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Evaluation of developmental risk factors in early childhood among children diagnosed with down syndrome: A comprehensive analysis

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Introduction

Down syndrome is the most common cause of developmental problems in the cognitive domain worldwide and the most common chromosome disorder among live-born babies [1]. The syndrome is a common chromosomal abnormality seen in 15 out of every 10,000 live births in the United States (US), and approximately 6000 children are diagnosed with Down Syndrome each year [2,3]. The family of an infant with Down syndrome may not realize or share that their child may have cognitive, language, and movement problems throughout the child's life. Children diagnosed with Down syndrome are at risk in physical, developmental, behavioral, and emotional areas. They are defined as children who require more health care than their healthy peers and have special needs [4]. As mortality rates in these children decrease and survival increases compared to the past, the need for access to health services due to accompanying health problems is noteworthy [5].

The need for health policies to consider the psychosocial and socioeconomic effects of the diagnosis of Down Syndrome on children and families has been becoming increasingly essential. Despite the vast knowledge available about the health problems of children with Down Syndrome, there are not ample studies on the effects of this syndrome on families and the access of individuals diagnosed with Down Syndrome to the health services they need. The American Academy of Pediatrics has emphasized what to look for in the first month of life between the first month and one year old and between 1 and 5 years of age of babies diagnosed with Down Syndrome. These are hypotonia, congenital heart diseases, feeding problems, eye problems, especially cataracts, hearing loss, hematological problems, respiratory tract problems, gastrointestinal problems such as gastroesophageal reflux, constipation, medical risks such as congenital hypothyroidism and conditions with a high probability of occurrence, developmental status, behavioral problems, access to early support and intervention services, and the monitoring is recommended [6,7].

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Material and methods

In the first or control examinations of children who applied to Department of Pediatrics, Division of Developmental Pediatrics with a diagnosis of Down syndrome between 0-42 months or who were under follow-up, families were informed about the study, their verbal and written consent were taken. Families who gave consent were asked to read, understand and answer the questions in the GMCD (International Guide for Monitoring Child Development) in writing within the framework of the research protocol. Then, the researcher read the questions answered by the family in the g-guide and completed the anamnesis by asking the family about the missing or incomprehensible answers. Then, a "detailed developmental assessment" was conducted by the researcher. In the "detailed developmental assessment", the child-mother relationship, mother-father relationship, and child-specialist relationship were observed, free play observation was made, and the child's developmental characteristics were determined with the observations and the applied scales. A family-centered approach was used in the assessment within the framework of biopsychosocial theory.

The International Guide for Monitoring Child Development and Bayley Developmental Assessment Scales for Infants and Children-III (BSID-III) scales were used to evaluate the child's developmental characteristics. The "Medical and Psychosocial Risk Determination Form for Down Syndrome in Early Childhood" developed by the researcher was filled out from the hospital information management system, patient files/epicrisis, and the family's verbal and written responses. The children's physical examination was performed, and the findings were recorded in the file.

All evaluations of the patients were completed on the same day. The researcher performed the standard anthropometric evaluation and physical examination and recorded weight, height, head circumference and examination findings. If there was any missing information regarding health monitoring, it was recorded in the form by looking at the hospital information management system. The children's needs, necessary guidance, treatments, and, if necessary, special needs reports were prepared for the children.

Results

Between May 1st and July 1st, 2019, four out of forty children diagnosed with Down syndrome who were either first-time visitors or being monitored by the Developmental Pediatrics Department were excluded from the study due to treatment for accompanying acute illnesses. The median age of the 36 children with Down syndrome included in the study was 21 months (ranging from 2 to 42 months). Of these children, 5(13.9%) were between 0-12 months, 15(41.7%) were between 13-24 months, 13(36.1%) were between 25-36 months, and 3(8.3%) were 37 months or older. The ratio of boys to girls was 1.25.

Looking at the children's medical history, 18(50%) were born before 37 weeks, and 18(50%) were born at 37 weeks or later. Half of the sample consisted of children with a history of premature birth. Among the sample, 22 children (61.5%) experienced issues after birth due to respiratory problems, feeding difficulties, prematurity, and jaundice. When considering the timing of the Down syndrome diagnosis, 21 children (58.3%) were diagnosed prenatally, and 15(41.7%) were diagnosed within the first month after birth.

A concurrent medical condition or illness was present in 33(91.6%) of the patients being monitored for Down syndrome. The top three accompanying issues in the sample were cardiac problems in 24 patients, endocrine issues in 18 patients, and sleep problems in 13 patients.

All children in the sample underwent a detailed developmental assessment to determine their developmental status and identify their special needs. The developmental characteristics according to the "Development Monitoring and Support Guide" and the "Bayley Scales of Infant and Toddler Development-III" are presented in Table 1.

While the growth and vaccinations of all patients participating in the study were regularly monitored by a physician, only 7(19.4%) had their development, speech skills, and motor development followed.

Special education and rehabilitation opportunities

The youngest patient starting at a special education and rehabilitation center was 5 months old, and the oldest was 12 months old. Another patient could not attend special education due to accompanying medical issues. Among the patients who participated in our study, 26(72.2%) had at least one special need that was not met. A health board report, which is required to benefit from special education rehabilitation social rights and opportunities, was available for 32(88.9%) families. During the research period, 4 families were referred to the ÇÖZGER (Child Disability Health Board Report). One patient could not attend special education due to medical issues. The special education and rehabilitation opportunities for the patients are listed in Table 2.

The delays in families accessing special education and rehabilitation opportunities were due to insufficient financial resources, the inability to obtain a health board report, and symptoms of depression identified within the family. The depression status of the families was assessed using the PHQ2 scale. A cut-off score of ≥3 was used to identify individuals at risk for depression. According to this, 11 (30.5%) families reported depressive symptoms.

Risks affecting development in early childhood in down syndrome

The risks affecting development in early childhood in Down syndrome are presented in Table 3. Four patients with vision problems were using glasses due to refractive errors and strabismus, while two patients with hearing problems were using hearing aids due to hearing loss. Two patients with cardiac issues had undergone surgery for VSD (ventricular septal defect), and surgery was planned for another patient. Two patients with current cardiac issues were taking medication. Out of 18 patients with endocrine issues, 10 were taking medication for hypothyroidism. Five patients had hypothyroidism, while three others were being monitored in the endocrinology department due to existing risks. Of the seven patients with feeding problems, two had not even been given solid food due to the families' fear of choking, while the other five experienced vomiting and poor appetite due to reflux and motility disorders. Of the 13 patients with sleep problems, 3 had apnea. One of these three had recently undergone surgery for adenoid vegetation, another was being monitored in the ENT (Ear, Nose, and Throat) department and was receiving medication, and the third was referred to the ENT clinic by us. Half of the children with sleep problems were waking up frequently at night.

Psychosocial risks in families

When the families were questioned about psychosocial risks, half of them reported difficulty in meeting basic needs such as electricity, water, and shelter. When depression in parents was assessed using the PHQ2 scale, depression symptoms were found in 9 mothers, 5 fathers, and both parents in 3 families. In the 3 families where both parents exhibited depression symptoms, in addition to financial difficulties, the children had multiple chronic diseases accompanying Down syndrome that required continuous monitoring. When risks in the home environment were questioned, it was found that in one case where the mother had passed away, the grandmother was the caregiver but expressed that she could not adequately care for the child. In two families, there were siblings who required continuous care due to autism and type 1 diabetes mellitus. One family reported having conflicts at home, while another was in the process of divorce. Approximately half of the mothers who were caring for their children at home expressed that they did not receive support from other family members, especially from the father. Six families faced problems while obtaining the health board report. Two families could not obtain the report due to the "young age" of their children. Four other families objected to the report due to low disability percentages stated in the report and expressed that they could not receive adequate services due to "financial difficulties." One family, who felt stigmatized, had not shared the child's diagnosis with anyone for about two years since birth. Another family did not want to talk or meet with their close circle and relatives.

It was found that the father's education level was directly proportional to language-cognitive development scores. The BSID-III language and cognitive scores of the children of fathers who were university graduates were found to be statistically significantly higher ($p<0.05$). It was also found that children with nutritional deficiencies had statistically significantly lower BSID-III language and cognitive scores ($p<0.05$).

Table 1: Developmental characteristics (n=36).

Results of the developmental assessment conducted with GMCD		
	n	**%**
Delay in at least one area	36	100
Delay in the gross motor skills	36	100
Delay in the language of expression	35	97,2
Delay in the fine motor skills	35	97,2
Delay in the area of relationship-building and communication	31	86,1
Delay in receptive language	28	77,8
Delay in the area of play	27	75
Developmental assessment results obtained using BSID-III**		
Language composite score (median)	61 (min:42-max:81)	
Cognitive composite score (median)	58 (min:48-max:83)	
Motor composite score (median)	53 (min:41-max:76)	

Table 2: Special education and rehabilitation services.

Special education and rehabilitation resources	**n**	**%**
Special education	31	86,1
Physical therapy and rehabilitation	31	86,1
Speech and language therapy	5	13,9
Occupational therapy	2	5,6

Table 3: Medical and psychosocial risks (N=36).

Medical risks	**N**	**%**
Cardiological disorders	24	66,7
Gender (male)	20	55,6
Endocrine disorders	18	50,0
Perinatal disorders (prematurity, low birth weight)	18	50,0
Nutrition deficiency (body weight below the 5th percentile according to Down syndrome growth curves)	17	47,2
Sleep problems (difficulty falling asleep, frequent waking, apnea, etc.)	13	36,1
Visual problems(refraction problems, strabismus, reduced vision, etc.)	9	25,0
Feeding issues (difficulty eating solid foods, etc.)	7	19,4
Hearing disorders (hearing loss)	2	5,6
Psychosocial risk factors		
Insufficient financial situation of the family (difficulty meeting basic needs such as food, water, clothing, electricity, and housing; financial hardship)	18	50,0
Home environment risks (presence of at least one) Disagreements, divorce Domestic violence Presence of a person requiring continuous care within the family Family members living separately due to their jobs Physical difficulties of the caregiver Difficulty in acquiring toys	10	27,8
Depressive symptoms in the mother PHQ2 (≥3)	9	25,0
Siblings' issues (health problems, very young age, step-siblings, etc.)	7	19,5
Inability to obtain a health board report or encountering issues during the process	6	16,7
Depressive symptoms in the father PHQ2 (≥3)	5	13,9
Family feeling stigmatized	3	8,3

Table 4: Data obtained from the Mann-Whitney U test analysis of developmentally affecting risks.

Risk variables	n	BSID-III Cognitive	p	BSID-III Speech	p	BSID-III Motor	p
Gender							
Male	20	58,75±6,2	>0,05	59,55±6,5	>0,05	53,60±6,1	>0,05
Female	16	62,81±9,9		61,19±11,1		55,81±10,6	
Mother's education level							
High school and below	24	58,71±7,4	>0,05	58,75±8,1	>0,05	53,50±7,6	>0,05
University	12	64,25±8,8		63,33±9,4		56,75±9,7	
Father education Level							
High school and below	20	56,80±5,8	**0,002***	57,10±7,5	**0,028***	52,15±6,8	>0,05
University	16	65,25±8,4		64,25±8,7		57,63±9,3	
Age							
24months and under	20	63,55±9,0	**0,009***	63,45±9,7	**0,007***	56,55±8,9	>0,05
25months and above	16	56,81±5,2		56,31±5,2		52,12±7,2	
Preterm birth							
Less than 37 weeks	18	60,22±8,8	>0,05	60,22±8,7	>0,05	54,94±8,0	>0,05
Full Term	18	60,89±7,7		60,33±9,0		54,22±8,9	
Hypothyroidism							
Present	18	59,61±8,0	>0,05	60,11±8,9	>0,05	54,11±7,7	>0,05
absent	18	61,50±8,5		60,44±8,8		55,06±9,2	
Cardiological disorder							
present	24	62,12±8,6	>0,05	61,75±8,6	>0,05	56,29±8,4	**0,045***
absent	12	57,42±6,5		57,33±8,4		51,17±7,5	

Discussion

In our study, children with Down syndrome who applied to the Department of Pediatrics, Division of Developmental Pediatrics were evaluated with the International Guide for Monitoring Child Development, a comprehensive tool designed to assess the developmental progress of children with special needs and that focuses on the early detection of developmental delays, and the Bayley-III scales, a widely used measure of infant and toddler development. These tools, along with family-centered, strength-based detailed developmental assessment methods, were used to evaluate the sociodemographic characteristics of children monitored with the diagnosis of Down Syndrome, the family's anxiety about their child's development, the child's developmental characteristics, environmental factors that may affect the child, the child's access to protective and supportive services related to his/her health and medical and psychosocial risks. The effects of medical and psychosocial risks on development were determined. In this study, the developmental status and biopsychosocial risks of 36 children aged 0-42 months who were followed up with the diagnosis of Down syndrome and who applied xxx University, Department of Pediatrics, Division of Developmental Pediatrics, for developmental evaluation and follow-up were evaluated. Male gender, perinatal problems, malnutrition, vision problems, cardiological problems, hearing problems, endocrine problems, eating problems, sleep problems, insufficient financial situation of the family, risks in the home environment such as domestic violence, presence of depressive symptoms in the mother and father, sibling problems, difficulty in obtaining a report, the family feeling stigmatized, and the fathers' educational status were determined as biopsychosocial risks. Among these risk factors is the fathers' education level is university or above. The children older than 24 months were found to be significant in the delay detected in language-cognitive development. In contrast, it was found that developmental delays in the movement area of children who underwent surgery for cardiovascular reasons were associated with this. Malnutrition was statistically significantly associated with the developmental delays detected in cognitive and movement areas.

Important findings were obtained regarding environmental factors such as preventive health services, dental health monitoring not being provided to any patient, delay in accessing special education and rehabilitation services that should be started early, presence of depressive symptoms in the mother and father, and the family feeling stigmatized. Although the sample group was small, the determination of a relationship with modifiable or monitorable risks provided important results in terms of determining the points to be considered in the health and education system in the early childhood of children monitored with the diagnosis of Down syndrome.

The mean age of the 36 children in the sample was 24±14.9 months. In our study, the ratio of boys to girls was found to be 1.25. Kava et al. (2004) reported this ratio as 1.37 in India, and Karlsson et al. [8] reported it as 1.02 in Switzerland [9]. In Turkey, Akkuş et al. [10] found this ratio as 1.24 in their study with 220 children diagnosed with Down syndrome; Dinçer found it as 1.43 [11]. This ratio, which shows the prevalence of Down syndrome between the genders reported in the world and in our country, is similar in our study. There were 24 children with Congenital Heart Disease (CHD) in the sample (66.7%). In the study conducted in Italy, CHD was 43.9% in 230 children with Down syndrome [12]. In the study conducted by Dinçer [11] in our country, it was evaluated as 61%. The CHD rate determined in the study was found to be close to our country's data.

Premature babies may encounter problems at different levels in language-cognitive, social-emotional, relationship-building, communication and motor development [13-15]. In our study, the number of cases born prematurely was 18 (50%). Due to the rapid brain development in early childhood, it is recommended that the development of high-risk premature babies be supported with appropriate stimuli and that inappropriate stimuli be removed from the environment [13-15]. Studies have shown that adverse outcomes such as delays in receptive and expressive language and behavioral problems can be prevented in the long term by supporting the mother-infant relationship with appropriate stimuli [16,17]. When the families of 36 children in our sample were asked questions about developmental follow-ups in preventive health services, they stated that their growth was not monitored sufficiently, that they were not given enough nutrition information, and that their child's learning, understanding, and speech were not monitored. A study conducted in the United States on children aged 4-36 months determined that when the status of meeting protective and developmental needs was questioned, parental education and biopsychosocial risks were identified and met in 94% [18]. The American Academy of Pediatrics (AAP) emphasizes that children with developmental delays should be monitored regularly and frequently in primary health care [19]. As compliance with the follow-up guide created by the AAP for children with a diagnosis of Down syndrome is good, follow-up and monitoring rates have increased over the years [20].

Unmet special needs in the sample

In the sample, 26 children (72.2%) had at least one unmet special need. A study conducted in the United States found that approximately one-third of children with special needs do not have their needs adequately met [21]. The rate found in our study is higher.

The research found a statistically significant relationship between the medical and psychosocial risks, including the child's age, father's educational level, nutritional deficiencies, and the presence of accompanying diseases, such as cardiac conditions, and the scores obtained from standard scales used to evaluate the children's development. A study conducted with preterm infants aged 18-21 months in the United States found that the education level of caregivers significantly impacted the language and cognitive development of babies, as measured by the Bayley-III scale [22]. In our study, it was found that the cognitive and language scores, measured by the Bayley-III scale, of children with Down syndrome who were monitored by university-educated fathers were statistically significantly higher. The most important reason for this significant difference is that the fathers, understanding the importance of monitoring Down syndrome, ensure early intervention without delay, are well-informed about their child's needs, and have better job opportunities, which reduces unmet needs related to poverty.

Although low maternal education levels have been identified as a risk factor for child development in many studies worldwide and in our country, our study did not find a statistically significant difference between developmental delays and maternal education level [23-25]. It is believed that as the sample size increases, maternal education level will become a more prominent risk factor.

In our study, 17 children (47.2%) were at or below 80% of the weight-for-height standard. Additionally, their body weights were found to be below the 5th percentile on Down syndrome growth curves. A study conducted on 576 infants in Spain indicated that chronic malnutrition significantly impacts language and motor development [26]. Another study emphasized that malnutrition in children negatively affects learning and cognitive processes [27]. In our study, 17 children (47.2%) were below the 5th percentile in weight, and these children's cognitive and motor scores on the BSID-III were found to be statistically significantly lower. In addition to the presence of accompanying problems, this finding highlights the need to emphasize the adequate support of nutrition and growth monitoring in these children with special needs.

Another important finding in our study was that as age increased, children's cognitive and language composite scores decreased. This is believed to be the result of increased unmet needs, delays in attending or being referred to early intervention programs, stigmatization, fragile family structures, and financial insufficiencies.

Sleep disorders, such as difficulty initiating and maintaining sleep and sleep apnea, are much more common in children with Down syndrome than in the general pediatric population. Sleep disorders in children can lead to medical conditions such as daytime behavior problems, learning difficulties, and slowed growth. A study reported that 65% of young children with Down syndrome had difficulty initiating or maintaining sleep and obstructive sleep apnea [28]. In our study, despite 13 patients (36%) having sleep disorders, it is believed that this rate will increase as these children age, as their sleep disorders have not been treated.

Maternal depression and developmental delay

Maternal depression can cause developmental delays in infants. A multi-center study conducted on children under 56 months of age using the BSID-II scale found that children of mothers with depression had lower MDI scores, which provide clues about cognitive development. The same study also emphasized the importance of supporting the mental health of the mother, in addition to the family's socioeconomic status, in early childhood development [29].

The concept of stigma, first introduced by Goffman, refers to a person who is perceived as different from those accepted by society and treated differently. Families may avoid taking their child to services due to not accepting the illness or service, hiding the illness from others due to fear of stigmatization, or not obtaining a report or taking the child to services. In our study, the issue of stigmatization was addressed in the environmental factors section of the GMCD (International Guide for Monitoring Child Development), which included open-ended questions about the family's experience of stigmatization and how they coped with it. These questions were: "There may be prejudiced attitudes from others regarding your child's condition. These negative attitudes can affect your child's condition and treatment, hurt the family, and limit or complicate the family's experiences. If such a situation exists, please explain it in writing." and "If you mentioned difficulties in the first question, how have you coped with these difficulties so far? What do you plan to do in the future?" These two stigma-related questions were used to inquire about the families' experiences with stigmatization. In our study, three families (8.3%) spoke in a manner that supported the stigma process. A study conducted by Ahmed KJ and colleagues [30] in Pakistan investigated the stigma process in the parents of children with Down syndrome and found that fathers often labeled their children as "Mongol" based on soci-

etal learning.

This study, grounded in the bioecological theory, has several strengths, including the comprehensive evaluation of the development of the children in the sample, the use of internationally standardized and validated developmental assessment tools, and the identification of unmet needs and appropriate referrals.

Study limitations

The limitation of this study is that the small sample size restricts the ability to compare the results with the rates reported in the literature. Increasing the number of patients monitored using the identified method is important. The fact that the patients were all from a single center and that most lived in xxx and had access to the city's resources makes it difficult to generalize the study's findings. Due to the small sample size in our study, it was not possible to identify which risks were most strongly associated with development.

In conclusion, it is believed that when the risk assessment form developed in this study is combined with Down syndrome monitoring forms and standard developmental assessment methods, it will enable ICF-based and family-centered assessment and monitoring of children with Down syndrome and their families.

Conclusions

This study concludes that health, participation in life, access to early support opportunities, and provision of necessary support for children and their families diagnosed with Down Syndrome are not sufficient. It underscores the importance of early detection of risks, as medical and psychosocial risks are related to their development. The study advocates for the determination of developmental risks and the creation of a follow-up plan accordingly. The development of children should be evaluated within the framework of biopsychosocial theory with family-centered, ICF-based and standard scales, and early support initiatives should be started at an early age. The risk assessment form developed in this study will allow the family physician and pediatrician to optimally monitor children born with Down Syndrome by determining their possible risks at a very early stage with all their health and psychosocial aspects. Increasing the number of patients in the sample will allow analytical tests to be performed to determine which of the identified risks affect development the most. Another suggestion would include children and their families in the assessment regarding participation in life, activity, and functionality. The developmental follow-up of children diagnosed with Down syndrome varies greatly from healthy babies. Considering that Down syndrome is the most common genetic disease and early intervention training is essential, physicians are expected to have special equipment to monitor children adequately. The developmental follow-up of children diagnosed with Down syndrome, which is of particular importance in terms of medical and psychosocial risks, should be family centered.

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