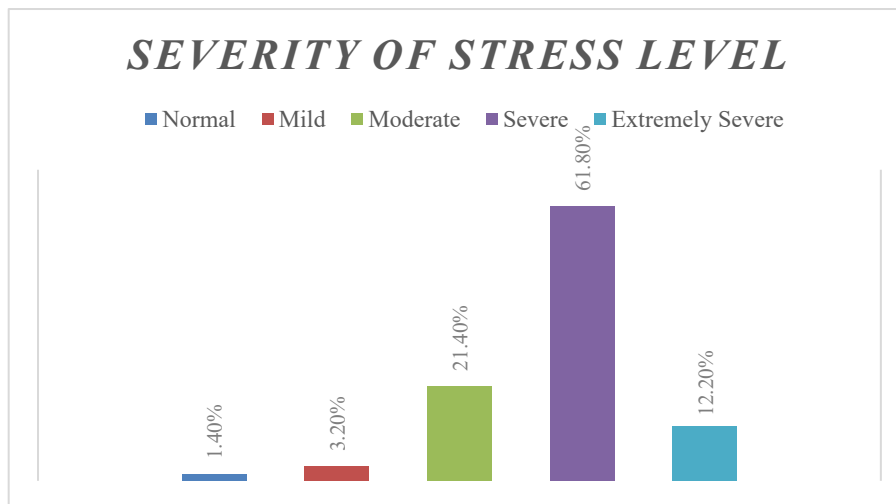


Figure 15: Severity of stress level

Only 1.4% of the participants fall within the normal stress level, while 3.2% experience mild stress. A larger proportion, 21.4%, reports moderate stress. The majority of participants, 61.8%, experience severe stress, which represents the highest category in the distribution. Additionally, 12.2% of participants fall into the extremely severe stress category.

3.16 Association between the gender of parents and the severity of anxiety level

Table 1: Association between the gender of parents and the severity of anxiety level

Gender of Parent	Severity of anxiety level					Total
	Normal	Mild	Moderate	Severe	Extremely Severe	
Male	8 8.9%	9 10.0%	35 38.9%	23 25.6%	15 16.7%	90 100.0%
Female	1 0.8%	4 3.1%	19 14.6%	25 19.2%	81 62.3%	130 100.0%
Total	9 4.1%	13 5.9%	54 24.5%	48 21.8%	96 43.6%	220 100.0%

3.17 Association between the gender of parents and the severity of depression level

Table 2: Association between the gender of parents and the severity of depression level

Gender of Parent	Severity of depression level					Total
	Normal	Mild	Moderate	Severe	Extremely Severe	
Male	1 1.1%	1 1.1%	26 28.9%	49 54.4%	13 14.4%	90 100.0%
Female	2 1.5%	1 0.8%	13 10.0%	32 24.6%	82 63.1%	130 100.0%
Total	3 1.4%	2 0.9%	39 17.7%	81 36.8%	95 43.2%	220 100.0%

3.18 Association between the gender of parents and the severity of stress level

Table 3: Association between the gender of parents and the severity of stress level

Gender of Parent	Severity of stress level					Total
	Normal	Mild	Moderate	Severe	Extremely Severe	
Male	0 0.0%	3 3.3%	27 30.0%	58 64.4%	2 2.2%	90 100.0%
Female	3 2.3%	4 3.1%	20 15.4%	78 60.0%	25 19.2%	130 100.0%
Total	3 1.4%	7 3.2%	47 21.4%	136 61.8%	27 12.3%	220 100.0%

3.19 Association between the monthly income of the family and the severity of anxiety level

Table 4: Association between the monthly income of the family and the severity of anxiety level

Monthly income of family	Severity of anxiety level					Total
	Normal	Mild	Moderate	Severe	Extremely Severe	
10,000-20,000 BDT	0 0.0%	2 2.9%	18 25.7%	13 18.6%	37 52.9%	70 100.0%
21,000-50,000 BDT	8 6.3%	8 6.3%	27 21.1%	31 24.2%	54 42.2%	128 100.0%

51,000-1,00,000 BDT	1 4.8%	3 14.3%	8 38.1%	4 19.0%	5 23.8%	21 100.0%
More than 1,00,000 BDT	0 0.0%	0 0.0%	1 100.0%	0 0.0%	0 0.0%	1 100.0%
Total	9 4.1%	13 5.9%	54 24.5%	48 21.8%	96 43.6%	220 100.0%

3.20 Association between the monthly income of the family and the severity of depression level

Table 5: Association between the monthly income of the family and the severity of depression level

Monthly income of family	Severity of depression level					Total
	Normal	Mild	Moderate	Severe	Extremely Severe	
10,000-20,000 BDT	2 2.9%	0 0.0%	9 12.9%	25 35.7%	34 48.6%	70 100.0%
21,000-50,000 BDT	1 0.8%	1 0.8%	24 18.8%	44 34.4%	58 45.3%	128 100.0%
51,000-1,00,000 BDT	0 0.0%	1 4.8%	5 23.8%	12 57.1%	3 14.3%	21 100.0%
More than 1,00,000 BDT	0 0.0%	0 0.0%	1 100.0%	0 0.0%	0 0.0%	1 100.0%
Total	3 1.4%	2 0.9%	39 17.7%	81 36.8%	95 43.2%	220 100.0%

3.21: Association between the monthly income of the family and the severity of stress level

Table 6: Association between the monthly income of the family and the severity of stress level

Monthly income of the family	Severity of stress level					Total
	Normal	Mild	Moderate	Severe	Extremely Severe	
10,000-20,000 BDT	2 2.9%	1 1.4%	13 18.6%	47 67.1%	7 10.0%	70 100.0%
21,000-50,000 BDT	1 0.8%	6 4.7%	24 18.8%	78 60.9%	19 14.8%	128 100.0%
51,000-1,00,000 BDT	0 0.0%	0 0.0%	9 42.9%	11 52.4%	1 4.8%	21 100.0%
More than 1,00,000 BDT	0 0.0%	0 0.0%	1 100.0%	0 0.0%	0 0.0%	1 100.0%
Total	3 1.4%	7 3.2%	47 21.4%	136 61.8%	27 12.3%	220 100.0%

3.22 Association between the number of family members and the severity of anxiety level

Table 7: Association between the number of family members and the severity of anxiety level

Number of family members	Severity of Anxiety level					Total
	Normal	Mild	Moderate	Severe	Extremely Severe	
3	4 3.5%	3 2.6%	20 17.4%	29 25.2%	59 51.3%	115 100.0%
4	1 2.1%	3 6.4%	20 42.6%	8 17.0%	15 31.9%	47 100.0%
5 or more	4 6.9%	7 12.1%	14 24.1%	11 19.0%	22 37.9%	58 100.0%
Total	9 4.1%	13 5.9%	54 24.5%	48 21.8%	96 43.6%	220 100.0%

3.23 Association between the number of family members and the severity of depression level

Table 8: Association between the number of family members and the severity of depression level

Number of family members	Severity of depression level					Total
	Normal	Mild	Moderate	Severe	Extremely Severe	
3	0 0.0%	0 0.0%	12 10.4%	45 39.1%	58 50.4%	115 100.0%
4	0 0.0%	0 0.0%	11 23.4%	22 46.8%	14 29.8%	47 100.0%
5 or more	3 5.2%	2 3.4%	16 27.6%	14 24.1%	23 39.7%	58 100.0%
	3 1.4%	2 0.9%	39 17.7%	81 36.8%	95 43.2%	220 100.0%

3.24 Association between the number of family members and the severity of stress level

Table 9: Association between the number of family members and the severity of stress level

Number of family members	Severity of stress level					Total
	Normal	Mild	Moderate	Severe	Extremely Severe	
3	0 0.0%	2 1.7%	19 16.5%	76 66.1%	18 15.7%	115 100.0%
4	1 2.1%	3 6.4%	8 17.0%	31 66.0%	4 8.5%	47 100.0%
5 or more	2 3.4%	2 3.4%	20 34.5%	29 50.0%	5 8.6%	58 100.0%
Total	3 1.4%	7 3.2%	47 21.4%	136 61.8%	27 12.3%	220 100.0%

3.25 Association between the position of the child and the severity of anxiety level

Table 10: Association between the position of the child and the severity of anxiety level

Position of the Child	Severity of anxiety level					Total
	Normal	Mild	Moderate	Severe	Extremely Severe	

1st Child	6 4.4%	4 2.9%	28 20.6%	36 26.5%	62 45.6%	136 100.0%
2nd Child	1 2.4%	4 9.5%	16 38.1%	4 9.5%	17 40.5%	42 100.0%
3rd Child	1 3.7%	3 11.1%	6 22.2%	4 14.8%	13 48.1%	27 100.0%
4th Child	1 7.1%	2 14.3%	4 28.6%	3 21.4%	4 28.6%	14 100.0%
5th Child	0 0.0%	0 0.0%	0 0.0%	1 100.0%	0 0.0%	1 100.0%
Total	9 4.1%	13 5.9%	54 24.5%	48 21.8%	96 43.6%	220 100.0%

3.26 Association between the position of the child and the severity of depression level

Table 11: Association between the position of the child and the severity of depression level

Position of the Child	Severity of depression level					Total
	Normal	Mild	Moderate	Severe	Extremely Severe	
1st Child	0 0.0%	0 0.0%	20 14.7%	53 39.0%	63 46.3%	136 100.0%
2nd Child	1 2.4%	0 0.0%	7 16.7%	18 42.9%	16 38.1%	42 100.0%
3rd Child	0 0.0%	2 7.4%	6 22.2%	7 25.9%	12 44.4%	27 100.0%
4th Child	2 14.3%	0 0.0%	6 42.9%	3 21.4%	3 21.4%	14 100.0%
5th Child	0 0.0%	0 0.0%	0 0.0%	0 0.0%	1 100.0%	1 100.0%
Total	3 1.4%	2 0.9%	39 17.7%	81 36.8%	95 43.2%	220 100.0%

3.27 Association between the position of the child and the severity of the stress level

Table 12: Association between the position of the child and the severity of stress level

Position of the Child	Severity of stress level					Total
	Normal	Mild	Moderate	Severe	Extremely Severe	
1st Child	0 0.0%	3 2.2%	24 17.6%	91 66.9%	18 13.2%	136 100.0%
2nd Child	1 2.4%	2 4.8%	7 16.7%	26 61.9%	6 14.3%	42 100.0%
3rd Child	0 0.0%	2 7.4%	12 44.4%	12 44.4%	1 3.7%	27 100.0%
4th Child	2 14.3%	0 0.0%	4 28.6%	6 42.9%	2 14.3%	14 100.0%
5th Child	0 0.0%	0 0.0%	0 0.0%	1 100.0%	0 0.0%	1 100.0%
Total	3 1.4%	7 3.2%	47 21.4%	136 61.8%	27 12.3%	220 100.0%

4. Discussion

Of the 220 participants, 130 (59.1%) were female, and 90 (40.9%) were male. We found that 9 (10%) male participants and 4 (3.1%) female participants experienced mild anxiety, whereas 35 (38.9%) male participants and 19 (14.6%) female participants had moderate anxiety. 25.6% (23) of males and 19.2% (25) of females reported severe anxiety and 16.7% (15) of males and 62.3% (81) of females extremely severe anxiety. Furthermore, 8.9% (8) of males and 0.8% (1) of females stated no symptoms of anxiety. We find that male parents are predominantly in the moderate anxiety group, but female parents have a much higher percentage in the extremely severe anxiety group.

Regarding the levels of depression, 1.1% (1) of the males and 0.8% (1) of the females were mildly depressed, 28.9% (26) of the males and 10% (13) of the females were moderately depressed. Severe depression was reported for 54.4% (49) of males and 24.6% (32) of females, amongst whom 14.4% (13) of males and 63.1% (82) of females had extremely severe depression. Additionally, 1.1% (1) of males and 1.5% (2) of females did not suffer from depression. Severe depression is more common in male parents, while extremely severe depression is disproportionately common in female parents. In terms of stress, 3.3% (3) of males and 3.1% (4) of females stated they had mild stress, but 30% (27) of males and 15.4% (20) of females had moderate stress. Among males, 64.4% (58) reported severe stress and 2.2% (2) reported extremely severe stress, while 60% (78) of females reported severe stress and 19.2% (25) reported extremely severe stress. Of note is that 0% (0) males and 2.3% (3) females did not experience stress. The findings show that male parents had a higher percentage in the severe stress category than female parents, who had a more balanced distribution of severe and extremely severe stress levels.

Previous research indicates that parents of children with disabilities are at higher risk of depression and anxiety, and supports these findings. For example, 57.6% of fathers and 91.8% of mothers of children with intellectual disabilities report significant anxiety symptoms, and 35.4% of fathers and 66.3% of mothers report significant depressive symptoms (Sharma et al., 2023). This study is consistent with these results, in which female parents had higher prevalence rates of anxiety, depression, and stress than male parents, which is similar to various studies and was statistically significant. ($\chi^2= 52.013$, $df= 4$, $p<0.05$), ($\chi^2= 52.824$, $df= 4$, $p<0.05$) & ($\chi^2= 20.111$, $df= 4$, $p<0.05$).

Additionally, this study investigated the relationship between monthly family income and the prevalence of anxiety, depression, and stress. Out of the participants, 70 (31.8%) had a monthly income of 10,000–20,000 BDT, 128 (58.2%) had a monthly income of 21,000–50,000 BDT, 21 (9.5%) had a monthly income of 51,000–100,000 BDT, and 1 (0.5%) had a monthly income of more than 100,000 BDT. In all income groups, 4.1% (9) had normal anxiety, 5.9% (13) mild anxiety, 24.5% (54) moderate anxiety, 21.8% (48) severe anxiety, and 43.6% (96) extreme severe anxiety. The prevalence of extremely severe anxiety was higher in lower income groups (10,000–20,000 BDT) than in higher income groups, and relatively lower in higher income groups.

Likewise, depression level across income groups was 1.4% (3) with normal depression, 0.9% (2) with mild depression, 17.7% (39) with moderate depression, 36.8% (81) with severe depression, and 43.2% (95) with extremely severe depression. As in the case of moderate to severe depression, lower income groups (particularly those earning 10,000–20,000 BDT) had a higher prevalence of severe and extremely severe depression, but higher income groups had more varied patterns across different severity levels. This is supported by other studies (Millaku & Kraja-Bardhi, 2022). where other studies confirm that financial strain significantly contributes to parental depression, and families in lower income brackets face larger depressive symptoms. Similar trends were seen across groups by income, with 1.4% (3) in the normal stress group, 3.2% (7) in the mild stress group, 21.4% (47) in the moderate stress group, 61.8% (136) in the severe stress group, and 12.3% (27) in the extremely severe stress group. Families with lower income, especially those with incomes between 10,000 and 20,000 BDT, had the highest prevalence of severe and extremely severe stress. The studies found financial strain and limited access to resources were the key factors which aggravated the stress levels among parents of their children with disabilities (Suganya & Balakrishnan, 2022).

This study found anxiety, depression and stress didn't vary significantly with the monthly income of the families which was not similar to various studies and was statistically non-significant. ($\chi^2= 17.340$, $df= 12$, $p>0.05$), ($\chi^2= 19.182$, $df= 12$, $p>0.05$) & ($\chi^2= 15.482$, $df= 12$, $p>0.05$).

Prevalence of anxiety, depression, and stress varied according to family size as well. Of the participants, 52.3% (115) of the children came from families of three members, 21.4% (47) from four members, and 26.4% (58) from five or more members. The highest percentages of extremely severe anxiety (43.6% (96)), extremely severe depression (43.2% (95)), and severe stress (61.8% (136)) were seen in families with three members. On the other hand, families with five or more members were more evenly distributed across the moderate and severe stress levels. According to studies, shared caregiving responsibilities might help mitigate the stress of looking after kids for bigger families (Singh et al., 2023), but the same might come at a financial and logistic price (Xia et al., 2023). This study found anxiety, depression and stress varied significantly with the number of family members which was similar to various studies and was statistically significant. ($\chi^2= 20.921$, $df= 8$, $p<0.05$), ($\chi^2= 28.945$, $df= 8$, $p<0.05$) & ($\chi^2= 16.268$, $df= 8$, $p<0.05$)

Finally, the child's position in the family was also found to be significantly associated with anxiety, depression and stress levels. Of the participants, 136 (61.8%) had their first child affected by disabilities, 42 (19.1%) had their second child affected, 27 (12.3%) had their third child affected, 14 (6.4%) had their fourth child affected and 1 (0.5%) had their fifth child affected. The highest percentages of extremely severe anxiety (43.6% (96)), extremely severe depression (43.2% (95)), and severe stress (61.8% (136)) were reported by parents of first-born children. This finding is supported by previous research, which shows that parents of firstborn children experience higher psychological distress as a result of long-term care giving demands and worries about their child's future (Pocinho & Fernandes, 2018). This study concludes that female parents, lower income families, smaller family units, and parents of firstborn children are at greatest risk for severe psychological distress. These findings support other research and highlight the requirement which was similar to various studies and was statistically significant. ($\chi^2= 20.198$, $df= 16$, $p>0.05$), ($\chi^2= 45.774$, $df= 16$, $p<0.05$) & ($\chi^2= 35.992$, $df= 16$, $p<0.05$).

5 Conclusion

This study investigated how prevalent and how severe depression, anxiety and stress are in parents of children with disabilities in Bangladesh. Results showed that 43.6% of parents had extremely severe anxiety, 43.2% had extremely severe depression and 61.8% had severe stress. In comparison to male parents, female parents had higher levels of extremely severe anxiety (62.3%) and depression (63.1%). For lower income families, those with incomes between 10,000–20,000 BDT, showed high rates of severe anxiety (18.6%) and very severe depression (48.6%). Furthermore, 45.6% of parents of firstborn children with disabilities experienced extremely severe anxiety and 46.3% experienced extremely severe depression. The urgency of creating structured mental health support systems (such as counseling, financial assistance and caregiver friendly policies) is spelled out by these findings. Parental educational programs also should include stress management and coping strategy instruction. Further longitudinal research is also suggested to validate these findings and inform evidence based interventions that are culturally and socioeconomically relevant to Bangladesh. Efforts to improve the mental well being of these parents and care they give their children depend on collaborative efforts by healthcare professionals, policymakers and community support services.

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Potential Expression of HER2 Protein According to the Macroscopic Type of Tumor in Gastric Cancer: Original Scientific Paper

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Abstract

The aim of the study was to determine the relationship between HER2 protein expression and macroscopic tumor type according to Borrmann in gastric cancer. Method: This study used archival tissue samples of gastric cancer from 60 patients obtained after subtotal or total gastrectomy with regional lymphadenectomy of lymph nodes. The most representative tissue samples of gastric cancer tissue selected by the standard hematoxylin-eosin staining method were re-cut on a microtome and immunohistochemically treated with an antibody to HER2 according to the manufacturer's protocol, and then evaluated by light microscopy and scored using a modified scoring system for HER2 positivity of surgical resections. Descriptive statistics, non-parametric significance tests, namely Chi square test and One sample T-test, as well as correlation tests, namely Pearson's correlation test, were used in data processing. Results: Statistical analysis of HER2 protein expression according to the macroscopic appearance of gastric carcinoma according to Borrmann performed using the chi-square test does not show a statistically significant relationship between these two variables ($\chi^2=66.267$), analysis using the one sample T-test does not show a statistically significant difference ($t=3.080$), and analysis using the Pearson correlation test shows a positive correlation that is not statistically significant ($r=0.069$) between these two examined parameters. Conclusion: HER2 protein expression showed a negligible positive correlation without statistical significance according to the macroscopic type of carcinoma according to Borrmann using the univariate statistical method according to Pearson.

Keywords: HER2, Macroscopic Type, Borrmann, Gastric Carcinoma

1. Introduction

According to the definition of the World Health Organization (WHO), gastric cancer is a malignant epithelial tumor of the gastric mucosa with glandular differentiation, and it is one of the most common tumors, and the second leading cause of death from cancer in the world, although its frequency has been declining, especially in developed countries, since the middle of the 20th century (Kelley and Duggan, 2003). The incidence of gastric cancer largely depends on the geographical area. It is especially common in the countries of the Far East, Asian

countries of the former Soviet Union, Eastern European countries and South America. The world's highest incidence of this tumor is in Japan, where it is up to 80/100,000 inhabitants per year with about 100,000 newly diagnosed patients per year and is eight to ten times higher than in Western Europe, where it is 10 to 15 new cases per 100,000 inhabitants per year (Troskot and Gamulin, 2006). Tumor stage assessment is based on the basic principles of tumor growth and spread. In the initial phase of growth, the tumor spreads in the organ in which it originated, and with further growth it can directly spread to neighboring organs. During tumor growth, tumor cells enter blood and lymph vessels and spread (metastasize) to lymph nodes and distant organs. Therefore, the most common elements used in tumor stage assessment are:

1. location of the tumor inside the stomach (there is a special scheme that is used to assess the expansion of the tumor),
2. the depth of tumor invasion in the stomach wall,
3. the presence of tumors in the lymph nodes and the number of affected lymph nodes,
4. presence of distant metastases.

When analyzing gastric adenocarcinoma, in addition to determining the histological type according to Lauren and the macroscopic type according to Borrmann, it is necessary to determine the degree of differentiation, and Goseki grade (Gullick, 2001). Borrmann's macroscopic classification of advanced gastric carcinomas that invade muscle dates back to 1928 and distinguishes:

- | | |
|--------------|---------------------------------------|
| I: Polypoid, | III: Ulcerated, |
| II: Fungal, | IV: Infiltrative ("linitis plastica") |

Types I, II/III, and IV tend to correspond to tubulo/papillary, intestinal, and adenocarcinomas of the "signet ring" cell type (linitis plastica), but there may be overlap between the categories. Polypoid/ulcerated tumors are considered to have a better prognosis than tumors of the infiltrative type. The tumor borders may be clear or unclear in relation to the surrounding tissue (Guan et al, 2009).

2. Molecular prognostic parameters

Overexpression of c-erbB-2 protein in gastric cancer (occurring in about 20% of cancer cases) has been shown to be an indicator of poor prognosis of gastric cancer (Jorgensen, 2010). However, such cancer cases may respond favorably to combination chemotherapy and trastuzumab (targeted therapy) (Hofmann et al, 2008).

Speaking of the p53 protein, in one series of studies from England (Gabbert et al, 2008) and another series of studies from Portugal (Allgayer et al, 1997), gastric cancers expressing the TP53 gene product were associated with a reduced survival rate (Dohchin et al, 2000), but in a series of studies from Germany such a relationship was not confirmed (Sgambato et al, 2000).

Also, increased levels of immunohistochemical detection of cathepsin D are associated with a worse survival rate in gastric cancer (Capuzzi et al, 2000). Similarly, high expression of cathepsin B and cathepsin L is associated with a greater propensity for tumor invasion and metastasis (Chung et al, 1996).

Immunohistochemical detection of the cyclin-dependent kinase p27 Kip1 has been demonstrated to be an indicator of reduced survival rates in patients with gastric cancer (Song et al, 2009). Preliminary studies indicate that loss of FHIT protein, or Bis (5-adenosyl)-triphosphatase, is an indicator of poor prognosis in gastric cancer (VanBeek et al, 2006). Expression of T-antigen as a precursor of the blood MN system is reported to correlate with the depth of invasion and the tendency of gastric cancer to metastasize to distant organs (Akiyama et al, 1986). EBV-positive gastric cancers have a better prognosis, probably due to the presence of activated cytotoxic T-cell infiltrate (Gullick, 2001; Coussens et al, 1985).

HER2 is a transmembrane glycoprotein essential for growth factor signaling. HER2 expression has also been found in colon, bladder, ovarian, endometrial, lung, cervical, head and neck, esophageal, and gastric cancers. Increased expression correlates with clinical outcome, conferring a poor prognosis, and is also a predictive factor for poor response to chemotherapy and endocrine therapy. The greatest value of determining HER2 status lies in predicting

response to HerceptinR-Trastuzumab therapy (HERCEPTIN F.Hoffmann-La Roche Ltd, Basel, Switzerland and Genetech, Inc., South San Francisco, CA), in the sense that the efficacy of anti-HER2 therapy correlates with the degree of HER2 positivity, and Herceptin therapy has revolutionized the treatment of breast cancer (Hetzl et al, 1992; Hirashima et al, 2001; Douglass and Nava, 1985).

The TNM classification is currently the most important prognostic factor for gastric cancer. However, the prognosis in different patients with the same stage of the disease is not the same. Therefore, it is necessary, in addition to the TNM classification and the classic pathological characteristics of the tumor, to identify biological prognostic factors, which are often derived from genetic processes and are considered to represent a key step in the prognosis of gastric cancer.

There are opinions that HER2 expression plays a key role in the development of gastric cancer, its progression and metastasis. However, little is known about its expression, because a limited number of papers have been published on this topic in the world (Gravalos and Jimeno, 2008). Given that the majority of stomach cancers, nowadays, unfortunately, are diagnosed at an advanced stage of the disease, it is still unclear whether the expression of the HER2 protein in this cancer is related to any of the proven prognostic factors, and whether it can have a potential role in the prognosis of the disease and possibly provide guidelines for therapeutic treatment.

The aim of the work was to determine the correlation of HER2 protein expression with macroscopic tumor type according to Borrmann in gastric cancer.

2. Material and methods

The research conducted and presented in this paper represents a fundamental or basic type of research with an observational method of obtaining data used in the study.

2.1. Material

This study used archival tissue samples of gastric carcinoma from 60 patients obtained after subtotal or total gastrectomy with regional lymphadenectomy of the lymph nodes of the perigastric fatty tissue along the lesser and greater curvature of the stomach, then the lymph nodes of the celiac tripus region and the hepatoduodenal ligament region. Pathohistological diagnostics of all gastric carcinoma samples included in this study was performed at the Department of Pathology and Cytodiagnostics of the Travnik Hospital, in the period from the beginning of 2010 to the end of 2012. The condition for including samples in this study is that the patients had an operable tumor with a known status of regional lymph nodes and without evident distant dissemination at the time of diagnosis. The same number, i.e. 60 samples of normal stomach tissue, were used as a control group. In the prospective part, a pathohistological profile of HER2 amplifying gastric carcinomas was constructed based on a retrospective study, which was applied in the selection of pathohistologically verified gastric carcinomas in which immunohistochemical detection of HER2 protein was performed. Data on the clinicopathological parameter of the macroscopic tumor type according to Borrmann were obtained by macroscopic examination of the material after subtotal or total gastrectomy.

2.2. Methods

Pathohistological processing of biopsy material obtained by subtotal or total gastrectomy with regional lymphadenectomy involved taking tissue samples according to dissection rules, and their standard histochemical processing and, in the first act, staining with the standard hematoxylin-eosin method as well as with the special histochemical method of staining PAS (Periodic Acid Schiff) for mucin. In the next procedure, the most representative tissue samples of gastric carcinoma tissue embedded in paraffin blocks were re-cut on a microtome and immunohistochemically stained, i.e. treated with an antibody to HER2 according to the manufacturer's protocol, and then evaluated by light microscopy and scored using a modified HER2 positivity scoring system for surgical resections.

2.3. Guide to HercepTest scoring in gastric carcinoma

Tests to test the consistency, i.e. validity of the results between immunohistochemical staining and in situ hybridization of the pre-ToGA study showed that the HER2 IHC test is suitable for staining gastric carcinoma cells, but differences appeared compared to breast carcinoma, and changes were required in the scoring system for gastric carcinoma. The pre-ToGA and ToGA (Trastuzumab for Gastric Cancer) studies showed that a modified HER2 positivity scoring system should be used for gastric carcinoma samples.

2.4. Ethical aspects of the study

The use of archival gastric cancer tissue samples in this study was approved by the Ethics Committee of the Travnik Hospital, the institution where the study was conducted, for the purpose of using the data for scientific purposes.

2.5. Statistical data processing

After microscopic processing of the material, the obtained data were entered into MS Excel 2007. The data stored in this way were transported to the SPSS 16.0 software package for statistical processing. Descriptive statistics, non-parametric significance tests, namely the Chi square test and One sample T-test, as well as correlation tests, namely the Pearson correlation test, were used in data processing.

3. Results

Analyzing the macroscopic appearance of the cancer tissue of the samples of the experimental group and using Borrmann's macroscopic classification, the results obtained showed that 4 samples, or 6.7% of the total number of samples of the experimental group, had a macroscopic appearance of a polypoid tumor mass, while only one sample had a fungal macroscopic appearance, which is 1.7% of the total number of samples of the experimental group. Furthermore, 41 samples, or 68.3% of the total number of samples, had the appearance of an ulcerative lesion, while a total of 14 samples, or 23.3% of the total number of samples of the experimental group, showed an infiltrative type of macroscopic appearance of the tumor. Data on the prevalence of individual macroscopic forms of gastric cancer according to Borrmann are numerically and in percentages shown in Chart 1.

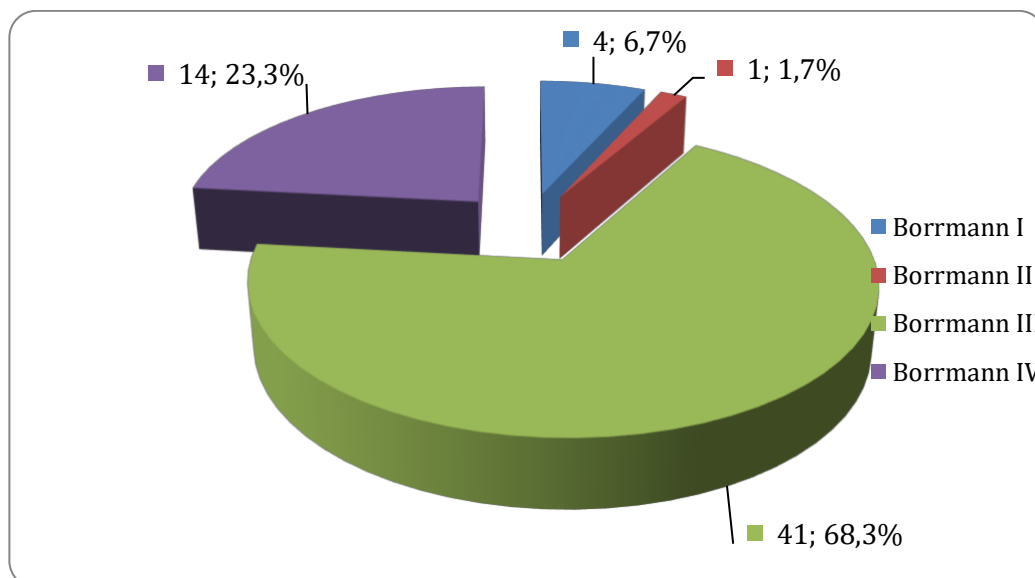


Chart 1: Structure of macroscopic forms of gastric cancer in samples of the experimental group according to Borrmann's division

After processing and analyzing the characteristics of the macroscopic tumor type according to Borrmann of the cancer samples of the studied group of patients, immunohistochemical staining and analysis of all samples of the experimental and control groups of samples are performed.

The immunohistochemical analysis of the application of Herceptest on the experimental group of gastric cancer biopsy samples obtained results showing that the largest number of gastric cancers showed HER2 negative immunoreactivity, that is, that the largest number of gastric cancers did not show immunoreactivity in the expression of the HER2 protein, and out of a total of 60 samples that made up the experimental group, 36 of them, or 60%, showed HER2 negative immunoreactivity (Figure 1). Furthermore, weak or barely visible membrane activity, some of which are only in parts of the cell membranes of the cancer cells, is shown by a total of 9 samples, or 15% of the total number of samples of the experimental group (Figure 2).

Ambiguous membrane activity was shown by 8 samples of the experimental group, i.e. 13.33% of the total number of samples of the experimental group (Figure 3), and these samples in further work should be retested by the method of in situ hybridization in the light microscopic field (CISH).

And finally, what is most important and why the research was done, hyperreactivity, i.e. baseolateral or lateral membrane reactivity in HER2 protein expression, was shown by 7 samples, i.e. 11.67% of the total number of samples of the experimental group (Figure 4).

One sample showed apical membranous activity, with no evident baseolateral or lateral membranous activity in HER2 protein expression, and that sample was considered a HER2-negative immunoreactivity sample (Figure 5). All samples from the control group of samples, which were represented by samples from histologically regular stomachs, showed HER2 negative immunoreactivity (Figure 6).

Examining the relationship between Borrmann's classification of macroscopic appearances of gastric carcinoma and membranous immunoreactivity in HER2 protein expression, the results showed that as many as 6 samples with hyperreactivity in HER2 protein expression, or 10% of the total number of samples in the experimental group, had a macroscopic appearance of an ulcerative lesion, while 1 sample with hyperreactivity, or 1.7% of the total number of samples, had the appearance of a diffuse infiltrative lesion according to Borrmann. Ambiguous membranous activity was shown by 5 samples, or 8.3% of the total number of samples with the appearance of an ulcerative lesion, and 3 samples, or 5% of the total number of samples with the appearance of a diffuse infiltrative lesion. Gastric carcinoma lesions with the appearance of polypous and fungal lesions did not show either hyperreactivity or ambiguous membrane activity in HER2 protein expression, which is numerically and in percentages shown in graph 2.

The control group samples did not show immunoreactivity in HER2 protein expression, and they do not have a defined macroscopic appearance according to Borrmann.

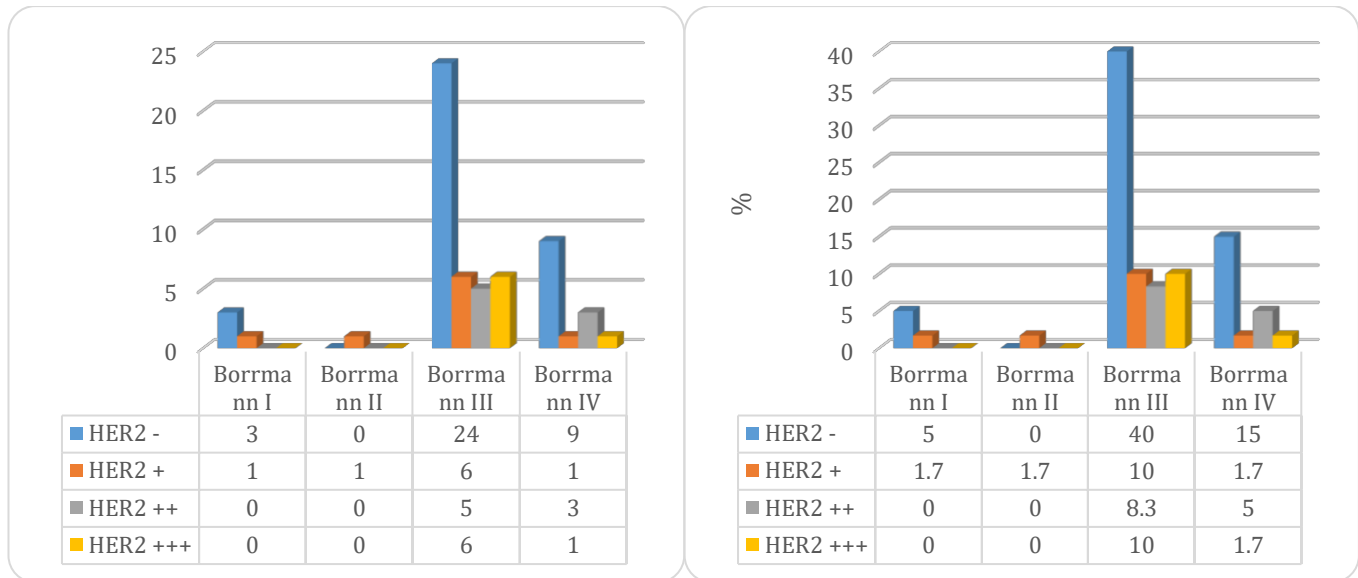


Chart 2: HER2 protein expression in relation to the macroscopic appearance of gastric cancer according to Borrmann in the examined group

Statistical analysis of HER2 protein expression according to the macroscopic appearance of gastric cancer according to Borrmann performed using the chi-square test does not show a statistically significant relationship between these two variables ($\chi^2=66.267$; a statistically significant relationship is if $p<0.05$), analysis using the one sample T-test does not show a statistically significant difference ($t=3.080$; the difference is not statistically significant if $p>0.05$), and analysis using the Pearson correlation test shows a positive correlation that is not statistically significant ($r=0.069$) between these two examined parameters.

4. Discussion and conclusion

The aim of the study was to qualitatively and quantitatively determine the possible expression of HER2 protein in gastric cancer, and to examine the correlation of HER2 protein expression with the examined clinicopathological parameter of gastric cancer, i.e. the macroscopic tumor type according to Borrmann.

Before discussing the main objectives of this study, we need to discuss the basic characteristics, i.e. the clinicopathological parameter of the experimental research group.

Analyzing the macroscopic appearance of the carcinoma samples of the experimental research group using Borrmann's macroscopic classification from 1928, we obtained results that showed that 4 samples, i.e. 6.7% of the total number of samples of the experimental group, had the macroscopic appearance of a polypoid tumor mass, while only one sample had a fungal macroscopic appearance, which is 1.7% of the total number of samples of the experimental group. Furthermore, 41 samples, which is 68.3% of the total number of samples, had the appearance of an ulcerative lesion, while a total of 14 samples, which is 23.3% of the total number of samples of the experimental group, showed the infiltrative type of macroscopic tumor appearance.

Examining the relationship between Borrmann's division of the macroscopic appearance of gastric cancer and membrane immunoreactivity in the expression of the HER2 protein, the result was that as many as 6 samples with hyperreactivity in the expression of the HER2 protein, i.e. 10% of the total number of samples of the experimental group, had the macroscopic appearance of an ulcerative lesion, while 1 sample with hyperreactivity, which was 1.7% of the total number of samples, had the appearance of a diffuse infiltrative lesion according to Borrmann. Ambiguous membrane activity was shown by 5 samples or 8.3% of the total number of samples with the appearance of an ulcerative lesion and 3 samples or 5% of the total number of samples with the appearance of a diffuse infiltrative lesion. Gastric carcinoma lesions with polypous and fungal appearance showed neither hyperreactivity nor ambiguous membrane activity in HER2 protein expression. Weak membrane activity in HER2

protein expression was shown by 1 gastric carcinoma sample with polypous appearance, then fungal and diffuse infiltrative lesions, which is 1.7% of the total number of samples, and 6 carcinoma samples with macroscopic appearance of ulcerative lesions, which is exactly 10% of the total number of samples in the experimental group. Negative HER2 immunoreactivity was shown by 3 polypous-appearing carcinoma samples, which is exactly 5% of the total number of samples, then 24 ulcerous-appearing carcinoma samples, which is exactly 40% of the total number of samples, and 9 diffuse infiltrative carcinoma samples, which is exactly 15% of the total number of samples in the experimental group. Control group samples did not show immunoreactivity in HER2 protein expression, and do not have a defined macroscopic appearance according to Borrmann. Statistical analysis of HER2 protein expression according to the macroscopic appearance of gastric carcinoma according to Borrmann performed using the chi-square test does not show a statistically significant relationship between these two variables ($\chi^2=66.267$; statistically significant relationship is if $p<0.05$), analysis using the one sample T-test does not show a statistically significant difference ($t=3.080$; the difference is not statistically significant if $p>0.05$), and analysis using the Pearson correlation test shows a positive correlation that is not statistically significant ($r=0.069$) between these two examined parameters.

The frequencies of HER2 protein expression in published studies vary enormously from 8% to 91%. One of the first studies on this topic was performed in 2000 when Allgayer et al. examining the frequency of HER2 protein expression in gastric carcinoma obtained an extremely high expression of 91%. However, both in this and other studies originally conducted on this topic, tumor heterogeneity was neglected, which is extremely pronounced in gastric cancer compared to breast cancer (4.80%:1.40%), and the malignant cell scoring system used was for breast cancer. These data can be taken as the reason for such a high percentage of HER2-positive gastric cancers (Heike et al, 2010).

Newer studies conducted after the pre-ToGa and large multicenter ToGa studies took into account the heterogeneity of gastric cancer, as well as a modified tumor cell scoring system adapted for gastric cancer. In our study, these two parameters were also taken into account and we obtained 11.67% of HER2-positive cancers, which is similar and different from the findings of previous studies: the large multicenter ToGa (Trastuzumab for GAstic Cancer) study in which there were 22.10%, the results of the Chinese study conducted by Guan Zhen Yu et al. who had overexpression of HER2 protein in 28% of the primary gastric adenocarcinomas examined, as well as the results of the largest, most recent, study conducted to date on 924 patients in which 7% of the cancers were HER2 positive (Guan et al, 2009).

In our study, a negligible positive correlation without statistical significance of HER2 protein expression was demonstrated by univariate statistical method in the macroscopic appearance of the cancer (Siewert et al, 1998).

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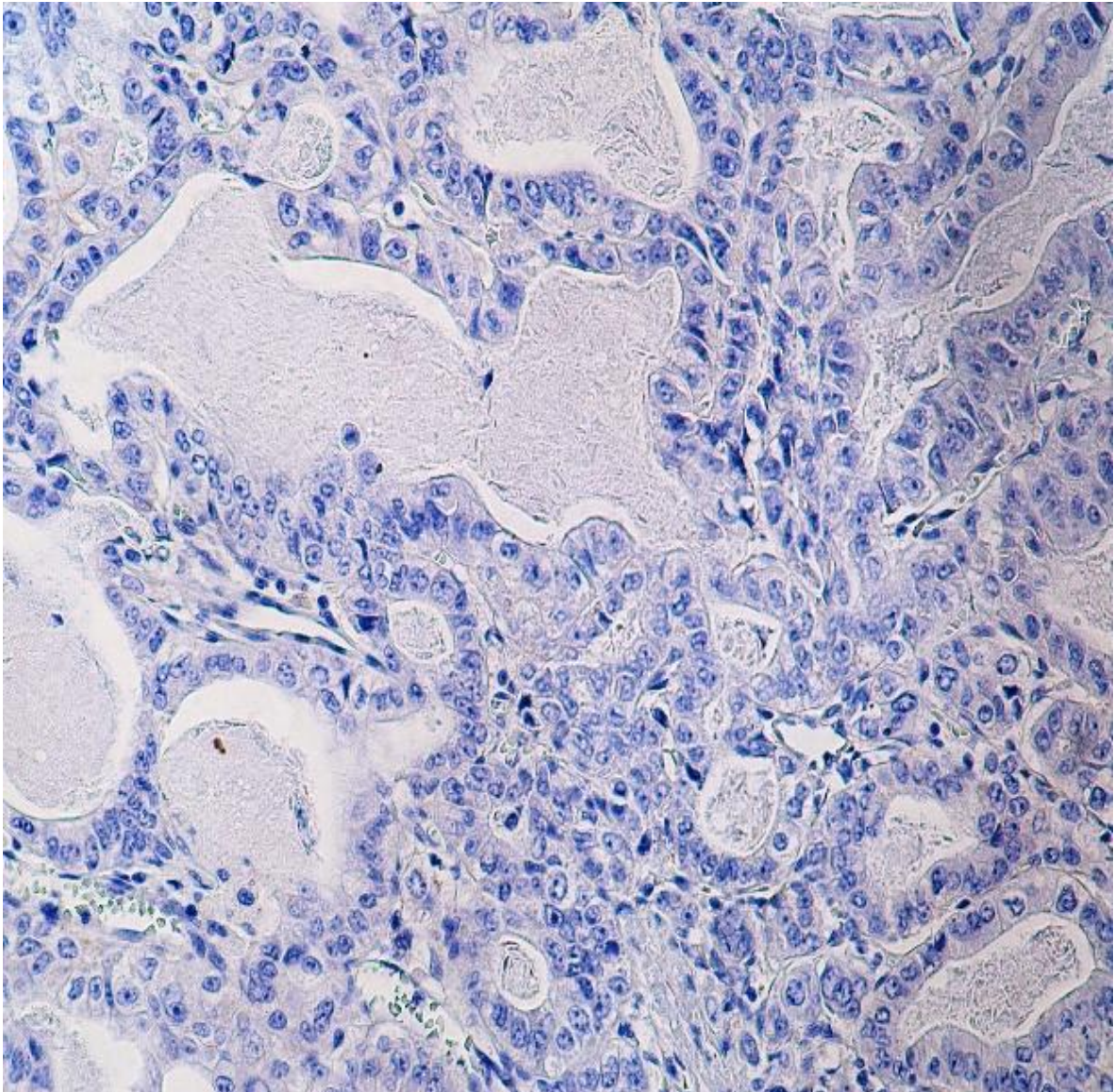


Figure 1: The negative reactivity of the HER2 protein (0) (40x)

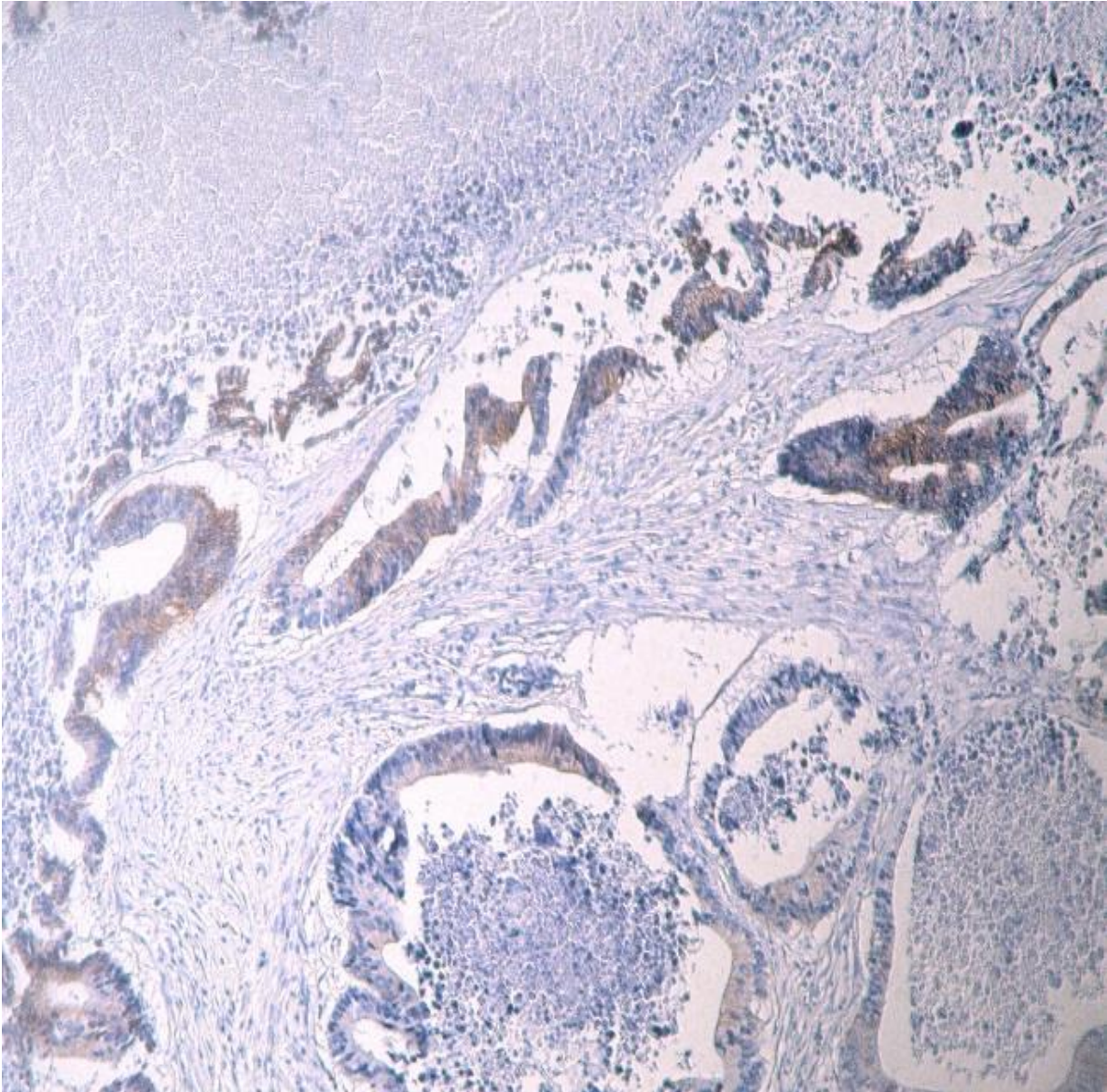


Figure 2: Light HER2 expression (+) (40x)

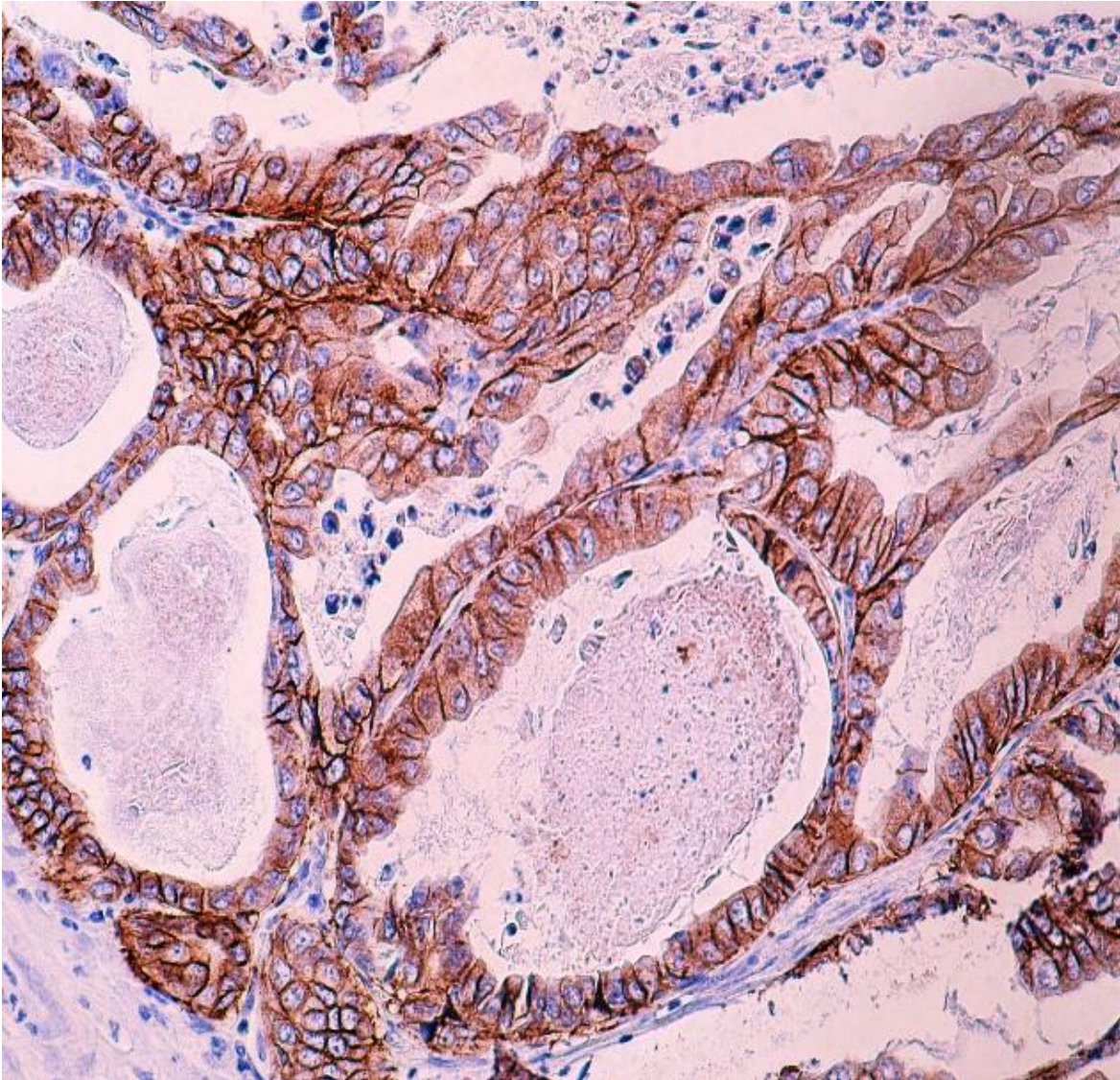


Figure 3: Ambiguous HER2 positivity (++) (40x)

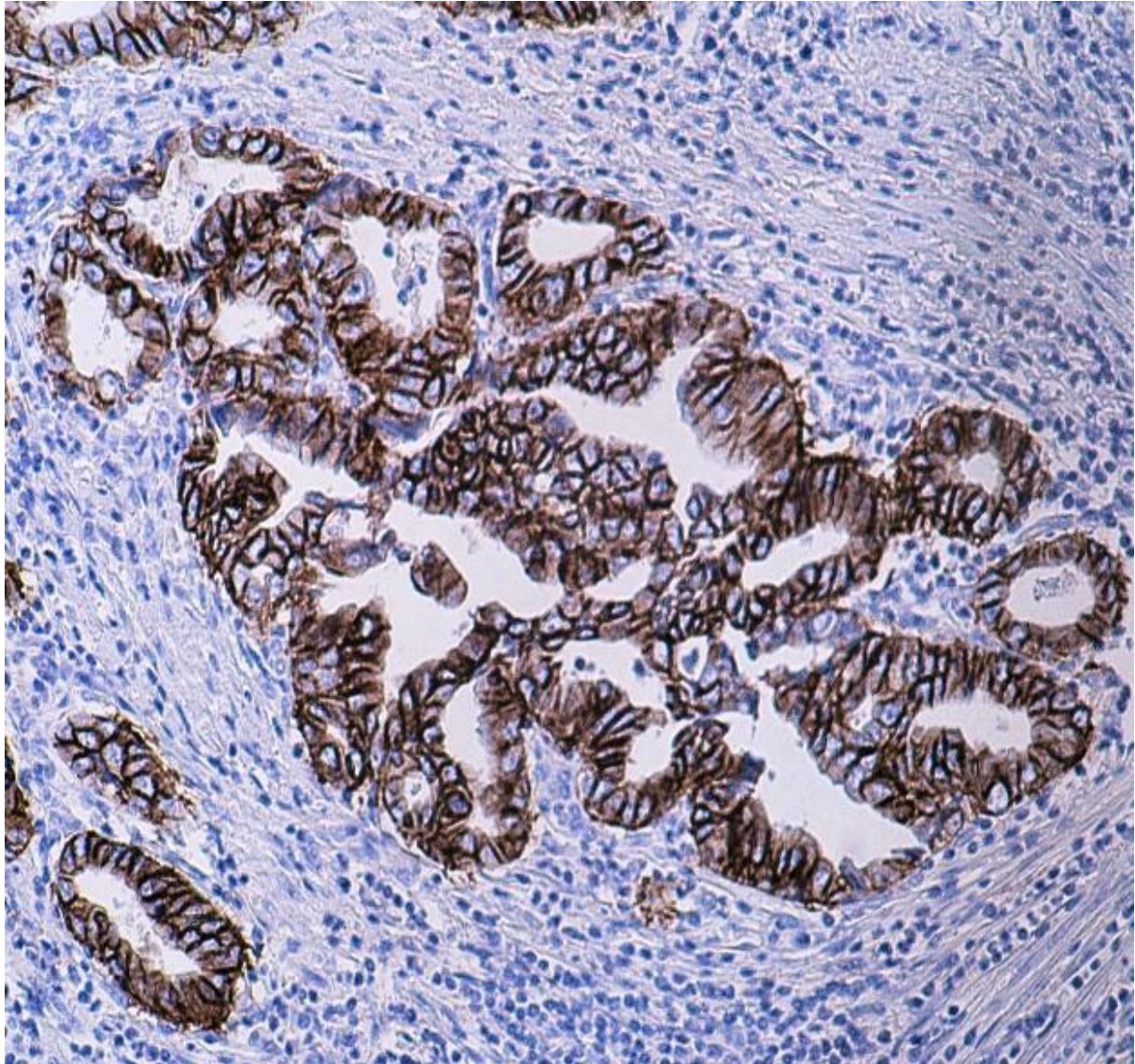


Figure 4: A strong expression of HER2 protein or hyperreactivity in the expression of HER2 protein (40x)

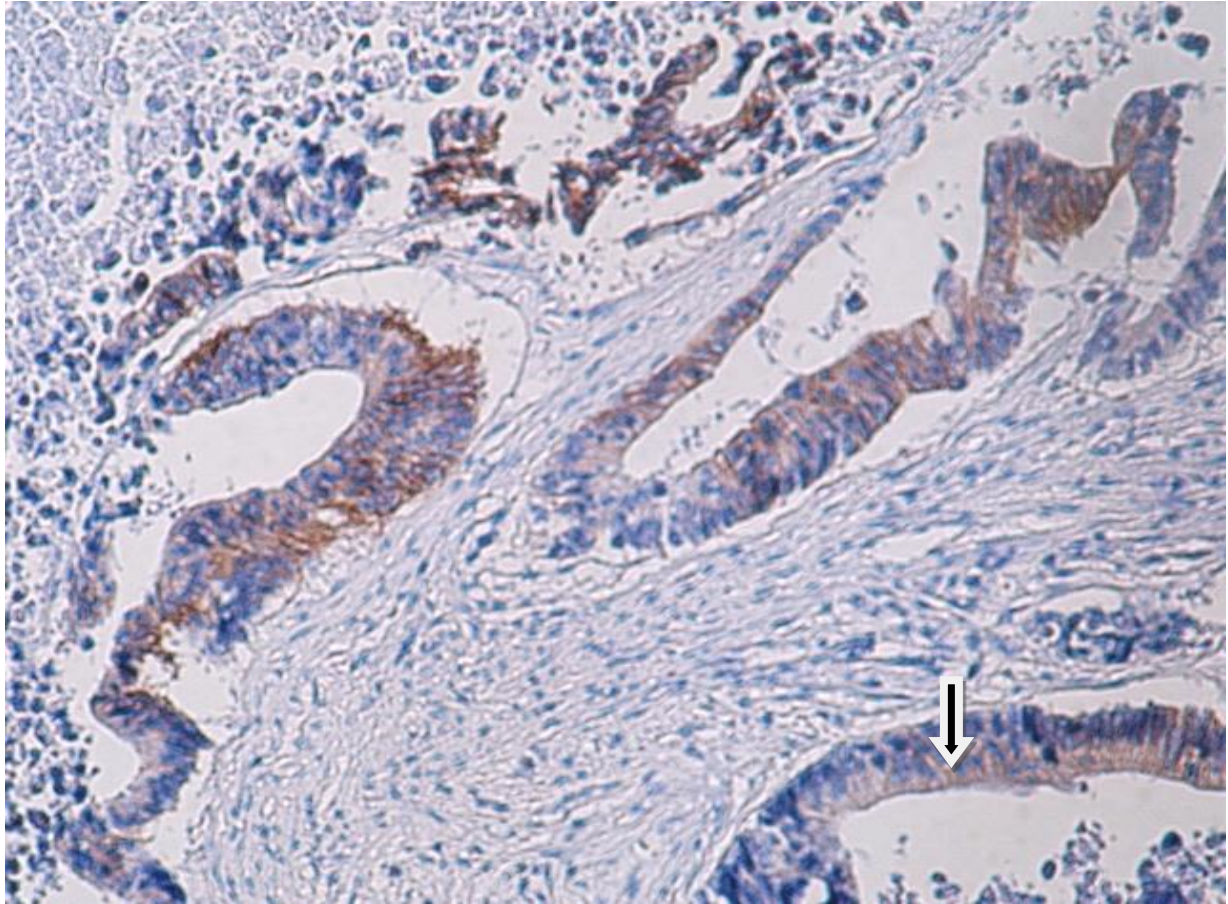


Figure 5: Apical membrane activity in HER2 protein expression (40x)

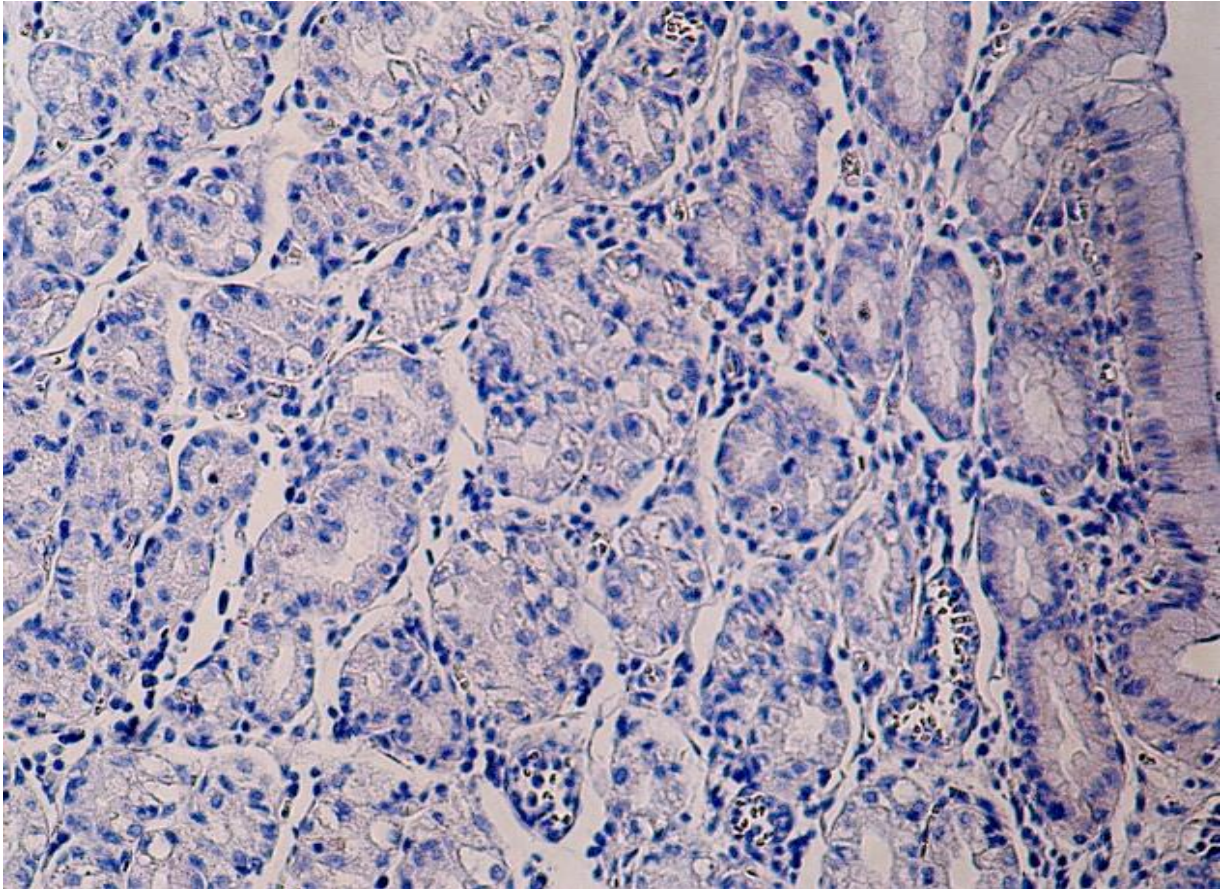


Figure 6: Negative expression of HER2 protein in control samples (40x)