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### Keywords

Language Tests  
 Child Language  
 Language Disorders  
 Primary Health Care  
 Language Development  
 Triage

### Descritores

Testes de Linguagem  
 Linguagem Infantil  
 Transtornos da Linguagem  
 Atenção Primária à Saúde  
 Desenvolvimento da Linguagem  
 Triage

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Received: 09/16/2014

Accepted: 12/19/2014

# Language evaluation protocol for children aged 2 months to 23 months: analysis of sensitivity and specificity

## *Protocolo de avaliação da linguagem de crianças na faixa etária de 2 meses a 23 meses: análise de sensibilidade e especificidade*

### ABSTRACT

**Purpose:** To establish cutoff points for the analysis of the Behavior Observation Form (BOF) of children in the ages of 2 to 23 months and evaluate the sensitivity and specificity by age group and domains (Emission, Reception, and Cognitive Aspects of Language). **Methods:** The sample consisted of 752 children who underwent BOF. Each child was classified as having appropriate language development for the age or having possible risk of language impairment. Performance Indicators (PI) were calculated in each domain as well as the overall PI in all domains. The values for sensitivity and specificity were also calculated. The cutoff points for possible risk of language impairment for each domain and each age group were obtained using the receiver operating characteristics curve. **Results:** The results of the study revealed that one-third of the assessed children have a risk of language impairment in the first two years of life. The analysis of BOF showed high sensitivity (>90%) in all categories and in all age groups; however, the chance of false-positive results was higher than 20% in the majority of aspects evaluated. It was possible to establish the cutoff points for all categories and age groups with good correlation between sensitivity and specificity, except for the age group of 2 to 6 months. **Conclusion:** This study provides important contributions to the discussion on the evaluation of the language development of children younger than 2 years.

### RESUMO

**Objetivo:** Estabelecer pontos de corte para análise do Protocolo de Observação de Comportamentos (POC) na faixa etária de 2 a 23 meses completos e avaliar a sensibilidade e a especificidade por faixa de idade e por domínios (Emissão, Recepção e Aspectos cognitivos da linguagem). **Métodos:** A casuística consistiu em 752 crianças que foram submetidas ao POC. Cada criança foi classificada com desenvolvimento da linguagem adequado para a idade ou com possível risco de alteração da linguagem. Foram calculados os Índices de desempenho (ID) em cada domínio e o ID geral. Também foram calculados os valores de sensibilidade e especificidade e, por meio da curva ROC, determinados os pontos de corte para possível risco de alteração de linguagem para cada domínio e faixas de idade. **Resultados:** Os resultados do estudo revelaram que um terço das crianças avaliadas apresenta risco de alteração de linguagem nos dois primeiros anos de vida. A análise do POC revelou alta sensibilidade (>90%) em todas as categorias e em todas as faixas de idade, contudo a chance de resultados falso-positivos foi superior a 20% na maioria dos aspectos avaliados. Foi possível estabelecer os pontos de corte para todas as categorias e faixas de idade com boa correlação entre sensibilidade e especificidade, exceto para a faixa etária de 2 a 6 meses. **Conclusão:** O presente estudo traz contribuições importantes para a discussão sobre a avaliação do desenvolvimento de linguagem de crianças menores que 2 anos.

Study carried out at the Speech Language Pathology and Audiology Department and the Pediatrics Department, School of Medicine, Universidade Federal de Minas Gerais – UFMG – Belo Horizonte (MG), Brazil.

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**Financial support:** Programa de Educação pelo Trabalho em Saúde – PET-saúde, in partnership with Universidade Federal de Minas Gerais – UFMG; Municipal Health Secretariat of Belo Horizonte – SMS-BH – and the Ministries of Health and Education.

**Conflict of interests:** nothing to declare.

## INTRODUCTION

In childhood, language is the primary means of socialization. It is through language that the child has access to values, rules, and knowledge of their culture. The first two years of life are crucial for the acquisition of skills and knowledge, for it is the period of greatest flexibility from the nervous system. In this stage, one of the best indicators of a good overall development is the onset of language<sup>(1)</sup>.

Studies point to a high prevalence of delay in language development for children under 3 years of age<sup>(2-4)</sup>. This fact indicates the need of monitoring language development in order to identify possible alterations in stages in which the consequences are reversible, preventing communication disorders and difficulties in learning<sup>(5,6)</sup>.

Knowing that the acquisition of language plays a central part in the first years of life, it is necessary that, in the context of primary care, that health professionals are able to carefully observe language with the objective of identifying, as early as possible, children at risk of language alterations and establishing referrals and interventions best suited for each case<sup>(7)</sup>.

In the context of primary health care, the use of screening instruments available to different health professionals, which are of low cost, easy to apply, and efficient in the detection of risk of language alterations, is necessary<sup>(8)</sup>. Thus, research focused on studying tests which evaluate the risk of language alteration among children younger than 2 years of age are extremely important in the context of primary health care.

One of the ways of verifying the risk of language alteration is to observe the child through an informal interaction, activities developed in a medical office or directly tested<sup>(9)</sup>. This way, such observation has the function of alerting for a potential risk<sup>(10)</sup>.

Among the instruments proposed by the Brazilian literature, there is the Behavior Observation Form (BOF) of children from 0 to 6 years of age<sup>(11)</sup>. This is a resource which has been used in clinical practice in Brazil for presenting good clinical use and covering up children from a wide age range, thus being useful in planning of Speech Language Therapy. Besides that, there are already studies published in Brazil supporting its use<sup>(12,13)</sup>. The BOF is a proposal for the systematization of observation of the aspects of child development, which approach the possible behaviors according to chronological birth age at 6 years, divided into the following domains: Reception, Emission, Motor, and Cognitive Aspects of Language<sup>(11)</sup>. The instrument is easy to be used and provides information on the development of children's language, although there is a need for the interpretation of the results by a Speech Language Therapist.

Therefore, this study aimed at establishing the cutoff point for the analysis of BOF within the age range from 2 months to 23 complete months, which facilitated the use of this instrument in the context of primary health care, even in the absence of a speech language pathologist, and in evaluating the sensitivity and specificity of the BOF by age range and domain (Emission, Reception, and Cognitive Aspects of Language).

## METHODOLOGY

It is a cross-sectional analytical observational study with non-probabilistic sample for the evaluation of language development of children within the age range from 2 to 23 months.

The study was conducted in three basic health units, located in the regions of Venda Nova, Northeast and North of the city of Belo Horizonte, encompassing areas of medium and high risk, according to the index of vulnerability to health (0.5–0.63)<sup>(14)</sup>.

The research was developed in the context of the *Programa de Educação pelo Trabalho em Saúde* (PET-saúde), a partnership between the *Universidade Federal de Minas Gerais* (UFMG), and the Health and Education Ministries. The team of researchers consisted of professors of Speech Language Pathology and Audiology and Pediatrics of the UFMG, professionals from the health teams of the SMS-BH, and scholarship students and volunteers of the health area of UFMG.

The inclusion criteria of the research were: living in the area covered by the basic health units, being aged between 2 and 23 complete months, and having the informed consent signed by parents or legal guardians. The exclusion criteria were children with previously diagnosed neurological alterations. The final sample consisted of 752 children.

The recruitment of the participants of the research was conducted through invitation to the guardians of the children during their consultations, vaccination campaigns and through community health agents.

The study used the BOF of children up to 6 years of age<sup>(11)</sup>, which was adapted (Chart 1) for its use in two groups: children from 2 to 11 months of age and children from 12 to 23 complete months of age. The instrument comprised lists of behaviors worthy of observation, arranged according to the chronological age and domains: Reception, Emission, Cognitive Aspects of Language and Motor. In this research, only the first three aspects were evaluated.

The data collection was performed by students of the health area from the courses of Speech Language and Audiology, Physical Therapy, Nursing, Medicine, Nutrition, and Occupational Therapy, monitored by professors and health professionals in the health units, in the period from July to December 2009. All involved in this research took part in a standardized training and a pilot study was conducted in order to adjust the instruments and the operational flows of the research.

The evaluation of language development of each child was done in individual sessions of approximately 30 minutes in a room made available by the *Unidade Básica de Saúde* (UBS). The records of answers referring to the behaviors expected for each age were made in individual charts, checking yes or no according to their presence or absence.

The data analysis occurred in two stages. In the first stage, two Speech Language Therapists conducted a qualitative analysis of the evaluation forms of the children, classifying them into two groups, appropriate language development according to age or possible language alteration, according to the criteria described in the specialized literature, in accordance to the adaptation of important studies published (Chart 2)<sup>(15-17)</sup>. The Speech Language Therapists performed previous training for the standardization of the analysis, conducted their

**Chart 1.** Behavior Observation Form of children from 2 to 11 months and from 12 to 23 months of age

	2–11 months	12–23 months	Y	N
Reception	01. Reacts to environmental stimuli in a reflexive way (an/ev).	01. Understands verbs representing concrete actions and their own needs (e.g. more, want, over, give) (ev).		
	02. Reacts to environmental stimuli altering the behavior significantly (laugh and cry) (an/ev).	02. Identifies 4 familiar objects by name (ev).		
	03. Responds to their own name (nickname) (an/ev).	03. Identifies 3 body parts in themselves or others by name (hair, mouth, ear, hands) (ev).		
	04. Responds to gesture requests (an/ev).	04. Executes up to 2 simple commands (ev).		
	05. Responds to verbal requests, accompanied by gestures (an/ev).			
	06. Responds to verbal requests (an/ev).			
	07. Reacts properly to “no” (an/ev).			
	08. Shows understanding of feelings: caring, mad, happy (an/ev).			
Emission	01. Appropriate suction (an/ev).	01. Beginning of the systematization of the phonetic system (an/ev).		
	02. Appropriate swallowing (an/ev).	02. Uses segments use naming function (an/ev).		
	03. Appropriate breathing (an/ev).	03. Uses of indicative and representative gestures and intonation (an/ev).		
	04. General vocalizations (an/ev).	04. Uses Word-phrase (an/ev).		
	05. Vocalizations with syllable patterns (an/ev).	05. Uses their own name (an/ev).		
	06. Vocalizations with variation of intonation in face of different stimuli (an/ev).	06. Uses overlapping words (an/ev).		
	07. Vocalizes to call for attention (an/ev).	07. All emissions in this stage are related to concrete situations (an/ev).		
	08. Vocalizes while manipulating objects (an/ev).	08. Names more or less three parts of the body of a doll or person (ev).		
	09. Makes indicative gestures (an/ev).	09. Answers yes or no (an/ev).		
	10. Uses syllable segments with naming functions (an/ev).	10. Beginning of simple phrases (an/ev).		
	11. Uses onomatopoeia (an/ev).	11. Names 4 daily days objects (ev).		
Cognitive Aspects of Language	01. Opens the mouth or starts sucking before the nipple touches the mouth (an).	01. Places objects in a recipient, emptying it later (ev).		
	02. Reacts to body contact (an/ev).	02. Rolls a ball under imitation (ev).		
	03. Reacts to auditory stimuli looking for the source of the sound (an/ev).	03. Places rings and pins and big pins in a tablet with holes (ev).		
	04. Observes their hands (an/ev).	04. Build 3 towers with cubes (ev).		
	05. Keeps eye contact (an/ev).	05. Pushes and pulls toys when they walk (ev).		
	06. When having a fabric over their face, they remove the fold (an/ev).	06. Takes objects from a recipient, one at a time (ev).		
	07. Takes objects to their mouth (an/ev).	07. Sits down on the chamber pot for more or less 5 minutes (an).		
	08. Hits objects (an/ev).	08. Pushes cubes imitating a train (ev).		
	09. Takes from and puts objects in a recipient, spontaneously (an/ev).	09. Up until more or less 2 years explores their specular image and recognize themselves (ev).		
	10. Drops and catches a toy (an/ev).			
	11. Executes simple gestures by request (an/ev).			
	12. Visually follows an object in the medium line of the body, without turning the head (an/ev).			
	13. Visually follows an object in the medium line of the body, turning the head (an/ev).			
	14. Looks for objects which have been removed from their visual field (ev).			
	15. Smiles and vocalizes when they see their image reflected in the mirror (ev).			
	16. Finds an object hidden under a recipient (ev).			

**Caption:** Y = it was possible to observe the evaluated aspect; N = it was not possible to observe the evaluated aspect; an = information obtained through anamnesis; ev = information obtained through evaluation

Source: adapted from Chiari, 1991<sup>(11)</sup>

evaluations separately, and, later on, performed the calculation of concordance between evaluations, which showed 98% of agreement. In the disagreement with respect to the evaluation between examiners, the case was discussed with a professor from the Speech Language and Audiology course of UFMG, the coordinator of this project, and then the final result of the qualitative evaluation in the BOF was defined.

In the second stage, a quantitative analysis was performed. For each child, the Performance Indicators (PI) were calculated in each domain (Reception, Emission, and Cognitive Aspects of Language) as well as the overall PI in all domains, according to the following formula considering the maximum value of 100%<sup>(12)</sup>.

In order to analyze the clinical applicability of the quantitative analysis (Performance Indicator) in the screening for possible risk of language alteration, a study was conducted on the validity of the diagnostic test based on the qualitative analysis of the BOF.

$$PI: \frac{(\text{Neb}-\text{Nnob}) \times 100}{\text{Neb}}$$

PI: Performance Indicator

Neb: number of evaluated behaviors

Nnob: number of no-observed behaviors

For each domain and age range (2–6 months, 7–11 months, 12–17 months, and 18–23 complete months), the cutoff points for the possible risk of language alteration were determined. The cutoff points were established by the curve of ROC (receiver operating characteristics), and then the values of sensibility and specificity were calculated.

The calculation of sensitivity was performed by the ones with scores below the cutoff point (positive test for possible language alterations) among those with possible language alterations according to the evaluation of reference. The specificity was calculated by the ones with scores above the cutoff point (negative test for possible language alteration) among those with no alterations according to the evaluation of reference.

The false-positive and false-negative rates were obtained by the calculation of 1-specificity and 1-sensitivity, respectively.

The cutoff point considered as ideal for the quantitative analysis was the one obtained through higher sensitivity, followed by higher specificity, once that a good screening test is the one with highest sensitivity value, once it will correctly identify those with the possible alteration.

The child who presented a score lower than the cutoff point was considered with possible risk of language

**Chart 2.** Parameters for the qualitative analysis of the communicative behaviors of children from 2 to 24 months of age

Age (months)	Reception	Emission	Cognition
2–4	- Reacts to environmental stimuli in a reflexive way alternating the behavior	- Appropriate suction, swallowing and breathing - Overall vocalizations	- Looks for the nipple - Reacts to body contact - Makes eyes contact - Visually follows an object in the medium line of the body without turning the head
4–6	-Demonstrates understanding feelings	- Vocalizations with tone variations, in order to call for attention and while manipulates objects	- Looks for the source of sounds - Visually follows an object in the medium line of the body turning the head - Observes their hands - Smiles and vocalizes when they see themselves in the mirror
6–8	-Answers to their own name -Answers to verbal and gesture requests	- Vocalizations with syllable pattern - Makes indicative gesture	- Removes fabric placed on their face - Takes objects to the mouth - Drops and catches objects - Searches for hidden objects
8–10	-Answers appropriately to no	- Vocalization with syllable pattern - Makes indicative gestures	- Hits objects - Takes from and puts objects in a recipient - Finds hidden objects
10–12	-Answers appropriately to no	- Uses syllable segments to name and produce onomatopoeia	- Performs simple gestures by request
12–15	-Understands verbs of concrete actions	- All emissions are from concrete situations - Answers yes or no	- Rolls a ball - Takes objects, one at a time
15–18	- Performs up to 2 complete commands	- Uses indicative gestures - Uses Word-phrases	- Build towers with 3 cubes
18–21	- Identifies familiar objects and parts of the body	- Beginning of the systematization of the phonetic system - Uses overlapping words - Names 3 parts of the body - Uses simple phrases	- Pushes and pulls toys when they walk - Sits down on the chamber pot for more or less 5 minutes
21–24	- Identifies familiar objects and parts of the body	- Uses their own name - Names 4 objects	- Places pins on a tablet with holes - Pushes cubes imitating a train - Recognize each other in the mirror

Source: adapted from the important studies published by the literature<sup>(15,17)</sup>

alterations (positive test for language alteration). Those who had a score above the cutoff point were considered as without risk of language alterations (negative tests for language alteration).

For the statistical analysis, the Statistical Package for Social Sciences (SPSS) software, version 18.0 for Windows, was used. For the prevalence analysis of possible language deficits, frequency distribution calculations were made. The best cutoff points for each age range and evaluated domains, with respective sensitivity and specificity values, were obtained through the ROC curve.

The present study was approved by the Research Ethics Committee of the UFMG, ETIC 410/09. All legal guardians responsible for the children in the study read and signed the informed consent.

## RESULTS

The qualitative analysis of the BOF showed that 30.3% (228/752) of the assessed children were at risk of having language alterations. When analyzed by age range and by domain, the results represented in Table 1 were obtained. The age range with the highest prevalence of children with possible language alterations was the one from 18 to 23 months of age.

In Table 2, the results of the quantitative analysis for possible risk of language alterations are presented, along with their respective cutoff points for each BOF domain, according to the age range of the child (2–6 months, 7–11 months, 12–17 months, and 18–23 months) and the values in the analysis of the ROC curve and the validity study. Table 2 also presents the result obtained by the overall index, which is the grouping of the domains of Reception, Emission, and Cognitive Aspects of Language.

Figure 1 presents the ROC curves obtained for each age range and evaluated domain. The solid line in diagonal presents random classification for the positive and negative tests. The solid line refers to the overall ROC curve. The short dashed line refers to the emission domain. The long dashed line refers to the reception domain. The dotted line refers to the Cognitive Aspects of Language.

Considering the cutoff points obtained through the described analysis, Figure 2 presents an interpretation proposal of the BOF through the Performance Indicator. The figure indicates the age ranges and a graphic for each category, in which the PI obtained by the child may be noted and interpreted.

In order to assist data interpretation and use of Figure 2, a simulation is presented: “A Child of 16 months of age was submitted to language evaluation through the BOF. The results of the Performance Indicators (PI) were: overall PI – 46%; Reception PI – 50%; Emission PI – 54%; Cognition PI – 44%”. The overall PI is below reference, and the reception and emission PIs are appropriate. The parts of language with the most possibility of alteration were the cognitive aspects of the language, which are below the cutoff point. This way, the child presented in the simulation most probably had a risk for language alteration characterized especially by the cognitive aspect of the language.

## DISCUSSION

The present study aimed at establishing cutoff point for the analysis of the BOF, within the age range from 2 months to 23 months, and evaluating the sensitivity and specificity of BOF by age range and by domains (Emission, Reception, and Cognitive Aspects of Language).

The sample of the study considered a population of children from regions of high and medium health vulnerability index in the city of Belo Horizonte<sup>(14)</sup>. Most participants in the research were subject who attended the health units on a daily basis; however, there is a fraction of subjects who have private health insurance and who attended to the unit only during vaccination campaigns. In the study, the risks of overall development delay, such as prematurity, were not discriminated.

The results show that one-third of children present risk of language alteration within their first two years of life. In a study carried out in public day care units in which children between 2 and 3 years of age were assessed using the Denver II Development Screening Test, 25.7% of them had an inappropriate (cautiousness or delay) language development<sup>(18)</sup>. Another study evaluated the neuropsychomotor development of infants and noted that the most affected area was language (25%)<sup>(2)</sup>. The high rate of language alterations indicated in the study may be justified by the medium and high vulnerability index of the studied population. These findings corroborate the study carried out in Pelotas which attempted to identify risk factors for the suspicion of development delay at age 2 and verified that children from social classes D and E had higher risk of development delay<sup>(19)</sup>. The prevalence of language alterations found in the present study deserves attention at least once in the first years of life, the period when there is an intense brain activity resulting from the interaction between the biological characteristics and the opportunity of experiences of each individual. The intense neuroplasticity during this period is also responsible for better outcomes if intervention occurs early<sup>(1,20,21)</sup>. The evidence of the high frequency of alterations demonstrates the need of broadening prevention actions on speech language and audiology problems and the promotion of language development in primary health care<sup>(20)</sup>.

When analyzing the sample by evaluated domain, it is verified that the highest frequency of risk of alteration is in the Emission domain (Table 1). A research which evaluated 115 infants as for their language development, auditory and visual functions also found results beyond the expected in relation to expressive language among children older than 12 months of age<sup>(1)</sup>. The results of the present study may be explained by the development chronology itself and by the demands of each development stage in language. According to the literature, from 12 years of age onward, the emission aspects are more often demanded by the environment, and the communication alterations become more evident<sup>(22)</sup>. The stage from 13 to 24 months of age coincides with the beginning of verbal communication itself; it is expected that the first words and statements are issued<sup>(21)</sup>. As the child progresses in their development, higher are the demands from the smallest to the largest impact on the communication alterations in social, emotional, and educational

**Table 1.** Distribution of children according to the result from qualitative evaluation of Behavior Observational Form by the domains of Reception, Emission and Cognitive Aspects of Language by age range

Age (months)	Domains evaluated through reference evaluation of the Behavior Observational Form								
	Reception		Emission		Cognitive Aspects of Language		Final result		Total n (%)
	Without alteration n (%)	Risk of alteration n (%)	Without alteration n (%)	Risk of alteration n (%)	Without alteration n (%)	Risk of alteration n (%)	Without alteration n (%)	Risk of alteration n (%)	
2–6	207 (93)	16 (7)	200 (90)	23 (10)	186 (83)	37 (17)	173 (78)	50 (22)	223 (30)
7–11	144 (80)	37 (20)	163 (90)	18 (10)	141 (78)	40 (22)	125 (70)	56 (30)	181 (24)
12–17	153 (97)	5 (3)	128 (81)	30 (19)	147 (93)	11 (7)	122 (77)	36 (23)	158 (21)
18–23	171 (90)	19 (10)	109 (57)	81 (43)	176 (93)	14 (7)	104 (55)	86 (45)	190 (25)
Total	675 (90)	77 (10)	600 (80)	152 (20)	650 (86)	102 (14)	524 (70)	228 (30)	752 (100)

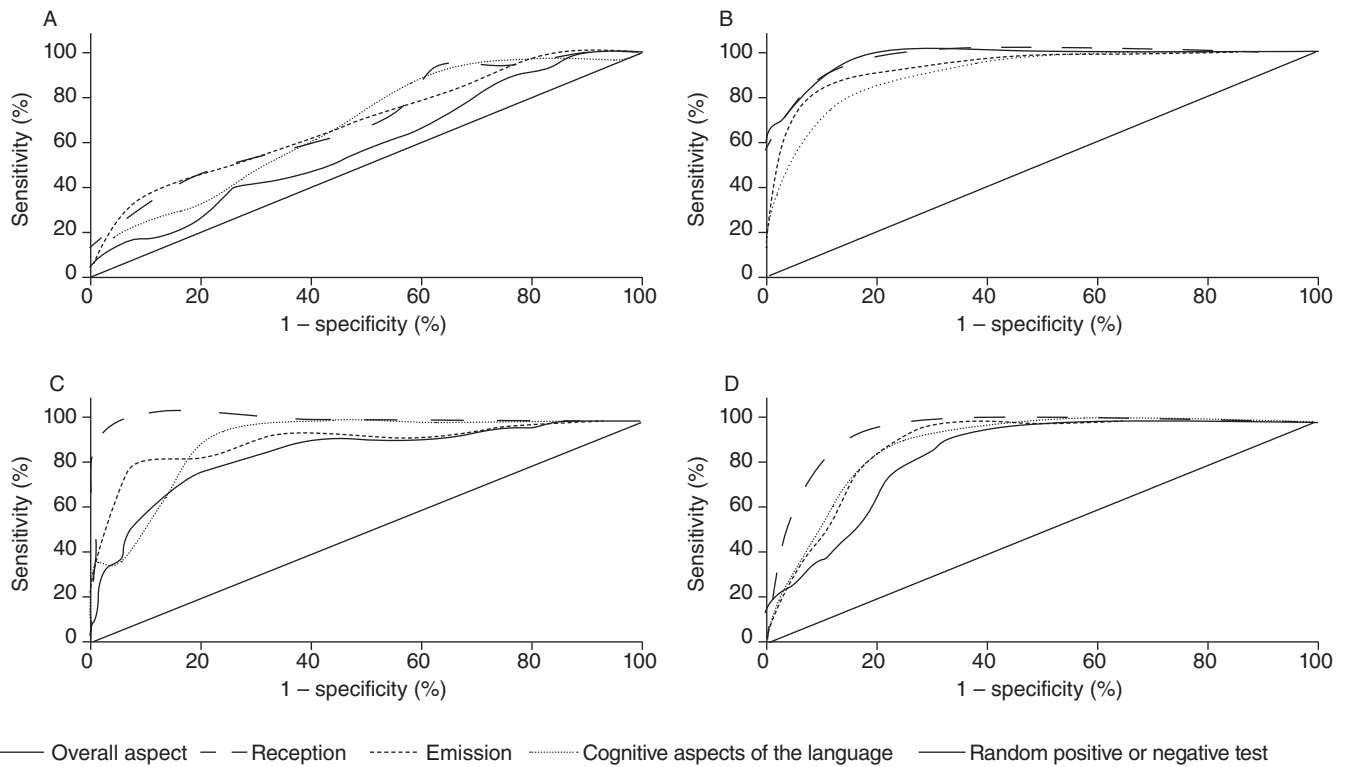
**Table 2.** Validity study on the quantitative analysis of the overall Behavior Observation Form and by domains, according to the age range of the children

Domains	Area under the ROC curve	p-value	Cutoff point (%)	Sensitivity (%)	Specificity (%)	False-positive (%)
<b>Reception</b>						
2–6 months	0.69	0.013	56	94	37	63
7–11 months	0.96	<0.001	94	100	79	21
12–17 months	0.98	<0.001	38	100	96	4
18–23 months	0.93	<0.001	88	100	77	23
<b>Cognition</b>						
2–6 months	0.67	<0.001	66	95	30	70
7–11 months	0.9	<0.001	91	95	63	37
12–17 months	0.9	<0.001	61	100	79	21
18–23 months	0.88	<0.001	83	100	53	47
<b>Emission</b>						
2–6 months	0.68	0.005	77	100	14	86
7–11 months	0.92	<0.001	86	94	68	32
12–17 months	0.9	<0.001	41	93	67	33
18–23 months	0.89	<0.001	86	99	69	31
<b>Overall</b>						
2–6 months	0.58	0.08	–	–	–	–
7–11 months	0.97	<0.001	90	100	80	20
12–17 months	0.85	<0.001	56	92	57	43
18–23 months	0.85	<0.001	90	98	68	32

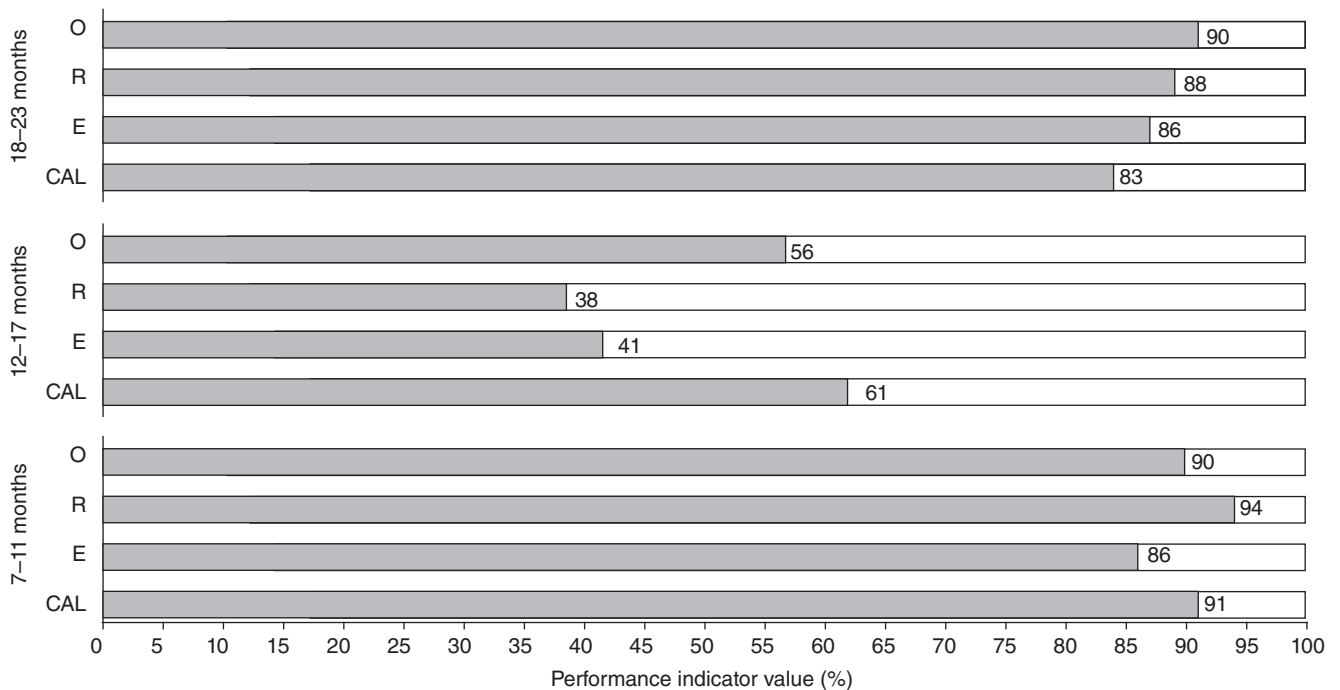
aspects. Thus, searching for strategies to promote health, prevent diseases, and early intervene in primary health care in the studied age range may bring great contributions into quality of life and the healthy development of the infant population<sup>(7)</sup>.

The ROC curve was chosen for being an efficient way of demonstrating the relation between sensitivity and specificity of the tests which present continuous results, such as the case of the Performance Indicator calculated by the quantitative stage of the study. The presentation was made through a

sensitivity graphic versus the false-positive rate (1-specificity). The diagonal line corresponds to a positive or negative test, randomly (random curve). The ROC curve shows the identification of values for which there is higher optimization of the sensitivity in relation to specificity, which correspond to the point where it is closer to the upper-left corner of the diagram. The area under the ROC curve is a measure of the test's accuracy index. A completely unable test in order to discriminate altered and non-altered individuals would have an area under



**Caption:** A = Presents the ROC curves of children between 2 and 6 months of age; B = Presents the ROC curves of children between 7 and 11 months of age; C = Presents the ROC curves of children between 12 and 17 months; D = Presents the ROC curves of children between 18 and 23 months  
**Figure 1.** Demonstration of the relation between sensitivity and specificity of the qualitative evaluation of the Behavior Observation Form by domain and age range evaluated



**Caption:** O = Overall domain; R = Reception domain; E = Emission domain; CAL = Cognitive Aspects of Language; Grey area = possible risk of language alteration; White area = absence of risk of language alteration

**Figure 2.** Clinical interpretation proposal of the Performance Indicator in the Behavior Observation Form in the evaluation of children from 7 to 23 months of age

the curve of 0.5. The area under the curve above 0.7 and with significance (p-value) lower than 0.05 is considered as a satisfactory performance.

The curves presented at age 2–6 months are very close to the random curve, which, from the practical point of view, shows that the score lower than the cutoff points for this age range will not have a good correlation between sensitivity and specificity (Figure 1). These data are confirmed by the statistical analysis (p-value), area under the curve, and calculation of the sensitivity and specificity (Table 2). The age range from 2 to 6 months presented the smallest area under the curve, and, in the case of the overall index, it was not possible to determine the best cutoff point. Thus, the BOF was not proved appropriate for the evaluation of this age range, considering the results must be interpreted with caution. The evaluation of language in infants younger than 6 months of age is a challenge, and the efficient instruments available for the evaluation of risk of development in this age range are rare<sup>(1)</sup>.

A Brazilian study assessed 304 children from 0 to 12 months of age through the “Questionnaire for monitoring of auditory and language development in the first year of life”. The evaluation showed specificity of 96% and sensitivity of 67% for the identification of possible alterations of auditory or language development, proving to be an efficient tool<sup>(23)</sup>.

In the remaining age ranges of this study, it is possible to observe the lines of the ROC curve are far from the random curve (Figure 1) and that they have an area under the curve higher than 0.7 and with a significant p-value ( $p < 0.001$ ). For the age range from 7 to 23 complete months, the cutoff points established are reliable and present good sensitivity.

The analysis of Table 2 allows us to conclude that there is a high sensitivity by the BOF ( $>90\%$ ) in all categories and in all age ranges, being this an important result since it is a screening test. Thus, it is possible to state that for all domains, a lower cutoff point is an extremely good predictor of the risk of language alteration for that category. Besides that, it can be affirmed that there is a small possibility that a child with possible language alteration is not diagnosed by the test.

However, with the specificity of the same sensitivity values, which means that there is also a strong possibility that when the values are below the determined cutoff point, children without alterations may be classified as subject to possible risk of language alteration. The chance of false-positive results was higher than 20% in most of the evaluated aspects (Table 2).

A study conducted using the Denver II within the age range from 3 to 72 months demonstrated that the sensitivity of the test was of 83% and the specificity was 43%. For the domain of language, specifically, the sensitivity was 67% and the specificity was 73%<sup>(24)</sup>.

It is noteworthy that the BOF does not have a diagnostic character; it is instead a screening for the identification of risk of development problems in children<sup>(10)</sup>. Thus, it is suggested, from results showing possible risk of language alteration, that the child should be reevaluated within a month to exclude possible temporary factors and, in the persistence of the findings, the subject should be referred to the speech language and auditory therapy services for the confirmation of the diagnosis<sup>(25,26)</sup>.

Figure 2 presents a practical use for the BOF through the calculation of the Performance Indicator (PI). It is recommended that the overall PI is performed and, in case of possible alterations, the remaining performance indicators are calculated, so that it is possible to know which domains are more affected, and this will aid the necessary guidance to be given to the families. If the PI is below the cutoff point (written in each bar), the child possibly presents risk of language alteration; if the PI is above the cutoff point, the child probably does not present risk of language alteration.

The present study provides important contributions to the discussion on the evaluation of language development and presents a proposal on the approach of children under 2 years of age through a screening test with sensitivity higher than 90%. Currently, there are few studies characterizing language development in the context of primary health care and proposing instruments for language evaluation, especially among children under 2 years of age. Knowing the prevalence of language alterations in this population and having a screening test of easy use and interpretation is essential so that the prevention actions are carried out, through systematic and continuous evaluations, early intervening in cases of delays and disorders, since the language is important for building the child's autonomy, socialization, development, and schooling.

Other studies with children in this age range are necessary so that they investigate more deeply the applicability of PI and the cutoff points suggested in other regions, such as the ones with low vulnerability risk, since the present study contemplates only regions of medium and high risk of vulnerability.

## CONCLUSION

The results of the study reveal that one-third of the children evaluated present risk of language alteration within the first two years of life. The analysis of the BOF revealed high sensitivity ( $>90\%$ ) in all categories and in all age ranges; however, the chance of false-positive results was higher than 20% in most evaluated aspects.

## ACKNOWLEDGMENTS

We are thankful to the employees of three *Unidades Básicas de Saúde*, to the parents and legal Guardians of children, to the children, to the students of the courses of health area who took part in data collection, to the *Universidade Federal de Minas Gerais*, to the *Secretaria Municipal de Saúde* of Belo Horizonte, and to the Ministries of Health and Education for the partnership in the development of the *Programa de Educação pelo Trabalho em Saúde* (PET-Saúde).

\*LL participated in data collection, statistical analysis of the data, the writing of the manuscript, and review of the article; CRLA participated in the planning of the study, data collection, the statistical analysis of the data, the writing of the manuscript, and the review of the article; LLCB participated in planning the study, data collection, and the writing of the manuscript; DDRD participated in the statistical analysis of the data, the writing of the manuscript, and the review of the article; CGA participated in the formulation of the study, data collection, and review of the article; SMAL participated in the formulation of the study, data collection, statistical analysis of the data, and review of the article.



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