Mouth breathing evaluation: use of Glatzel mirror and peak nasal inspiratory flow

Avaliação do respirador oral: uso do espelho de Glatzel e do peak nasal inspiratory flow

ABSTRACT

Purpose: Purpose: To compare the use of the Glatzel mirror and peak nasal inspiratory flow in the evaluation of mouth-breathing participants and to analyze the correlation between these instruments. Methods: Sixty-four children were evaluated — 32 mouth breathers and 32 nasal breathers; the children were aged 4 to 12 years. The mouth breathers were subdivided according to the cause of obstruction by a multidisciplinary team. The Glatzel mirror and peak nasal inspiratory flow were used in both groups to evaluate patency and nasal airflow. Data were then subjected for statistical analysis. Results: The Glatzel mirror allowed us to differentiate the breathing mode considering gender, age, weight, height, and body mass index, but it did not help in identifying the cause of mouth breathing. The peak nasal inspiratory flow did not allow differentiation of the breathing mode and identification of the cause of mouth breathing. In our sample, there was no correlation between the instruments used. Conclusion: The Glatzel mirror was reliable in identifying participants with and without nasal obstruction, although it was not possible to differentiate subgroups of mouth breathers using this instrument. The peak nasal inspiratory flow showed differences only between nasal breathers and surgical mouth breathers. Low correlation was found between these two instruments.

RESUMO

Objetivo: Comparar o uso do espelho de Glatzel e do peak nasal inspiratory flow na avaliação de indivíduos respiradores orais, bem como analisar a correlação dos dois instrumentos. Métodos: Foram avaliadas 64 crianças, sendo 32 respiradoras orais e 32 respiradoras nasais, na faixa etária de 4 a 12 anos. Os respiradores orais, diagnosticados de acordo com equipe multiprofissional, foram subdivididos de acordo com a causa da obstrução. Foram utilizados o espelho de Glatzel e o peak nasal inspiratory flow nos dois grupos para avaliação da permeabilidade e fluxo aéreo nasal. Os dados foram submetidos à análise estatística. Resultados: O espelho de Glatzel diferenciou o modo respiratório considerando-se os estratos gênero, faixa etária, peso, altura e índice de massa corporal da amostra. Entretanto, não foi capaz de dar indícios sobre a causa da respiração oral. Com o uso do peak nasal inspiratory flow, não foi possível diferenciar o modo respiratório e tampouco a causa da respiração oral. Na amostra pesquisada, não houve correlação entre os instrumentos utilizados. Conclusão: O espelho de Glatzel mostrou ser capaz de identificar indivíduos com e sem obstrução nasal, embora não tenha sido possível diferenciar os subgrupos de respiradores orais entre si com o uso do instrumento. Já o peak nasal inspiratory flow mostrou-se capaz de diferenciar apenas respiradores nasais de respiradores orais cirúrgicos. Foi encontrada baixa correlação entre os dois instrumentos.
INTRODUCTION

Mouth breathing may bring many health problems such as changes in orofacial muscle tone, occlusal changes, chewing and swallowing pattern deviations, speech disorders, sleep disorders, learning disabilities, among others(1).

Good patient assessment and, thus, good diagnosis precede an effective speech therapy. Many professionals are responsible for assessment and treatment of mouth breathing patients, but the otolaryngologist is concerned with the definition of the triggering factors of changes in the breathing pattern. However, many patients relying on the Brazilian Public Health System (SUS) have to wait long times for an opportunity to consult an otolaryngologist and to go through exams that can diagnose the causes of mouth breathing(2).

It is important that the speech therapist hold assessment tools that can identify possible nasal obstructions, thus defining management and prognosis based on evidence(3); so the use of easy-to-manipulate, simple, and cheap, but accurate, instrument is necessary. Nowadays, different tools are used to assess nasal patency and resistance. The Glatzel Mirror (GM) is used in clinical practice to assess breathing mode, measuring the nasal airflow by condensation of the expired air, which helps in the identification of nasal obstruction causes(3-7). The literature lacks studies on the validation of this method, so one can question the reliability of the measures it provides.

The peak nasal inspiratory flow (PNIF) is another instrument that can aid in the detection of nasal obstruction causes(8-11), composed of a face mask attached to a graded flow meter that measures the nasal airflow at forced inspiration(12). Both instruments are currently available in the market and can be easily acquired by Speech Therapists. It must be underscored that all instruments must be used in compliance with the manufacturer’s orientation and that the professional should be familiar with all benefits and contraindications related to their use.

Considering the high prevalence of mouth-breathing patients, the consequences of such disorder, and need for an effective evaluation, this study aims to compare the use of the GM and PNIF to assess these patients and to analyze the correlation of both instruments.

METHODS

The research project was approved by the Ethics Committee of four institutions, with protocol number 541/09, and all participants had to sign the informed consent form. This was a cross-sectional descriptive study conducted with a convenience sample comprising participants from an outpatient clinic for mouth-breathing patients and from Elementary and Middle schools of Belo Horizonte. The above-mentioned outpatient clinics admits 2- to 12-year-old children, but only those diagnosed with mouth breathing are followed-up by an interdisciplinary team comprised of otolaryngologists, allergists, orthodontists, and a speech therapist. All children were submitted to skin prick testing and nasofibroscopy.

Sixty-four individuals of both genders and aging from 4 to 12 years were assessed, of which 32 were mouth-breathing patients (MB — case group) and 32 were nasal-breathing patients (NB — control group). Patients were divided by gender, age, weight, and height in groups, for these are important variables for PNIF(2). Mouth-breathing patients were divided into four subgroups by cause of nasal obstruction — allergy, surgery, allergy-surgery, and function — after being classified by an otolaryngologist and an allergist. This characterization is summarized in Table 1.

Inclusion criteria for the MB Group were patients from the outpatient clinics of the institution and, therefore, diagnosed by different professionals with mouth breathing. Inclusion criteria for the NB Group were children without complaint or evidence of nasal obstruction according to speech therapist evaluation(13), anamnesis and parents’ interview(14). Participants whose caregivers did not sign the informed consent form were excluded from both groups, as well as those who reported chronic use of nasal decongestants in the past 3 months, clinical picture of airway infection upon anamnesis, chronic obstructive pulmonary disease, cardiovascular disorders, craniofacial abnormalities or neurologic disorders, self-debasing cognitive distortions, and those not capable of performing the peak inspiratory flow maneuvers.

Exclusion criteria for control group patients who gave affirmative answers for one or more items of the anamnesis form: allergy, rhinitis, recurrent flu, waking up with dry mouth

Table 1. The sample according to gender, age, and breathing mode

| Age group | Females | | Males | | Total | |
|-----------|---------|-------|-------|-------|-------|-------|
|           | MB      | NB    | MB    | NB    | MB    | NB    |
| 4–4:11 years | 0 (0.0) | 0 (0.0)| 2 (6.3)| 2 (6.3)| 2 (3.1)| 2 (3.1)|
| 5–5:11 years | 0 (0.0)| 0 (0.0)| 1 (3.1)| 1 (3.1)| 1 (1.6)| 1 (1.6)|
| 6–6:11 years | 3 (9.4)| 3 (9.4)| 3 (9.4)| 3 (9.4)| 6 (9.4)| 6 (9.4)|
| 7–7:11 years | 4 (12.5)| 4 (12.5)| 5 (15.6)| 5 (15.6)| 9 (14.1)| 8 (12.5)|
| 8–8:11 years | 1 (3.1)| 1 (3.1)| 1 (3.1)| 1 (3.1)| 2 (3.1)| 2 (3.1)|
| 9–9:11 years | 4 (12.5)| 4 (12.5)| 3 (9.4)| 3 (9.4)| 7 (10.9)| 7 (10.9)|
| 10–10:11 years | 1 (3.1)| 1 (3.1)| 3 (9.4)| 3 (9.4)| 3 (9.4)| 3 (9.4)|
| 11–12 years | 1 (3.1)| 1 (3.1)| 0 (0.0)| 0 (0.0)| 1 (1.6)| 1 (1.6)|
| Total       | 14 (43.8)| 14 (43.8)| 18 (56.3)| 18 (56.3)| 32 (50.0)| 32 (50.0)|

Legend: NB = nasal breathers; MB = mouth breathers.
or thirsty, mouth breathing, snoring, resonating, drooling on
the pillow, excessive saliva, apnea, sleeping with the mouth
open, asthma, sinusitis, and bronchitis. In addition, those
who presented, at myofunctional evaluation, lowered mandible,
clenching, tension at mouth closing, mouth ranging from
open and closed, half-open or open were excluded. Patients who
could not keep their mouth closed loosely during the 5-minute
observation were also excluded. Participants excluded from
the control group due to suspected mouth breathing were referred
to otolaryngological evaluation.

The management of mouth-breathing patients was carried out
at the outpatient clinics while they were waiting for the multipro-
essional evaluation. To compose the control group, invitations
with the informed consent form and the anamnesis report were
sent to 140 caregivers of students from Elementary and Middle
schools of Belo Horizonte. In response, 109 forms and reports
were returned, out of which six were not filled in and five were
not correctly filled in. According to the anamnesis report, 58
children were excluded from the study because they presented
at least one characteristic indicating breathing obstruction and
eight because they presented a clinical sign indicating alteration
in breathing mode at speech evaluation.

Each child was taken to a room for evaluation, where
they could be weighed, measured, and oriented to perform a
nasal cleansing action\(^{15}\) to eliminate the possibility of airflow
obstruction due to excess mucous. Afterward, the child was
supposed to remain sitting and breathe normally with eyes
closed, while a researcher would perform the GM examination.
The instrument was placed under the nose of the child, at the
anterior nasal spine, and after 1 minute of habitual expiration
and inspiration, the condensation area was marked on the mir-
ror using a proper pen. Afterward, the indication was put on a
reference note for the Altmann\(^\circ\) mirror. The annotations were
then scanned one by one in a HP PSC 1315 scanner, so the area
could be measured in cm\(^2\) using the software AutoCAD 2009.
The GM was sanitized with 70% alcohol.

The measures of peak inspiratory flow were made us-
ing the In-Check Inspiratory Flow Meter (Clement Clarke
International). Patients were briefly oriented about how to
use the instrument; they were supposed to stand up, put on
the face mask, covering the regions of the mouth and nose,
nose, breathe out and then breathe in at their utmost. We performed
three measures and considered the highest value for the analysis\(^{9-12,16,17}\).

Data were analyzed using the SPSS statistical program,
with significance level set at 5%. Age group, weight, height,
and body mass index (BMI) were grouped according to the
sample distribution, by quartiles.

To assess the distribution of quantitative variables, we
used measures of central tendency and dispersion and the
Kolmogorov–Smirnov normality test. The Mann-Whitney test
was applied to compare medians and the Spearman’s coefficient
to assess the correlation of PNIF and the GM results.

**RESULTS**

A descriptive analysis of the quantitative variables was
made, and the Kolmogorov–Smirnov test showed a normal
distribution only for the variables of height, weight, and PNIF
measures (Table 2).

In the GM data analysis, we found a difference between
mouth and nasal-breathing patients for all variables, except for
one weight (22.40–27.29 kg) and one height band (0.95–1.21 m),
being the nasal breathing higher. As to PNIF, only one height
band (1.22–1.27 m) presented difference (Table 3).

Considering the subgroups, GM was able to distinguish al-
lergic, surgical and allergic-surgical nasal-breathing patients, as
well as allergic and functional mouth-breathing patients. PNIF
was only able to distinguish surgical nasal-breathing patients
though (Table 4).

Correlation between PNIF and the GM was analyzed
for each group of individuals — divided as to breathing
mode — and was proven low in all situations, with no evidence
for significant association between them (Table 5).

**DISCUSSION**

After review, we found that the literature lacks studies
on GM; so there are no reference values, standardization
data, or proof of efficacy. This instrument has been used in
some studies aiming to assess the nasal airflow\(^{3,7,18-20}\). PNIF
has been widely used in studies aimed at the assessment
of nasal airflow, especially in allergic rhinitis patients. The
studies found in the literature address data on sensibility,

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### Table 2. Descriptive analysis of variables (age, height, weight, body mass index) and measures by Glatzel mirror and peak nasal inspiratory flow

| Variables               | Mean   | SD    | Minimum | Q1    | Median  | Q3   | Maximum | 95%CI        | p-value |
|-------------------------|--------|-------|---------|-------|---------|------|---------|--------------|---------|
| Age (months)            | 96.25  | 21.58 | 49.00   | 79.25 | 92.50   | 117.00 | 133.00  | 90.86–101.64 | 0.040*  |
| Height (m)              | 1.28   | 0.11  | 0.95    | 1.22  | 1.28    | 1.35  | 1.51    | 1.25–1.31    | 0.200   |
| Weight (Kg)             | 27.63  | 6.54  | 14.50   | 22.40 | 27.30   | 31.75 | 40.00   | 25.99–29.26  | 0.200   |
| BMI                     | 16.84  | 2.97  | 11.30   | 15.06 | 16.05   | 16.87 | 25.35   | 16.09–17.58  | 0.001*  |
| PNIF (L/min)            | 83.39  | 25.66 | 30.00   | 67.75 | 82.50   | 100.00| 160.00  | 76.98–89.80  | 0.200   |
| GM RN (cm\(^2\))        | 6.26   | 3.33  | 0.31    | 2.82  | 6.54    | 9.00  | 12.40   | 5.43–7.10    | 0.000*  |
| GM LN (cm\(^2\))        | 6.59   | 3.59  | 0.82    | 2.86  | 7.54    | 9.00  | 14.64   | 5.69–7.49    | 0.000*  |
| GM TN (cm\(^2\))        | 12.19  | 6.71  | 1.61    | 5.91  | 12.02   | 18.06 | 25.62   | 10.51–13.86  | 0.025*  |

*Significant values (p≤0.05) — Kolmogorov–Smirnov test

Legend: SD = standard deviation; Q1 = first quartile; Q3 = third quartile; CI = confidence interval; BMI = body mass index; PNIF = peak nasal inspiratory flow; GM = Glatzel mirror; RN = right nostril; LN = left nostril; TN = total nostril

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diagnosis accuracy, reproducibility, and reference values of the instrument(8-11,16,17,21,22).

Our sample showed higher prevalence of mouth-breathing patients in the age group of 6–10 years (Table 1), in agreement with findings of the literature(23,24) — even though some studies have not identified differences concerning age(7,19). The dominance of mouth breathing among patients aging 6–10 years may be justified by the occurrence of physiological tonsil hyperplasia (pharynges, palate, and tongue) at the ages of 4–12 years.

At this age, the structures go through atrophy along with an increase in the size of the upper airways(1). We did not perform

### Table 3. Comparison between values obtained from Glatzel mirror and peak nasal inspiratory flow according to sample characteristics.

| Variables          | GM (cm²) | PNIF (L/min) |
|--------------------|----------|--------------|
|                    | MB       | NB Total | p-value | MB | NB Total | p-value |
| Gender             |          |          |         |    |          |        |
| Male               | 7.75     | 17.40    | 12.57   | <0.01* | 85.11    | 94.44   | 89.78   | 0.10 |
| Female             | 7.00     | 16.39    | 11.69   | <0.01* | 70.36    | 80.00   | 75.18   | 0.23 |
| Age groups         |          |          |         |    |          |        |         |      |
| 4–6.6 years        | 6.87     | 13.24    | 10.06   | 0.02* | 63.86    | 76.67   | 70.36   | 0.21 |
| 6.7–7.6 years      | 8.09     | 17.18    | 12.64   | 0.01* | 73.13    | 93.33   | 83.23   | 0.14 |
| 7.7–9.8 years      | 5.50     | 17.50    | 11.50   | <0.01* | 82.00    | 92.27   | 87.14   | 0.35 |
| 9.9–12 years       | 9.94     | 21.32    | 15.63   | <0.01* | 95.00    | 92.50   | 93.75   | 0.84 |
| Weight             |          |          |         |    |          |        |         |      |
| 14.50–22.39 kg     | 7.92     | 13.73    | 10.46   | 0.02* | 65.78    | 82.86   | 73.25   | 0.17 |
| 22.40–27.29 kg     | 7.88     | 14.55    | 11.00   | 0.06  | 81.88    | 77.14   | 79.67   | 0.78 |
| 27.30–31.74 kg     | 5.35     | 19.83    | 13.87   | <0.01* | 84.29    | 93.50   | 89.71   | 0.23 |
| 31.75–40.00 kg     | 8.20     | 18.29    | 13.24   | <0.01* | 85.00    | 95.63   | 90.31   | 0.38 |
| Height             |          |          |         |    |          |        |         |      |
| 0.95–1.21 m        | 8.01     | 10.57    | 9.04    | 0.22  | 66.89    | 68.33   | 67.45   | 0.86 |
| 1.22–1.27 m        | 8.38     | 18.32    | 14.06   | <0.01* | 68.33    | 95.00   | 83.57   | 0.04* |
| 1.28–1.34 m        | 5.19     | 17.24    | 12.55   | <0.01* | 85.00    | 89.09   | 87.50   | 0.38 |
| 1.35–1.51 m        | 7.87     | 20.42    | 13.04   | <0.01* | 91.00    | 95.71   | 92.94   | 0.54 |
| BMI                |          |          |         |    |          |        |         |      |
| 11.30–15.05        | 8.02     | 15.93    | 11.48   | 0.01* | 76.11    | 90.00   | 82.19   | 0.21 |
| 15.06–16.04        | 5.68     | 17.59    | 12.38   | <0.01* | 82.86    | 86.67   | 85.00   | 0.47 |
| 16.05–18.67        | 9.34     | 17.14    | 12.27   | 0.02* | 69.20    | 79.17   | 72.94   | 0.15 |
| 18.68–25.35        | 5.34     | 17.00    | 12.63   | <0.01* | 93.33    | 93.50   | 93.44   | 0.88 |

*Significant values (p<0.05) – Mann-Whitney test.

Legend: GM = Glatzel mirror; PNIF = peak nasal inspiratory flow; MB = mouth breather; NB = nasal breather; BMI = body mass index.

### Table 4. Comparison of Glatzel mirror’s and peak nasal inspiratory flow’s values according to the classification of mode of breathing.

| Measures          | Allergic MB | Surgical MB | Allergic-surgical MB | Functional MB | NB            |
|-------------------|-------------|-------------|----------------------|---------------|---------------|
| Glatzel mirror    |             |             |                      |               |               |
| Allergic MB       | –           | 0.251       | 0.144                | 0.014*        | <0.01*        |
| Surgical MB       | 0.251       | –           | 0.587                | 0.100         | <0.01*        |
| Allergic-surgical MB | 0.144     | 0.587       | –                    | 0.345         | <0.01*        |
| Functional MB     | 0.014*      | 0.100       | 0.345                | –             | 0.112         |
| Nasal breathing   | <0.01*      | <0.01*      | <0.01                | 0.112         | –             |
| PNIF              |             |             |                      |               |               |
| Allergic MB       | –           | 0.137       | 0.620                | 0.609         | 0.654         |
| Surgical MB       | 0.137       | –           | 0.419                | 0.472         | 0.007*        |
| Allergic-surgical MB | 0.620     | 0.419       | –                    | 0.479         | 0.240         |
| Functional MB     | 0.609       | 0.472       | 0.479                | –             | 0.820         |
| Nasal breathing   | 0.654       | 0.007*      | 0.240                | 0.820         | –             |

*Significant values (p<0.05) – Mann-Whitney test.

Legend: PNIF = peak nasal inspiratory flow; MB = mouth breathing; NB = nasal breathing.

### Table 5. Comparison between mean values of Glatzel mirror and peak nasal inspiratory flow according to breathing mode

| Breathing mode                | GM  | PNIF  | CC   | p-value |
|-------------------------------|-----|-------|------|---------|
| Allergic MB                  | 5.51| 84.55 | -0.04| 0.92    |
| Surgical MB                  | 7.30| 67.70 | 0.15 | 0.67    |
| Allergic-surgical MB         | 8.49| 77.50 | -0.31| 0.45    |
| Functional MB                | 11.99| 96.67 | -1.00| –       |
| Total MB                     | 7.42| 78.66 | -0.07| 0.69    |
| Nasal breathing              | 16.96| 88.13 | 0.33 | 0.07    |

* Significant values (p<0.05) – Spearman correlation coefficient.

Legend: GM = Glatzel mirror; PNIF = peak nasal inspiratory flow; CC = correlation coefficient; MB = mouth breathing.
analysis regarding gender (Table 1) because the study was paired and, although the literature does not have reports on the association of gender with breathing mode\(^7,10\), a study showed higher prevalence of males with such clinical picture\(^24\).

In the comparisons between nasal and mouth breathing modes, all medians obtained from the MB group using GM (Table 3) were lower than those from the NB group, which agrees with the literature\(^7\). Therefore, the GM was able to distinguish mouth-breathing patients from nasal-breathing patients according to gender, age group, weight, height and BMI. Median values provided by PNIF (Table 3), unlike the findings reported in the literature\(^10,11\), were not considered different in the division by gender.

As to the remaining variables, PNIF did not show differences between groups; the literature\(^12\), on the other hand, reports higher values for nasal-breathing patients. Thus, the GM was proven more effective to assess a possible nasal obstruction compared to PNIF in samples stratified by gender, age group, weight, height and BMI.

In analysis involving subgroups (Table 4), that is, Allergic MB, Surgical MB, allergic and Surgical MB, functional MB and NB, we verified that the GM was not able to distinguish patients with no breathing changes from those with a functional picture. It happens because the absence of obstruction makes the measure closer to that of a nasal-breathing patient; hence the instrument is not considered reliable to distinguish MB subgroup patients.

The GM can be used to identify the presence of obstruction, but not its cause. In a previous study\(^7\), the GM was not considered reliable to assess nasal patency, for it was only able to distinguish nasal-breathing cases from allergic-surgical cases. It is important to mention that the aforementioned study considered nasal-breathing patients who had been submitted to surgical treatments for obstruction and later on adopted the nasal-breathing mode.

At PNFI between MB subgroups (Table 4), difference was found only between surgical MB and NB; therefore, it may not be considered reliable to identify most patients with nasal obstruction. The results found were unexpected, because PNIF is usually considered more reliable than the GM\(^2\).

Mean values found by the GM in patients grouped according to breathing mode do not agree with a study\(^7\) that reported lower values mainly for nasal-breathing patients. In our study, we took the classification of these studies’ samples, which diverge.

In literature review, we found a study involving two groups of children aging 4 years to 4 years and 8 months where nasal airflow was measured using the GM. In the first group, submitted to removal of sucking habits, nasal aeration was increased from 10.70 to 18.10 and 18.40 cm\(^2\). The second group, submitted to both removal of sucking habits and to myofunctional therapy, showed increase from 14.10 to 26.40 and 26.50 cm\(^2\). Comparing these values with those of our study, considering the closest group age (4–6.6 years — 6.87 cm\(^2\) for mouth breathing and 13.24 cm\(^2\) for nasal breathing), we found a divergence with data from the literature.

A study addressed the variation of nasal obstruction using the GM after maneuvers of massage and nasal cleansing in mouth-breathing children aging 4 to 11 years. An improvement in airflow was observed right after it, with measures of 16.6 cm\(^2\) before and 20.3 cm\(^2\) after\(^9\). These findings are not in concordance with ours, which reports 7.42 cm\(^2\) for mouth-breathing patients and 16.96 cm\(^2\) for nasal-breathing patients. Differences in the marks of the GM may explain the results.

As to PNIF, we were not able to make comparisons with data from the literature because the studies that used the instrument did not stratify the sample in groups according to the cause of alteration in breathing mode.

In a study conducted with 526 participants aged 8 to 15 years, the researchers presented a mathematic model to calculate the expiratory flow measured by PNIF as related to gender only\(^25\). Another study, with 212 children aging 6 to 11 years, reported that PNIF results were only influenced by age, the variables of gender, height, weight and ethnicity being not decisive for values\(^26\).

Another published study brought reference values for healthy participants, but with an adult-only sample\(^27\). Overall, studies using PNIF describe the instrument as a simple, easy-to-handle, low-cost and fast tool that can provide important data for the management of patients with breathing disturbances, but there are divergences as to the normality pattern of results.

In our study, when assessing the correlation coefficient of measures by both tests (Table 5), we verified a low association in all situations, with no evidence of association between groupings. This finding cannot be compared with the literature, because the studies published did not compare nasal obstruction measures by PNIF with those by the GM.

The lack of studies with samples with subgroups divided by breathing mode also hinders comparison. However, we found a study\(^22\) that compared active anterior rhinomanometry, acoustic rhinometry, and PNIF and found that any of these methods can be used to assess nasal obstruction. PNIF is emphasized because of its low cost, good reproducibility and short measurement time.

The same author conducted a study\(^16\) where he compared the measures by PNIF with anterior rhinomanometry in allergic individuals and concluded that PNIF is reliable for diagnosis and therapeutic follow-up in the field of allergy. A study\(^60\) compared the GM with nasopharyngoscopy and proved the validity of such correlation.

An editorial\(^29\) addressing instruments used to measure nasal patency stated that the Glatzel and Gertner Mirrors, the peak nasal inspiratory or expiratory flow, and oscilometry are tests intended to assess nasal patency, which have been used to identify nasal obstruction.

Nevertheless, the most specific currently available tests are rhinomanometry and acoustic rhinometry. It’s important to mention that the most reliable way of measuring nasal patency is by associating instruments. Moreover, anamnesis data plus clinical examination can be useful in providing information about participants’ breathing mode\(^14,29\).

The lack of studies on GM, on the comparison between methods used in the present study, and between measures of mouth and nasal-breathing patients was a limitation for our work, as well as the small sample size, which did not allow data generalization.
Therefore, further studies are needed to increase the sample, in addition to the inclusion of a gold-standard exam such as Measurement of nasal patency. Speech therapists from SUS believe that it is important to use an instrument that is reliable and actually give evidence of obstruction while patients wait for the otolaryngologist’s assessment.

**CONCLUSION**

The GM was proven able to identify patients with and without nasal obstruction regardless of the cause; however it could not point this cause. PNIF, on the other hand, was shown to be able to distinguish only nasal-breathing patients from surgical mouth-breathing patients; so its applicability is more limited. The correlation of PNIF and the GM was found low in the studied sample.

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