

## Developmental delay assessment in children < 5 years of age attended in the Pediatric Rehabilitation Service of a reference hospital in Peru

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### Abstract

**Background:** Child development is a complex biological, psychological, and emotional process. Timely screening for developmental delay allows early interventions. Therefore, this study sought to assess the frequency and characteristics of developmental delay in children < 5 years of age who attended the Pediatric Rehabilitation Service of a referral hospital in Peru. **Methods:** We conducted a cross-sectional study. Information was collected from medical records of children < 5 years of age who attended between April and September 2022 at the Rebagliati Hospital's Pediatric Rehabilitation Service. The REBA-PED Child Developmental Assessment Profile was used for the developmental assessment, which allows to identify the degree of delay in each area (gross motor, fine motor, hearing and language, intelligence and learning, and personal-social) and the presence of warning signs. **Results:** Of 226 children who attended the service, 49.1% were between 3 and 5 years old, 57.1% were female, only 3.1% were referred for suspected developmental delay, and none had had a previous developmental assessment. Among the children evaluated, 12.4% had a simple developmental delay, 19.5% had a significant developmental delay, and 53.5% had a global developmental delay. In addition, 70.8% presented a warning sign of developmental delay. Hearing and language (86.8%) and intelligence and learning (83.5%) areas had a higher frequency of significant developmental delay. **Conclusions:** We found a high frequency of developmental delay in the children assessed, predominantly in hearing and language. Although all the children were referred, none had had a previous developmental assessment.

**Keywords:** Child Development. Developmental disabilities. Rehabilitation. Pediatrics. Peru.

### Evaluación del retraso del desarrollo en niños < 5 años atendidos en el Servicio de Rehabilitación Pediátrica de un hospital de referencia en Perú

### Resumen

**Introducción:** El desarrollo infantil es un proceso complejo de cambios biológicos, psicológicos y emocionales. El despistaje oportuno del retraso del desarrollo permite implementar intervenciones tempranas. Este estudio buscó evaluar la frecuencia

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y las características del retraso del desarrollo en niños < 5 años atendidos en el Servicio de Rehabilitación Pediátrica de un hospital de referencia de Perú. **Métodos:** Se llevó a cabo un estudio transversal en el que se recolectó información de niños < 5 años atendidos entre abril y septiembre del 2022 en el Servicio de Rehabilitación Pediátrica del Hospital Rebagliati, para lo cual se revisaron sus historias clínicas. Para la evaluación del desarrollo, se utilizó el Perfil de Evaluación del Desarrollo Infantil REBA-PED, que permite reconocer el grado de retraso por área (motora gruesa, motora fina, audición y lenguaje, inteligencia y aprendizaje, y personal social) y los signos de alarma. **Resultados:** De 226 niños atendidos, el 49.1% tenía entre 3 a 5 años, el 57.1% era de sexo femenino, solo el 3.1% fue remitido por sospecha de retraso del desarrollo y ninguno había tenido una evaluación previa del desarrollo infantil. Entre los niños evaluados, el 12.4% presentó un retraso simple del desarrollo, el 19.5% presentó un retraso significativo y el 53.5%, un retraso global. Además, el 70.8% presentó algún signo de alarma durante el desarrollo infantil. La frecuencia de retraso significativo fue mayor en las áreas de audición y lenguaje (86.8%) y de inteligencia y aprendizaje (83.5%) tuvieron mayor frecuencia de retraso significativo. **Conclusiones:** Se encontró una frecuencia elevada de retraso del desarrollo entre los niños evaluados, con predominio del área de audición y lenguaje. Si bien todos los niños fueron referidos, ninguno había tenido una evaluación previa del desarrollo.

**Palabras clave:** Desarrollo infantil. Discapacidades del desarrollo. Rehabilitación. Pediatría. Perú.

## Introduction

Child development, also called psychomotor development or neurodevelopment, is a complex process of biological, psychological, and emotional changes resulting from the interaction between genetic and environmental factors<sup>1,2</sup>. The sequence of child development is usually presented in the form of milestones<sup>1</sup>. Several screening instruments have been adapted for each country to facilitate the assessment of these milestones in children under five years of age, and are used systematically at key moments of child development<sup>3</sup>.

The American Academy of Pediatrics recommends universal child development screening through standardized tests (at 9, 18, and 30 months of corrected age), paying particular attention to four and five-year-old children before entering school<sup>4</sup>. Timely screening for developmental delay allows early interventions so that children can adequately develop their potential<sup>5</sup>; however, the regular use of screening instruments is often low and less frequent in vulnerable populations and areas with high poverty rates<sup>6,7</sup>.

In Peru, since 2011, a national health strategy of the Ministry of Health (MINSA) called *Norma Técnica de Salud para el Control de Crecimiento y Desarrollo (CRED) de la Niña y el Niño Menor de Cinco Años* (Technical Health Standard for the Control of Growth and Development of Children under Five Years of Age) has been implemented<sup>8</sup>. However, in 2016, nine impoverished departments in Peru reported inadequate CRED care due to limitations in infrastructure, equipment, materials, management and organizational capacities at the local level, and human resources<sup>9</sup>.

A study conducted in 2012 at the National Institute of Rehabilitation (Lima, Peru) reported that the two most

frequent diagnoses in children < 8 years of age were specific developmental motor function (17.5%; n = 400) and specific mixed developmental (15%; n = 400) disorders. However, milestones or areas of child development were not evaluated, but subjectively assessed the presence of deficits in any function<sup>10</sup>. Similarly, in 2017, Díaz et al. evaluated the influence of sociodemographic factors on motor and language development in children < 5 years of age in Peru, and reported that those who lived in rural areas or who were children of mothers with low schooling or belonged to households with unsatisfied basic needs showed lower values in the two evaluated areas of child development<sup>11</sup>.

Unfortunately, these studies did not use an instrument with validity in the Peruvian population and did not evaluate all areas of child development. In addition, few studies in our country have evaluated in depth the characteristics of children who receive care in rehabilitation services, which is essential to understand the needs of rehabilitation teams and to adopt improvement proposals. Therefore, we conducted the present study to evaluate the frequency and characteristics of developmental delay in children < 5 years of age seen at the Pediatric Rehabilitation Service of Edgardo Rebagliati Martins National Hospital (PRS-ERMNH) in Lima, Peru.

## Methods

### Study design and population

We conducted an analytical cross-sectional study based on information from the medical records of all children < 5 years of age seen at the PRS-ERMNH between April 1 and September 30, 2022. We included those children who did not receive previous care from

a physiatrist and excluded those children whose medical records did not present all the variables of interest.

## Context

Peru is a country with a shortage of specialized human resources in health (physiatrists, physical therapists, occupational therapists, speech therapists, and psychologists, among others)<sup>12</sup> in which there are several health systems, with the largest being the Ministry of Health and the Social Health Insurance (*Seguro Social de Salud, EsSalud*).

The ERMNH is one of the most important *EsSalud* national referral centers due to its high specialization and resolution capacity<sup>13</sup>. It should be noted that all PRS-ERMNH patients were referred from a less complex *EsSalud* health care center (outside Lima or the Rebagliati Health Care Network) or by inter-consultation with another ERMNH service. At the PRS-ERMNH, during the medical consultation (face-to-face or virtual), all children < 5 years of age undergo a child development evaluation.

## Procedures

After ethics committee approval, we requested from PRS-ERMNH the list of all children under five years of age who were evaluated for the first time through a medical consultation (face-to-face or virtual) between April and September 2022. Subsequently, we reviewed each electronic medical record to extract the data of interest to a database in Microsoft Excel.

## Evaluation of child development

Child development was evaluated by PRS-ERMNH physiatrists using the Rebagliati Hospital Child Development Assessment Profile (REBA-PED) ([Annex 1](#)).

The REBA-PED is a child development screening test, developed and revised by experts in the PRS-ERMNH in 2020. This test is based on an analysis of the instruments used in various countries and has the Peruvian Child Development Assessment Test as its conceptual foundation<sup>14</sup>.

The REBA-PED was developed through an exhaustive review of seven tests currently used in various countries of the region. Regular meetings were held to select the developmental milestones for each age group, and three important characteristics were considered: ease of use, evaluation based on direct

observation or on what parents reported, and objectivity to detect simple, global, or organic delays<sup>14</sup>.

A pilot study was conducted with two groups of physiatrists who evaluated 100 children to test the reliability of the REBA-PED. In both groups, one person administered the test, and the other observed and scored independently. Inter-rater agreement was found to be high in both groups, with a Kappa of 0.82 in the ERMNH group and 0.84 in the group from the other institution. In addition, the application of the instrument was quick, lasting 5-10 minutes<sup>14</sup>.

The REBA-PED assesses five areas of child development (gross motor, fine motor, hearing and language, intelligence and learning, and personal-social), showing the degree of delay for each area and the warning signs in child development<sup>14</sup>.

The gross motor area assesses movement involving the larger muscle groups. The development of movements occurs in a cephalo-caudal pathway, from proximal to distal, which requires the inhibition of primitive neurological reflexes, and the emergence of others. The fine motor area assesses the control of the hand, fingers, and thumb; its development is highly dependent on adequate vision<sup>15</sup>.

The area of hearing and language assesses the development of verbal (expressive language, comprehensive language, articulation, and prosody) and non-verbal communication. Communication development is highly dependent on adequate hearing. The area of intelligence and learning assesses thinking, reasoning, and problem-solving skills. This area involves other areas such as fine motor or hearing and language<sup>15</sup>.

The personal-social area assesses the development of independence in a practical sense, personality development, and awareness of separation from others. This area includes feeding, toileting, and dressing abilities, and also the acquisition of social skills that evolve into meaningful relationships<sup>15</sup>.

The REBA-PED was applied through an interview with the person responsible for the child during the medical consultation (face-to-face or virtual). Delay  $\geq 25\%$  (equivalent to 2 standard deviations in similar instruments) was considered a significant developmental delay in any area<sup>16</sup>. We consider global developmental delay<sup>16,17</sup>. Delay  $\geq 25\%$  in two or more areas was considered as a simple developmental delay was considered as a delay  $> 0\%$  but  $< 25\%$  in one or more areas.

Warning signs in child development represent a significant chronological delay in the onset of

developmental milestones, and also findings of the persistence of patterns that should have disappeared by a particular age<sup>18</sup>.

Intervention for developmental delay was deemed necessary when there was a significant delay, global delay, or any warning sign.

### Other variables

Sociodemographic variables such as age (1 to 11 months, 12 to 35 months, 36 to 60 months), sex (male and female), and origin (Lima and other departments) were collected. Clinical variables were also collected, including cause of attendance at the PRS-ERMNH, diagnosis of low weight or short stature, diagnosis of anemia, behavioral problems, associated disease or condition, history, and classification of prematurity (non-premature [gestational age  $\geq$  37 weeks], extreme or very extreme [ $<$  32 weeks], moderate [32 weeks to 33 weeks with 6 days], and late prematurity [34 weeks to 36 weeks with 6 days]), and prior child development assessments recorded in the electronic medical file (no or yes).

For this study, a behavioral problem was defined as a "behavior of the patient with negative repercussions for him/her (affective) and the environment in which he/she lives (family, school, work, neighbors) for breaking the rules of coexistence"<sup>19</sup>.

### Statistical analysis

We imported the collected data into R software version 4.1.0 (R Foundation for Statistical Computing, Vienna, Austria), for conducting all analyses and graphs. Numerical variables presented a non-normal distribution; consequently, we used medians and interquartile ranges (IQR). Categorical variables were presented with absolute and relative frequencies. We evaluated the association between categorical variables using the  $\chi^2$  test or Fisher's exact test (according to the expected values) for bivariate analysis. We considered p values  $< 0.05$  as statistically significant.

### Ethical aspects

The present study was approved by the Institutional Research Ethics Committee of the ERMNH (N°61-GRPR-ESSALUD-2023). All the information collected remained absolutely confidential, and its use was exclusive for the study.

## Results

Between April and September 2022, we identified 226 children  $< 5$  years of age seen for the first time at the PRS-ERMNH: 120 by referral and 106 by inter-consultation. Of these children, seven had a suspected developmental delay as a reason for consultation, and the rest had genetic diseases (20.8%), neurological diseases (15.0%), musculoskeletal disorders (10.6%), autism spectrum disorder (5.3%) and other diseases (10.6%) (Table 1).

Of these patients, 49.1% were 3-5 years old, 57.1% were female, 85.4% were from Lima, and 81% were born at term. At the time of the first evaluation, 18.6% were underweight, 13.3% were short, and 11.5% were anemic. None had had a previous child development evaluation recorded in the electronic medical file (Table 1).

According to the child developmental assessment through the REBA-PED, we identified 12.4% of the children with simple developmental delays, 19.5% with significant developmental delays, and 53.5% with global developmental delays. Moreover, 70.8% of the children showed some warning signs. On this basis, we identified that 78.8% of the children needed intervention for developmental delay (Table 1).

We found that more than half of the children evaluated (54.4%) presented significant delay in the area of hearing and language, followed by gross motor (49.1%) and intelligence and learning (45.6%) (Table 2). The medians and distributions of the results in each area are shown in a raincloud diagram (Figure 1).

We found a significant correlation of child development among all areas. The strongest correlation ( $\rho = 0.82$ ) was found between the fine motor and the intelligence and learning areas, and the weakest ( $\rho = 0.49$ ) between the gross motor and the hearing and language areas (Figure 2).

Furthermore, we compared the frequencies of significant delay ( $\geq 25\%$ ) in certain subgroups of interest. We found that the frequency of significant delay in any area, except gross motor, was higher in children  $> 12$  months ( $p < 0.002$ ) and in those who presented behavioral problems ( $p < 0.001$ ). The frequency of significant delay in gross motor was higher in females ( $p = 0.025$ ). The frequency of significant delay in gross motor, hearing and language, and personal-social areas was higher in patients with no history of prematurity. Finally, the frequency of significant delay in any area was higher



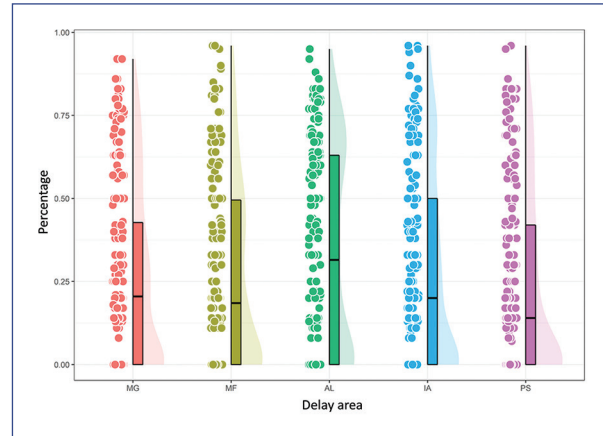
**Table 1.** Characteristics of patients seen for the first time in Pediatric Rehabilitation, (n = 226)

Characteristic	n (%)
Age (months) <sup>a</sup>	35.0 (16.3-47.0)
Groups of age	
1 to 11 months	47 (20.8)
12 a 35 months	68 (30.1)
36 a 60 months	111 (49.1)
Female sex	129 (57.1)
Origin: Lima	193 (85.4)
History of prematurity	
Non-premature ( $\geq 37$ weeks)	183 (81.0)
Extreme or very extreme ( $< 32$ weeks)	13 (5.8)
Moderate (32-33 weeks)	12 (5.3)
Late (34-36 weeks)	18 (8.0)
Underweight <sup>b</sup>	42 (18.6)
Low height <sup>b</sup>	30 (13.3)
Anemia <sup>c</sup>	26 (11.5)
Behavioral problems	124 (54.9)
Associated disease or condition	
None	85 (37.6)
Genetic diseases	47 (20.8)
Neurological diseases	34 (15.0)
Musculoskeletal disorders	24 (10.6)
Autism spectrum disorder	12 (5.3)
Other diseases	24 (10.6)
Previous child developmental assessment	0 (0.0)
Type of development delay	
No (0% delay in all areas)	33 (14.6)
Simple (delay $> 0\%$ but $< 25\%$ in one or more areas)	28 (12.4)
Significant ( $\geq 25\%$ delay in one area)	44 (19.5)
Global ( $\geq 25\%$ delay in two or more areas)	121 (53.5)
Warning signs of child development	160 (70.8)
Need for intervention due to developmental delay (significant, global or presence of a warning sign).	178 (78.8)
Reason for admission at the PRS-ERMNH	
Interconsultation (for prematurity, congenital hypertonia, congenital hypotonia, genetic or neurological disorder)	106 (46.9)
Referral for suspected developmental delay	7 (3.1)
Referral for other reasons (trisomy 21, musculoskeletal disorders, autism spectrum disorder, dyslalia, etc.)	113 (50.0)

<sup>a</sup>Median (25<sup>th</sup> percentile - 75<sup>th</sup> percentile).<sup>b</sup>According to the World Health Organization's child growth standards<sup>35</sup>.<sup>c</sup>According to the technical norm of the Peruvian Ministry of Health, considering age and sex<sup>36</sup>.

PRS-ERMNHs: Pediatric Rehabilitation Service of the Edgardo Rebagliati Martins National Hospital.

in patients with genetic diseases or underweight, but it was not associated with short stature in any area (Table 3).

**Figure 1.** Raincloud plot showing the percentage of developmental delay by area. The bars show the 25<sup>th</sup> percentile and 75<sup>th</sup> percentile. The line within the bars shows the median score. The silhouette of each bar represents the number of individuals for each level of delay (percentage). AL: hearing and language; IA: intelligence and learning; MF: fine motor; MG: gross motor; PS: personal-social.

## Discussion

We found a high frequency of children who required intervention for developmental delay (19.5% with significant delay, 53.5% with global delay, and 70.8% with some warning sign). Most of the patients studied were female, from Lima, born at term, without malnutrition or anemia, with behavioral problems, and mainly neurological and genetic comorbidities. The behavioral problems and comorbidities, and the fact that ERMNH is a national referral center, may explain this high need for intervention for developmental delay.

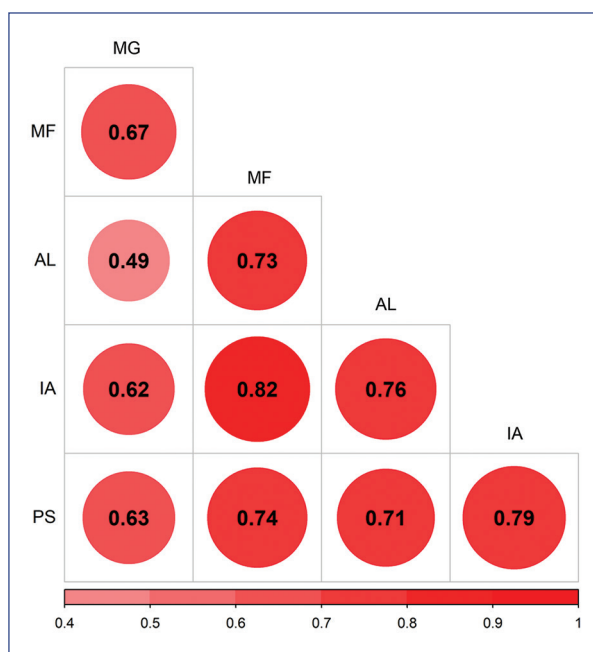
No patient had had previous child developmental assessment recorded in the electronic medical file. This deserves to be studied in depth since the universal use of screening tests, especially at the first level of care by health personnel such as pediatricians and physiatrists, is part of CRED care, and their adequate application and recording are essential to guarantee an objective and systematic evaluation in children  $< 5$  years of age<sup>8,20,21</sup>.

As the present study was conducted during the COVID-19 pandemic, we cannot ignore its possible influence on our findings. Other researchers have shown the possible detrimental effects of social isolation, reduced interaction among children, and lack of access to recreational activities on children's development and growth<sup>22-24</sup>. For example, a systematic review involving 21,419 infants (11,438 examined during the pandemic and 9,981 in the

**Table 2.** Child development area according to the need for intervention due to developmental delay

Child development area	Frequency of any delay (> 0%) n (%)	Frequency of significant delays (≥ 25%) n (%)	Percentage of delay median (IQR)
Hearing and language	153 (67.7)	123 (54.4)	31.5 (0.0-63.0)
Gross motor	142 (62.8)	111 (49.1)	20.5 (0.0-42.8)
Intelligence and learning	136 (60.2)	103 (45.6)	20.0 (0.0-50.0)
Fine motor	143 (63.2)	100 (44.2)	18.5 (0.0-49.5)
Personal-social	125 (55.3)	88 (38.9)	14.0 (0.0-42.0)

IQR: interquartile range.

**Figure 2.** Correlation graph between the areas of child development assessed with the REBA-PED. Note: each point indicates the percentage of delay for each patient, while the central point indicates the median and the straight line the interquartile range. AL: hearing and language; IA: intelligence and learning; MF: fine motor; MG: gross motor; PS: personal-social.

pre-pandemic period) reported a higher probability of communication deficits (odds ratio (OR): 1.70; 95% confidence interval (CI), 1.37-2.11) in the pandemic cohort compared to the pre-pandemic cohort.<sup>25</sup> Similarly, a study in China reported that the COVID-19 pandemic might be associated with an increased risk of delayed fine motor (OR: 2.50; 95% CI, 1.25-4.99) and language development (absolute risk difference (RRa): 1.13; 95% CI, 1.02-1.25) in 1-year-old children<sup>26</sup>. In Peru, due to its

precarious health system and controversial political decisions, an aggressive and prolonged quarantine was applied in contrast to other countries<sup>27,28</sup>, which may have had a relevant impact on child development in our population since most of them were > 3 years. This could explain, at least in part, the high frequency of delay in the area of hearing and language.

Furthermore, the fact that the area of hearing and language was the most affected suggests the of having many speech therapists in the PRS-ERMNH, and cohorts and experimental studies, to understand the outcomes of these patients and the efficacy of interventions.

A strong correlation was observed between the delay percentages in certain areas of child development (e.g., fine motor and intelligence and learning). This correlation was expected since impairment or progress in one area is related to the others. Hence, the importance of assessing not only one area or milestone at a time but the sequence of milestone acquisition in all areas of child development<sup>2,20</sup>.

The frequency of significant delay in the gross motor area was not higher in children > 12 months than those aged 0-12 months, in contrast to what was found in all other areas of child development. This observation could be related to previous studies reporting that the prevalence of delay in the gross motor area decreases with age<sup>29,30</sup>.

The frequency of significant delay in most areas of child development was higher in children with behavioral problems. This finding is consistent with previous studies in which children with developmental delay are three to four times more likely to have behavioral problems than children without developmental delay<sup>31,32</sup>. In addition, many behavioral problems are part of diseases or conditions associated with global developmental delay, such

**Table 3.** Significant delay in child development in each area according to the characteristics of patients seen for the first time in Pediatric Rehabilitation

Characteristics	Significant delay ( $\geq 25\%$ ) in child development, n (%)				
	Gross motor	Fine motor	Hearing and language	Intelligence and learning	Personal-social
Age					
1 a 11 months	19 (40.4)	7 (14.9)	5 (10.6)	11 (23.4)	4 (8.5)
12 a 35 months	40 (58.8)	32 (47.1)	46 (67.7)	39 (57.4)	30 (44.1)
36 a 60 months	52 (46.9)	61 (55.0)	72 (64.9)	53 (47.8)	54 (48.7)
p value	0.122	< 0.001	< 0.001	0.001	< 0.001
Sex					
Female	56 (57.7)	45 (46.4)	52 (53.6)	46 (47.4)	40 (41.2)
Male	55 (42.6)	55 (42.6)	71 (55.0)	57 (44.2)	48 (37.2)
p value	0.025	0.574	0.831	0.629	0.539
Behavioral problems					
No	43 (42.2)	30 (29.4)	35 (34.3)	30 (29.4)	22 (21.6)
Yes	68 (54.8)	70 (56.5)	88 (71.0)	73 (58.9)	66 (53.2)
p value	0.058	< 0.001	< 0.001	< 0.001	< 0.001
Origin					
Lima	91 (47.2)	84 (43.5)	105 (54.4)	86 (44.6)	73 (37.8)
Outside Lima	20 (60.6)	16 (48.5)	18 (54.6)	17 (51.5)	15 (45.5)
p value	0.153	0.596	0.988	0.458	0.406
History of prematurity					
Non-premature ( $\geq 37$ weeks)	98 (53.6)	84 (45.9)	111 (60.7)	88 (48.1)	80 (43.7)
Extreme or very extreme (< 32 weeks)	5 (38.5)	6 (46.2)	4 (30.8)	6 (46.2)	2 (15.4)
Moderate (32-33 weeks)	4 (33.3)	5 (41.7)	4 (33.3)	3 (25.0)	3 (25.0)
Late (34-36 weeks)	4 (22.2)	5 (27.8)	4 (22.2)	6 (33.3)	3 (16.7)
p value <sup>a</sup>	0.036	0.534	0.001	0.319	0.023
Underweight (current)					
No	80 (43.5)	74 (40.2)	94 (51.1)	74 (40.2)	60 (32.6)
Yes	31 (73.8)	26 (61.9)	29 (69.1)	29 (69.1)	28 (66.7)
p value	< 0.001	0.011	0.035	0.001	< 0.001
Low height (current)					
No	92 (46.9)	83 (42.4)	104 (53.1)	85 (43.4)	72 (36.7)
Yes	19 (63.3)	17 (56.7)	19 (63.3)	18 (60.0)	16 (53.3)
p value	0.094	0.141	0.293	0.088	0.083
Associated disease or condition					
None	29 (34.1)	31 (36.5)	38 (44.7)	29 (34.1)	23 (27.1)
Musculoskeletal disorders	6 (25.0)	1 (4.2)	0 (0.0)	2 (8.3)	0 (0.0)
Genetic diseases	40 (85.1)	39 (83.0)	41 (87.2)	36 (76.6)	34 (72.3)
Autism spectrum disorder	4 (33.3)	5 (41.7)	9 (75.0)	8 (66.7)	8 (66.7)
Neurological diseases	25 (73.5)	20 (58.8)	26 (76.5)	25 (73.5)	20 (58.8)
Other diseases	7 (29.2)	4 (16.7)	9 (37.5)	3 (12.5)	3 (12.5)
p value <sup>a</sup>	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

<sup>a</sup>  $\chi^2$  test or Fisher's exact test.

as autism spectrum disorder, attention deficit hyperactivity disorder, and anxiety disorder, among others<sup>33</sup>.

Finally, the frequency of significant delay in any area of child development was higher in patients with genetic diseases or underweight. This finding is consistent with previous studies in which 30-50% of cases of global developmental delay are of genetic etiology<sup>17,33</sup> and significant developmental delay is associated with a higher prevalence of exposure to indicators of

malnutrition (underweight, wasting, and stunting) in middle- and low-income countries similar to Peru<sup>34</sup>.

### Limitations and strengths

This study has some limitations: 1) Child development was evaluated using the REBA-PED instrument proposed for the Peruvian and Latin American context<sup>14</sup>. However, like the instruments used in other

countries in the region, it has yet to be validated in long-term cohorts or compared with a comprehensive reference test. Therefore, future studies are necessary to validate these instruments in different contexts.

2) As this study was conducted based on clinical record review, it was not possible to assess the adequacy of data recording. However, the care of each patient was performed by a psychiatrist.

This is one of the first Peruvian studies that has evaluated in depth the characteristics of children receiving care in rehabilitation services. Moreover, to our knowledge, this is the first study to address this topic after the COVID-19 pandemic, which provides relevant information to understand the needs of rehabilitation teams and to make proposals for improvement.

In conclusion, a high frequency of developmental delay was found among the children evaluated, with a predominance in the area of hearing and language. Although all children were referred from the first or second level of care, none had a previous child development assessment recorded in the electronic medical file. Future studies should further evaluate and explore whether child development is being assessed objectively and systematically at different levels of health care.

## Ethical disclosures

**Protection of human and animal subjects.** The authors declare that no experiments were performed on humans or animals for this study.

**Confidentiality of data.** The authors declare that they have followed the protocols of their work center on the publication of patient data.

**Right to privacy and informed consent.** This study involved a retrospective review of medical records, for which approval was obtained from a formally constituted review board (Institutional Review Board or Institutional Ethics Committee).

## Conflicts of interest

Roger De la Cerna-Luna and Giancarlo Alvarado-Gamarra work at the Edgardo Rebagliati Martins National Hospital. The other authors report no potential conflicts of interest regarding the present study.

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## Supplementary data

Supplementary data are available at *Boletín Médico del Hospital Infantil de México* online (10.24875/BMHIM.23000026). These data are provided by the corresponding author and published online for the benefit of the reader. The contents of supplementary data are the sole responsibility of the authors.

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**Suppl. Table 1.** Rebagliati Hospital Child Development Assessment Profile (REBA-PED)

Age (months)	Areas				
	Gross motor skills	Fine motor skills	Hearing and language	Intelligence and learning	Personal-social
1	Asymmetrical movements of legs and arms. When lying face down, he/she raises the head momentarily. When standing, he/she extends his/her legs.	Squeezes any object placed in his hand. Frowns and blinks away intense light.	Smiles or is calmed by mother's voice. Cries for a reason (hungry, cold or sleepy). Stops movements at hearing a sound.	Demonstrates attentiveness (fixes gaze and becomes interested when looking at a face, usually his/her mother's).	When crying, calms down when held or caressed. Sucks
	Warning signs: Does not react to noises. Sucking disorder. Swallowing disorder. Does not fix the gaze even momentarily. Strange crying (due to possible genetic disorder). Constant irritability (excessive crying).				
2	When standing, he/she does not support his/her body weight. When lying face down, he/she turns his/her head sideways.	Follows nearby soundless objects with the gaze at a 90° angle.	Emits sounds or "agu" when spoken to.	When touching an object, he/she opens and closes the hand.	Smiles at any face (social smile).
	Warning signs: Flaccidity or stiffness in the extremities. Absent or asymmetric Moro reflex. Adduction of the thumb over the rest of the fingers. Exaggerated overreaction to noise. Persistent irritability.				
3	When sitting or standing, the head accompanies the movement of the trunk, the head does not drop. Unstable support on forearms. When lying face down, raises the head for at least 3 seconds.	Open hands, open arms in front of object. Follows nearby soundless objects with the gaze at an angle of 180°.	Turns at the sound of his mother's voice or the ringing of a bell.	He or she is happy when going to breastfeed.	Plays with his/her hands. Responds differently to angry voices and cheerful voices.
	Warning signs: Absence of cephalic support. Asymmetry in hand movements (early "laterality"). Does not recognize his/her mother visually. Does not follow with the gaze. Weak cry. Poor or absent smile.				
4	Turns from prone to supine. When lying on the back, turns sideways.	Joins his/her arms in the middle line and grasps objects with both hands.	Laughs. Makes high-pitched squeals. Pays attention to conversations.	When a toy is placed in his/her hand, he/she looks at it.	Brings hands or toys to his/her mouth. Interacts with adults (seeks continuation of play).
	Warning signs: Hypertonia in adductors (angle less than 90°). Galant reflex persists. Closed hands. No reaction to sounds. Does not imitate or produce sounds. Excessive passivity.				
5	When sitting with support, keeps head steady. Begins to stand (rests on legs for a very short time).	Attempts to grasp nearby objects, even if unable to reach them.	Recognizes his/her name. Repeats to self and in response to others: "ta-ta-ta".		Plays with his/her hands and feet.
	Warning signs: When lying face down, he/she does not lift or move his head. Does not emit sonorous laughter.				
6	Turns from supine to prone.	Holds an object in each hand. Passes objects from one hand to the other (contralateral transfer).	Understands "come", "bye", and "upa" when picked up. Locates, differentiates and reacts to different sounds with full head movements.	Watches when an object falls.	Reacts to his or her image in the mirror (smiles or makes sounds). Picks up objects and repeats the stroke (against a surface).
	Warning signs: When lying on his/her back, he/she does not turn sideways. Does not initiate sitting with support. Hypertonia in extremities. Hypotonia in neck and trunk. Moro reflex persists. Absence of voluntary grasping. Asymmetric cervical tonic reflex persists.				

(Continues)

**Suppl. Table 1.** Rebagliati Hospital Child Development Assessment Profile (REBA-PED) (*continued*)

Age (months)	Areas				
	Gross motor skills	Fine motor skills	Hearing and language	Intelligence and learning	Personal-social
7	Sits without support.	Grasps objects with thumb and fingertips.	Says “ma-ma” and “pa-pa” to anyone.	Retrieves objects that fall out of his/her hand.	Reacts suspiciously to strangers. If you cover your head with a cloth, laughs when it is uncovered. Turns to reach for toys.
	Warning signs: Absent anterior parachute reaction. No voice orientation. No babbling.				
8	Stands briefly supported by hands. Adopts posture to crawl on hands and knees.	Clumsy index-thumb clamp.	He/she expresses himself/herself with gestures.		Calls or screams to establish contact with others. Intentionally drops objects and enjoys the sound. Touches, rubs or licks mirrors.
9	Adopt the sitting position.	Grasps objects with thumb and fingers, making a rake-like motion.	Understands “no”. Makes sounds similar to “ba-ba”, “da-da” or “ga-ga”.	Find hidden objects.	Expresses emotions (anger, fear, joy or sadness).
	Warning signs: Failure to sit without support. Axial hypotonia. Absence of clumsy index-thumb gripper. Does not pass objects from one hand to the other. Does not take objects or food to the mouth. Does not emit unspecific bisyllables. Does not react to his/her image in the mirror.				
10	Walks leaning on things. Crawls.	Grasps an object and holds it in the center of the hand.	Says “mama” and “dada” with meaning. Understands some gestures.	Looks for toys in boxes. Grasps one object in each hand for approximately 1 minute, when presented with a third.	Explore the environment. Repeats activities if they are celebrated.
11	Stands with support. Walks holding one hand.	Pincer grasp. Strikes an object against another object held in the hand.	Responds to simple commands and identifies objects. Says ‘bye-bye’ with hand.	Explore his/her toys.	Eats with hands on plate. Imitates gestures. Pushes balls with the foot, holding hands.
12	Walks with poor balance, legs wide apart.	Holds 2 objects in one hand. Knows how to clap. Takes objects out of a container.	Says 2 single words in addition to “mama” and “dada”.	Scribbles.	Offers toys. Struggles to remove shoes. Helps to get dressed after finishing putting arm through sleeve.
	Warning signs: Failure to stand with support. Abnormal reflexes or pyramidal signs. Clumsy manipulation. Does not recognize his/her name. Does not wave goodbye. Apparently does not understand what is said to him/her. Does not smile at familiar people. Not interested in surroundings.				
14	Walks with arms in ‘high guard’ or ‘middle guard’.	Throws objects.	Indicates ‘yes’ or ‘no’ with a nod of the head.	If you put a toy in a container, he/she tries to imitate it, although he/she may not release it.	Helps dress him/her by lifting his/her foot when putting on shoes, socks or pants.

*(Continues)*

**Suppl. Table 1.** Rebagliati Hospital Child Development Assessment Profile (REBA-PED) (*continued*)

Age (months)	Areas				
	Gross motor skills	Fine motor skills	Hearing and language	Intelligence and learning	Personal-social
15	Walks without falling often.	Put a bean in a jar. Makes towers of 2 cubes.	Says 4 or more words in addition to "mama" and "dada".	Identifies shapes of common objects. Points to his or her shoe or body part.	Eats at the table with others. Gives symbolic value to toys (carries or hugs them, makes them walk, etc.).
	Warning signs: Does not crawl or move on his/her own. Does not crawl up steps. Absence of fine grasping. Does not throw objects. Does not say at least 3 words. Says "mama" and "dada" without meaning. Does not imitate gestures. Repetitive or stereotyped behaviors. Significant and constant loss of skills he/she used to have.				
18	Runs clumsily. Stands without support. Walks with arms 'off guard'. Climbs up, sits down and gets down from a small chair.	Makes towers of 3 cubes. Turns pages of a book, more than one at a time.	Says words-phrases ("mamateta"). Distinguishes between "you" and "I". Says 8 or more words in addition to "mama" and "dada". Says "no".	Uses one object to reach another (e.g., pulls a cloth). Points to 2 to 5 parts of his or her body.	Mimics simple household tasks. Notifies his needs. Defends his/her toys (refuses to give them up because they "belong to him/her"). Helps undress.
	Warning signs: Walks in an immature way. Does not make towers of 2 cubes. Does not say at least 7 words. Does not scribble spontaneously. Does not point to, look at, or touch named objects. Does not recognize body parts. Does not drink from a cup. Poor affectivity. Shifts uninterruptedly from one activity to another.				
21	Run without falling. Walks backwards.	Makes towers of 5 cubes.	Understands 2 consecutive simple commands ("pick up the cube and give it to me").	If the child is given a bottle, spoon or pencil upside down, he/she tries to turn it upside down to use it correctly.	Child attempts to remove lower garments. Plays with other children. Uses spoon, but spills. Drinks from cup without spilling.
24	Child walks up and down stairs, one foot at a time, leaning on handrails or holding hands. Kicks a ball without losing balance.	Makes towers of 7 cubes. Caps a pencil. Unwrap a candy.	Says 2-word sentences. Understands 3 commands (e.g., "sit down, take off your shoes and give them to me"). Says between 20 and 50 words.	Identifies basic emotions in a picture. Plays with objects imagining they are other things.	Unscrews a plug to look inside. Feeds, cradles, or puts a toy to bed. Asks for help when he/she wants something he/she can't reach.
	Warning signs: The child does not run, does not make towers of 4 cubes, does not say "no". Verbal stereotypes. Prefers to use gestures rather than words. Does not understand simple commands. Does not imitate actions or familiar sounds. Does not point to show or ask. Inability to engage in symbolic play. Shows excessive indifference to the environment.				
30	The child throws a ball forward, with the hand, standing upright. Stands on one foot, with support.	Bridges 3 cubes. Copies a vertical line. Strings beads on a string. Turns pages of a book, one by one.	Turn pages, choose 5 figures from a book and name them.	Places rings in order of size. Helps to place things in the right place.	Attempts to screw on a threadlocker. Puts on some clothes. Social play (waits for turn, shares, accepts ideas, etc.). Daytime sphincter control (uses the toilet).
	Warning signs: Constantly falls down. Has trouble walking up or down stairs. Drools a lot or speaks in a way that is hard to understand. Has trouble chewing.				

(*Continues*)

**Suppl. Table 1.** Rebagliati Hospital Child Development Assessment Profile (REBA-PED) (*continued*)

Age (months)	Areas				
	Gross motor skills	Fine motor skills	Hearing and language	Intelligence and learning	Personal-social
36	The child climbs stairs alternating feet, with or without support. Jump in the same place with feet together. Pedal a tricycle.	The child can copy horizontal lines. Put a pin through the holes of a shoe.	Says 3-word phrases or simple sentences. Says his/her name. Says his or her age. Uses some plurals.	Name 3 colors. Identifies 5 objects by their use. Recognizes qualities of objects (e.g., soft or hard). Points to 7 body parts.	Identifies his or her sex. Washes and dries hands and face. Uses spoon without spilling. Verbally expresses emotions.
	Warning signs: The child does not copy lines. Does not say 2-word sentences. Limited vocabulary. Does not understand 2 consecutive simple commands. Echolalic language. Frustration in communicative situations. Does not identify images. Restricted or repetitive play. No daytime sphincter control. Remains isolated.				
42	The child stands on one foot, unsupported, for 1 second. Jump 15 cm forward with feet together.	The child can copy a circle. Hold the pencil like an adult. Try cutting with scissors.	Can describe pictures. Turn pages, choose 10 figures from a book and name them.	The child counts to 2. If you tell him/her 2 random numbers and ask him/her to repeat them, he/she does so in the same order.	Put on a coat or jacket without assistance.
48	Walks down stairs alternating feet, without support. Catches a large ball with both hands. Jumps backwards. Climbs up the steps of a slide and then slides down.	Cuts with scissors. Draws a rudimentary human figure. Assembles a puzzle of 5 to 7 pieces. Makes a paper ball with his/her fingers.	Says 5-word sentences. Asks questions such as "why?", "who?", "where?" and "when?".	Names 5 colors. Carries out 3 different instructions containing the words "under", "between", and "center".	Dresses and undresses without help, ignoring buttons and zippers. Cooperative play (e.g., with other children 'mommy and daddy' or 'cops and robbers').
	Warning signs: Does not say 3-word sentences. Difficulty saying 2-word sentences. Does not say adjectives or pronouns. Alterations in the articulation of phonemes. Does not know shapes, colors or sizes. Limited comprehension. Does not eat alone. Does not show interest in playing with other children.				
54	Jumps on one foot, at least 1 time. Jumps 50 cm forward with feet together.	The child can copy a square and a cross. Colors, usually without going out of the line. Folds a paper.	Uses past tense verbs. Says his/her first and last name. Answer 3 questions about a story.	Dresses up and acts pretending to be someone or something different. Counts to 5. Discriminates morning and afternoon.	Brushes teeth. Says the name of 2 playmates (not including siblings).
60	Jumps on one foot at least 3 times in a row. Knows how to do 'cartwheels'. Jumps over small obstacles.	Draws a person with head, trunk and limbs. Copies a triangle. Writes 2 or more letters.	Tells stories. Uses past, present and future verbs. Repeats words with complex phonemes with correct pronunciation. Tells his or her home address or the city where he or she lives.	Counts to 10. Draws a man or a woman. Recognizes numbers.	Dresses and undresses without help, being aware of buttons and zippers. Competitive play (respects rules). Self-sufficiency in the bathroom. Sphincter control at night. Collaborates in household cleaning.
	Warning signs: Does not draw simple pictures. Does not say his or her first and last name. Does not speak fluently. Omission of links, pronouns, articles or verbs. Does not respond to "when" or "how". Difficulty narrating events that have happened to him/her. Difficulty understanding long, complex or abstract sentences.				