# Correlation between the Arabic pediatric voice handicap index and both the auditory perceptual assessment and acoustic analysis of voice in patients with hyperfunctional childhood dysphonia

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**Background**
Pediatric voice disorders have typically been blamed on vocal abuse. Changes in the pitch, loudness, and overall vocal quality tend to interfere with communicative abilities. Recently, research has focused on pediatric voice disorders and the effects of a voice disorder on a child's life. It has been reported that children felt that their voice disorders resulted in negative attention and limited their participation in activities.

**Aim**
The aim of this study was to examine the relationship between the pediatric voice handicap index (p-VHI) and both the auditory perceptual assessment (APA) and acoustic analysis of voice in patients with hyperfunctional childhood dysphonia.

**Participants and methods**
This study included 32 children diagnosed with hyperfunctional childhood dysphonia within the age range of 4.7–11.8 years, with a mean of age of 8.4 years; 22 (68.75%) were boys and 10 (31.25%) were girls. All patients were subjected to an APA of their voice after a modified GRBAS (grade, roughness, breathiness, asthenia, strain) scale, and the domains were graded on a scale of 0–3, in which 0 is normal and 3 is severe. Acoustic voice analysis was carried out using Kay Elemetrics' Computerized Speech Laboratory to obtain the following perturbation measures: jitter (%), shimmer (%), and harmonic to noise ratio. All patients were examined by videolaryngoscopy using fiberoptic nasofibrolaryngoscopes. Parents of all patients were given an Arabic p-VHI form that consists of 23 items divided among three subscales: functional, physical, and emotional. Scoring of the Arabic p-VHI is on the basis of an ordinal scale: the parents rate each statement between '0' and '4', in which '0' represents a response of 'never', '1' represents 'almost never', '2' represents 'sometimes', '3' represents 'almost always', and '4' represents 'always'. From these responses, a total score was obtained by adding the values of all responses ranging from 0 to 92.

**Results**
The mean scores on the different domains of the Arabic p-VHI among the study groups were $18.6 \pm 3.75$ in the functional domain (range 4–31), $20.91 \pm 8.36$ in the physical domain (range 6–34), $13.11 \pm 4.86$ in the emotional domain (range 3–28), and $52.77 \pm 18.15$ (range 13–80) in the total score. Correlation between the domains of the APA and those of the Arabic p-VHI showed a significant correlation between both the functional and physical domains of the Arabic p-VHI, namely roughness, breathiness, and strain quality, and pitch, and overall severity, whereas the emotional domain was not correlated with any of the APA domains. The p-VHI total score showed a significant correlation with the overall severity of dysphonia and breathiness. Correlation between the Arabic p-VHI domains and perturbation measures showed a significant correlation between all the domains and all acoustic perturbation measures, namely jitter ($r=0.83$; $P=0.42$), shimmer ($r=0.81$; $P=0.39$), and harmonic to noise ratio ($r=0.76$; $P=0.36$).

**Conclusion and recommendations**
The Arabic p-VHI seems to be a useful tool in children with dysphonia. Although it could help in assessment of the degree of disability that a voice disorder is causing, it should not be used as a sole clinical tool. Other clinical evaluation procedures such as APA and acoustic analysis of voice are strongly recommended in the evaluation of voice disorders and defining the amount of voice handicap.

**Keywords:**
auditory perceptual assessment, pediatric dysphonia, pediatric voice handicap index

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## Introduction

Pediatric voice disorders have typically been blamed on vocally 'abusive' behaviors, and many practitioners tended not to intervene because they believed that the children would 'grow out of it'. However, changes in the pitch, loudness, and overall vocal quality tend to interfere with communicative abilities. Recently, research has focused on pediatric voice disorders and the effects of a voice disorder on a child's life. It has been reported that children and adolescents felt that their voice disorders resulted in negative attention and limited their participation in activities [1].

Dysphonia in childhood may have negative impacts on communication, social relationship, and self-esteem in performing school activities. Although the clinical problems of childhood dysphonia appear significant, attitudes of dysphonic children or their families with regard to voice-related, social, functional, and emotional challenges have not been examined systematically. Voice disorders can be evaluated with the use of instrumental and perceptual approaches; generally, most children with voice problems routinely undergo instrumental evaluations such as laryngoscopic, acoustic, and aerodynamic assessment when visiting hospital. However, it is sometimes difficult to carry out a voice evaluation because the children do not willingly comply with the objectives of the voice assessment. Considering this problem in current practice, it was necessary to standardize the method for evaluating the psychometric characteristic pediatric voice handicap index (p-VHI) [2].

Jacobson's voice handicap index (VHI) has been widely used and accepted for adult clinical practice [3]. The VHI has been translated and validated in several languages, including German, Portuguese, French, Hebrew, Dutch, and Spanish [4,5]. When these various versions of VHI are applied in cross-national comparisons, accurate translations are required to obtain valid results [6]. VHI scores are not diagnosis-bound but rather reflect the subjective assessment of a handicap due to voice problems perceived by the patients and relative comparisons before and after treatment.

Zur *et al.* [7] proposed a modification of the adult VHI known as the p-VHI; this modification involved changing the language of the statement to reflect the responses of the parents/caregivers toward their child and eliminating questions that are not related to the pediatric population. The p-VHI was modified in content and language, and the final 23-item form was validated. These items are equally distributed over three domains: functional, physical, and emotional aspects of voice disorders. The functional domain includes statements that describe the 'impact of voice disorders on patient's daily activities'. The emotional domain indicates the patient's 'affective responses to a voice disorder'. Items comprising the physical domain are statements representing perceptions of laryngeal discomfort and voice output characteristics.

Recently, the Arabic version of the VHI has been validated, both in the extended 30-question format [8] and in the abbreviated 10-question format [9]. The questionnaire quantifies the impact of voice problems on the quality of life of adult patients in the context of their functional, physical, and emotional aspects. However, it has no application for the pediatric population with voice disorders as it lacks questions that explore the parent's responses on the voice problems of their child. Numerous health-related quality of life instruments have been developed to measure the effect of the illness and disability on the daily living activities of children; these instruments focus mainly on the general concepts related to physical abilities, growth and development, and general health perception [10].

Shoeib *et al.* [11] carried out a study to develop an Arabic version of p-VHI and test its validity and reliability. The results of the study suggested that the Arabic p-VHI can be reliably applied to Arabic-speaking children. The Arabic version of p-VHI appears to be a valid and reliable assessment tool that can be used by the parents of Arabic-speaking children with voice disorders to assess the impact of the disorder.

### Aim of the work

The aim of this study was to examine the relationship between the p-VHI and both the auditory perceptual assessment (APA) and acoustic analysis of voice in patients with hyperfunctional childhood dysphonia.

## Participants and methods

This study included 32 children diagnosed with hyperfunctional childhood dysphonia recruited from the Phoniatric Outpatient Clinic, Ain Shams University Hospitals, during July–October 2012; their age range was 4.7–11.8 years, with a mean of 8.4 years. Of them, 22 (68.75%) were boys and 10 (31.25%) were girls. All patients were subjected to the following assessment procedures.

### Perceptual and acoustic voice analysis

A comprehensive protocol for voice assessment used at the Unit of Phoniatrics, Ain Shams University [12] was followed stressing on the following points: (a) patient and parent interview, including personal data and analysis of the complaint, (b) APA of the patient's voice was performed by two expert phoniatricians after the administration of a modified GRBAS (grade, roughness, breathiness, asthenia, strain) scale [13], which classifies dysphonia on a scale of 0–3, in which '0' represents normal voice, '1' represents slight dysphonia, '2' represents moderate dysphonia, and '3' represents severe dysphonia. The APA was documented by voice recording, which was carried out in a sound-treated room with a high-fidelity computerized audio recording system. (c) acoustic voice analysis was carried out using Kay Elemetrics' Computerized Speech Laboratory (model 4300; Kay Elemetric Corporation, New Jersey, USA) to obtain the following perturbation measures: jitter (%), shimmer (dB), and harmonic to noise ratio (H/N). The

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voices of the patients were recorded using a microphone positioned ~15 cm from the mouth, and the patients were asked to phonate a sustained vowel /a/; thereafter, perturbation analysis was carried out to obtain the aforementioned measures.

### Videolaryngoscopic examination of the larynx

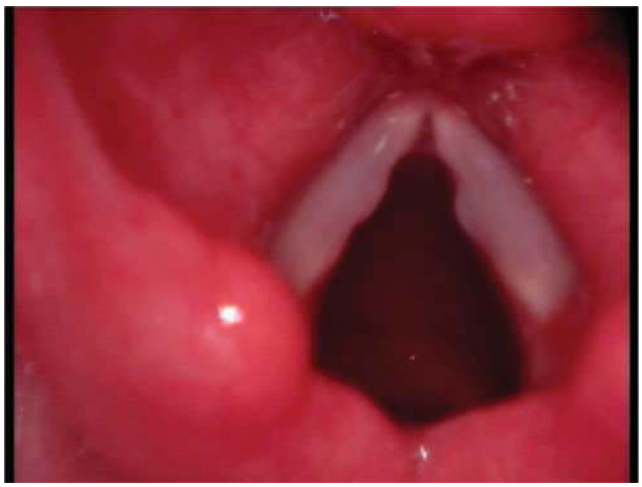
All the patients were examined by videolaryngoscopy using fiberoptic nasopharyngolaryngoscopes Olympus enf type xp. (Olympus Medical Systems Corp., Tokyo, Japan).

### Application of the Arabic pediatric voice handicap index

Parents of all patients were given an Arabic p-VHI form [11], which is a 23-item instrument for the measurement of the parental voice-related quality of life. It consists of three subscales: functional, physical, and emotional (see Appendix). The overall score is a subset of three scores that include functional, physical, and emotional domains. The questionnaire was administered to the parents of all study participants before their clinical voice assessment. The parents were instructed that this questionnaire includes 23 statements that many people have used to describe their voices and the effects of their voices on their lives, and they were asked to circle the response that indicates how frequently they have had the same experience. Scoring of the Arabic p-VHI is on the basis of an ordinal scale; the parents rates each statement between '0' and '4', in which '0' represents a response of 'never', '1' represents 'almost never', '2' represents 'sometimes', '3' represents 'almost always', and '4' represents 'always'. From these responses, a total score was obtained by adding the values of all responses ranging from 0 to 92.

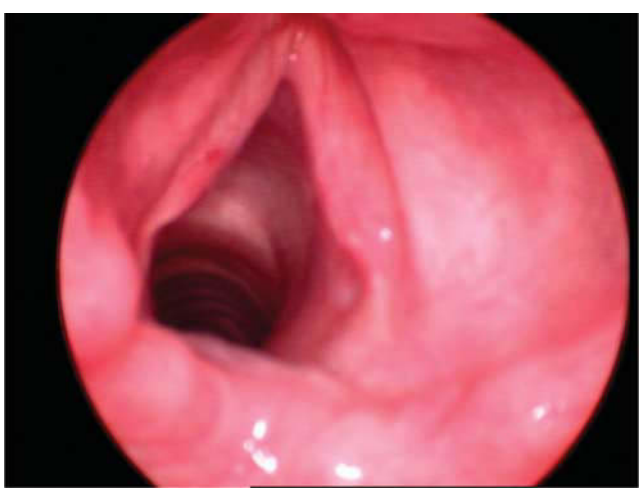
The data were analyzed statistically using the statistical package for social sciences program (version 17; SPSS Inc., Chicago, Illinois, USA). Quantitative data were presented as mean and SD. Correlations between overall categories and subgroup domains were examined using the Spearman rank correlation coefficient, with statistical significance for all analysis set at $P$ equal to 0.05.

**Figure 1**



A case of hyperfunctional childhood dysphonia with bilateral vocal fold nodules.

**Figure 2**



A case of hyperfunctional childhood dysphonia with increased vascular markings.

## Results

Videolaryngoscopic examination of the children showed broad-based nodules at the middle of the free edge (Fig. 1), with incomplete glottal closure caused by these nodules; these findings were present in 24 (75%) of the 32 children involved in this study. Eleven (34%) children showed increased vascular markings in the vocal folds (Fig. 2).

The mean scores on the different domains of the Arabic p-VHI among the study groups (Table 1) were 18.6 ± 3.75 in the functional domain (range 4–31), 20.91 ± 8.36 in the physical domain (range 6–34), 13.11 ± 4.86 in the emotional domain (range 3–28), and 52.77 ± 18.15 (range 13–80) in the total score.

Correlation between the domains of the APA and of the Arabic p-VHI showed a significant correlation between both the functional and physical domains, namely roughness, breathiness, and strain quality and pitch, and overall severity, whereas the emotional domain was not correlated with any of the APA domains. The p-VHI total score showed a significant correlation with the overall severity of dysphonia and breathiness (Table 2).

Correlation between the Arabic p-VHI domains and acoustic voice perturbation measures showed a significant correlation between all the domains and all acoustic perturbation measures, namely jitter ($r = 0.83$; $P = 0.42$), shimmer ($r = 0.81$; $P = 0.39$), and H/N ratio ($r = 0.76$; $P = 0.36$) (Table 3).

## Discussion

The assessment of dysphonia in pediatric patients with vocal fold lesions remains a significant challenge for

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**Table 1 The mean scores on the Arabic pediatric voice handicap index domains in the study group**

| Arabic p-VHI domain (maximum possible score) | Mean ± SD | Range |
|---|---|---|
| Functional (28) | 18.6 ± 3.75 | 4–31 |
| Physical (36) | 20.91 ± 8.36 | 6–34 |
| Emotional (28) | 13.11 ± 4.86 | 3–28 |
| Total score (92) | 52.77 ± 18.15 | 13–80 |

APA, auditory perceptual assessment; p-VHI, pediatric voice handicap index; *r*, Spearman's correlation coefficient.

**Table 2 Correlation between the auditory perceptual assessment domains and Arabic pediatric voice handicap index domains**

| | p-VHI domains | | | |
|---|---|---|---|---|
| APA domains | Functional | Physical | Emotional | p-VHI total |
| Overall severity | $r=0.67$* | $r=0.7$* | $r=0.16$ | $r=0.58$* |
| | $P=0.038$* | $P=0.041$* | $P=0.27$ | $P=0.39$* |
| Roughness | $r=0.49$* | $r=0.53$* | $r=0.06$ | $r=0.21$ |
| | $P=0.02$* | $P=0.006$* | $P=0.63$ | $P=0.07$ |
| Breathiness | $r=0.41$* | $r=0.47$* | $r=0.18$ | $r=0.46$* |
| | $P=0.008$* | $P=0.01$* | $P=0.29$ | $P=0.002$* |
| Strain | $r=0.54$* | $r=0.61$* | $r=0.07$ | $r=0.27$ |
| | $P=0.03$* | $P=0.03$ | $P=0.64$ | $P=0.09$ |
| Pitch | $r=0.43$* | $r=0.46$* | $r=0.04$ | $r=0.17$ |
| | $P=0.003$* | $P=0.004$ | $P=0.87$ | $P=0.3$ |
| Loudness | $r=0.18$ | $r=0.24$ | $r=-0.02$ | $r=0.01$ |
| | $P=0.29$ | $P=0.11$ | $P=0.78$ | $P=0.54$ |

APA, auditory perceptual assessment; p-VHI, pediatric voice handicap index; *r*, Spearman's correlation coefficient.
*Statistically significant ($P<0.05$).

**Table 3 Correlation between the Arabic pediatric voice handicap index domains and acoustic voice perturbation measures**

| Arabic p-VHI domain | Jitter | Shimmer | H/N ratio |
|---|---|---|---|
| Functional | 0.91 ± 0.3 | 0.9 ± 0.13 | 12.4 ± 2 |
| Physical | 1.64 ± 0.3 | 1.32 ± 0.2 | 11.19 ± 1.5 |
| Emotional | 1.23 ± 0.1 | 1.65 ± 0.18 | 7.93 ± 0.8 |
| Total score | 1.75 ± 0.2 | 1.58 ± 0.18 | 11.61 ± 1.43 |
| | $r=0.83$ | $r=0.81$ | $r=0.76$ |
| | $P=0.42$ | $P=0.39$ | $P=0.36$ |
| | Significant correlation | Significant correlation | Significant correlation |

H/N, harmonic to noise; p-VHI, pediatric voice handicap index; *r*, Spearman's correlation coefficient.

pediatric voice professionals. There is no single criterion standard measure for assessment of voice outcome. Voice assessment measures are often used during the evaluation of pediatric dysphonia and generally include aerodynamic and acoustic measures, videostroboscopy and endoscopy, clinician-derived perceptual assessment measures [such as the GRBAS and the Consensus Auditory Perceptual Evaluation of Voice (CAPE-V)], and patient-derived or proxy-derived measures of dysphonia impact (such as the Pediatric Voice Outcome survey, the Pediatric Voice-Related Quality-of-Life Survey, and the p-VHI). Establishing a single criterion standard outcome measure for voice assessment has been difficult because many of these measures assess different aspects of the voice disorder. Several research groups have studied the relationship between the perceptual evaluation and patient-perceived effect on the voice-related quality of life [14].

The purpose of this study was to examine the correlation between the Arabic p-VHI and both the APA and acoustic analysis in children suffering from hyperfunctional childhood dysphonia. The p-VHI is presently used as a tool by many speech-language pathologists for assessing the pediatric patient's handicap as a result of voice problems, and it has also been applied to various patient groups [15,16]. This scale has been shown to have strong test–retest reliability and construct validity and has been used by researchers to study a wide range of voice disorders in the pediatric population [11].

The p-VHI stands to become an important tool that should be incorporated into the comprehensive evaluation of any pediatric dysphonia patient. Results can be used to expand our current knowledge on the effects of a pediatric voice disorder on a child's social, emotional, and educational well being and to empower treatment advocacy [7].

Proper evaluation and treatment of children with voice disorders requires reliable quantitative recording and voice analyses for a thorough assessment and for measuring treatment outcomes after behavioral and/or surgical management [17].

Two formal perceptual assessments commonly used among clinicians to rate voice quality are the GRBAS scale and CAPE-V. Both scales describe the severity of the voice disorder and its attributes. However, perceptual rating of voice quality has been shown to be inconsistent across listeners [18]. Although the'ear' is an important instrument in analyzing voice quality and should always be considered during voice evaluation, objective measures such as acoustic and aerodynamic assessments offer supplemental unbiased documentation of voice change over time [19].

The present study adds to the information on how acoustic measures and APA relate to the degree of handicap a child experiences (as measured by the Arabic p-VHI) as a result of their voice disorder.

Dysphonia, which is a perceptual audible change in a patient's voice as judged by his or her listeners [12], is hypothesized to be a reliable reflection of the degree of voice handicap, because the more severe is the degree of dysphonia, the more difficult it is for people to hear and understand him/her and more is the restriction in joining conversation, with the resultant emotional effects on the patient that may take the form of feeling upset, tensed, or incompetent. In a study carried out by Floris *et al.* [20], dysphonia, as measured by the dysphonia severity index, which is an index designed to establish an objective and quantitative correlate of the perceived voice quality, was found to be highly correlated with the VHI. This is in agreement with the results of our study that showed a significant correlation between the degree of dysphonia and functional, physical, and overall domains of the Arabic p-VHI.

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The data set was analyzed with regard to both individual measures, namely APA and Arabic p-VHI domains. It was found that the studied acoustic parameters are predictive of the severity of handicap in each of the Arabic p-VHI domains and its total score as shown by the significant correlation between these parameters. Moreover, APA was found to be predictive of the functional and physical domains of the Arabic p-VHI as represented by the significant correlation between these parameters, except for loudness. The poor correlation in the Arabic p-VHI emotional domain may reflect the difficulty parents face in recognizing the emotional correlates of their children's voices, although it is also possibly due to the difficulties in the terminology used. This is consistent with the results of Johnson *et al.* [14], who found a fair overall correlation between the clinician-derived CAPE-V assessments and p-VHI assessments in pediatric patients with vocal fold lesions.

The feeling that a patient's voice makes it difficult for people to understand him/her, how they react to this voice problem, and the effect of this problem on the patient himself/herself are related to the decreased loudness and deviant acoustic measures (jitter, shimmer, and H/N ratio) that occur with dysphonic voice [21,22]. Dysphonia is the result of a deviation from the normal vibratory pattern of the vocal fold's mucosal wave; this deviation is described in acoustic analysis as jitter (which reflects a cycle-to-cycle fluctuation in the fundamental period of vocal fold vibration), shimmer (which reflects a cycle-to-cycle variation in the waveform amplitude), and H/N ratio (which indicates the relationship between the regular vocal fold signals and vocal tract noise of the acoustic wave) [21]. This is in agreement with the results of our study that showed a positive correlation between Arabic p-VHI domains and the acoustic perturbation measures (jitter, shimmer, and H/N ratio).

## Conclusion and recommendations

The Arabic p-VHI seems to be a useful tool for assessing children with dysphonia. Although it could help in assessment of the degree of disability that a voice disorder is causing, it should not be used as a sole clinical tool. Other clinical evaluation procedures such as APA and acoustic analysis of voice are strongly recommended for the evaluation of voice disorders and defining of the amount of voice handicap.

## Acknowledgements

### Conflicts of interest

There are no conflicts of interest.

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## Appendix

Arabic pediatric voice handicap index (Arabic p-VHI)

**مؤشر الإعاقة الصوتية للأطفال:**

إختر أحد الأرقام المقابلة لكل سؤال والذي يصف شدة المشكلة لدي طفلك/طفلتك

0= أبدا 1 = نادرا 2= أحيانا 3= غالبا 4= دائما

**الجزء الأول:**

| | |
|---|---|
| 1. صوت طفلي يصعب علي الآخرين سماعه | 4 3 2 1 0 |
| 2. يجد الناس صعوبة في فهم صوت طفلي عندما يتحدث في غرفة كثيرة الضوضاء | 4 3 2 1 0 |
| 3. نجد صعوبة في سماع صوت طفلي عندما ينادي في المنزل | 4 3 2 1 0 |
| 4. طفلي يميل إلي تجنب الكلام مع الناس بسبب صوته | 4 3 2 1 0 |
| 5. طفلي يتحدث مع الأصدقاء، الجيران، المعارف والأقارب بشكل أقل مما يجب بسبب صوته | 4 3 2 1 0 |
| 6. الناس تطلب من طفلي أن يكرر ما يقول عندما يتحدث إليهم وجها لوجه | 4 3 2 1 0 |
| 7. مشكلة الصوت لدي طفلي أثرت سلبا علي حياته الشخصية والتعليمية والإجتماعية | 4 3 2 1 0 |

**الجزء الثاني:**

| | |
|---|---|
| 1. يفقد طفلي الكثير من هواء التنفس عندما يتحدث | 4 3 2 1 0 |
| 2. صوت طفلي يتغير خلال اليوم | 4 3 2 1 0 |
| 3. يسألني الناس دائما "ماذا حدث لصوت طفلك؟" | 4 3 2 1 0 |
| 4. صوت طفلي جاف، خشن/ أجش | 4 3 2 1 0 |
| 5. صفاء صوت طفلي لا يمكن التنبؤ به | 4 3 2 1 0 |
| 6. يبذل طفلي الكثير من الجهد ليتحدث | 4 3 2 1 0 |
| 7. صوت طفلي أسوأ في المساء | 4 3 2 1 0 |
| 8. ينقطع صوت طفلي أثناء الحديث | 4 3 2 1 0 |
| 9. يحتاج طفلي أن يصرخ بصوت عال حتي يتمكن الآخرون من سماعه | 4 3 2 1 0 |

**الجزء الثالث:**

| | |
|---|---|
| 1. يكوت طفلي متوترا عندما يتحدث مع الآخرين بسبب صوته | 4 3 2 1 0 |
| 2. ينزعج الناس بسبب صوت طفلي | 4 3 2 1 0 |
| 3. تجد أن بعض الناس لا تفهم طبيعة مشكلة صوت طفلي | 4 3 2 1 0 |
| 4. طفلي محبط بسبب مشكلة صوته | 4 3 2 1 0 |
| 5. طفلي قليل الخروج من البيت بسبب مشكلة صوته | 4 3 2 1 0 |
| 6. يشعر طفلي بالإنزعاج عندما يطلب منه الآخرون تكرار ما قاله | 4 3 2 1 0 |
| 7. يشعر طفلي بالإحراج عندما يطلب منه الآخرون تكرار ما قاله | 4 3 2 1 0 |

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