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TITTLE: Intraocular pressure fluctuations assessment in professional wind instrument players.

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Running title: Intraocular pressure variation in musicians

Key Words: Glaucoma risk factors, Intraocular pressure fluctuation, Ocular risk factors, Wind instrument musicians

Clinical relevance: Due to the long-time that wind musicians spend playing their instruments, it is important to investigate if intraocular pressure could be affected by this activity.

Background: To assess the intraocular pressure fluctuations and fluctuations affecting factors in professional wind musicians while playing different tones.

Methods: 30 professional wind musicians (23.0 ± 3.20 years) were recruited from the Professional Music College of A Coruña. A questionnaire about environmental/demographic factors was given to participants. Intraocular pressure was measured four times by ICare IC100 tonometer: before, during low and high-pitched tones, and immediately after stopping playing the wind instrument.

Results: Pairwise comparison revealed statistical differences between measurement points (Sidak, all $p \leq 0.019$), except between before playing and while playing low-pitched tones (Sidak, $p = 1.000$). Intraocular pressure increases during high pitch playing and decreases after stopping playing. No significant differences in intraocular pressure fluctuation were reported between physically active (> 2 days/week) and non-physically active participants (Unpaired t-test, $p = 0.680$). Regarding correlations, all intraocular pressure values were positively correlated (Pearson's correlation, all $r \geq 0.505$, $p \leq 0.004$). Intraocular pressure fluctuations were negatively correlated with musical playing years (Pearson's correlation, $r = -0.396$, $p = 0.030$). There were no significant correlations among intraocular pressure fluctuation and gender, age, weight, height, or daily time playing (Pearson's correlation, all $p \geq 0.058$).

Conclusion: Professional wind musicians suffer intraocular pressure peaks while playing high-pitched tones, therefore, ocular fundus evaluation and visual campimetry should be performed as routine tests in the visual exam of this population.

The intraocular pressure (IOP) value is an indicator of the balance between the production and drainage of aqueous humor.[1] The homeostasis of this process is essential to maintain good eye function, since its increase or decrease is related to different eye pathologies, such as glaucoma (increase) or retinal detachment (decrease).[1,2] In addition to the absolute value, the fluctuation of IOP has also been determined as a risk factor.[3] Due to circadian rhythm, IOP physiologically changes throughout the day, being the difference between the mean diurnal and nocturnal IOP ranges from 3 to 5 mmHg,[4] or even more in pathological populations.[5] Normally, the minimum value is obtained at the end of the afternoon, meanwhile, the maximum value appears between the middle and the end of the night period. It means there is an IOP peak in the early morning that decreases during the day (bathyphase) until reaching the lowest IOP value in the late afternoon when IOP starts to rise again (acrophase).[4]

In addition to the physiological functioning, other exogenous factors have been established as a cause of IOP fluctuations, such as the body posture (greater IOP value in a supine position than in a sitting position),[6] the respiration (there is an IOP increase during Valsalva manoeuvre),[6] physical efforts (decreasing IOP while aerobic exercise[7] and increasing with isometric efforts in high-load condition,[8] perhaps related to a Valsalva manoeuvre), cognitive efforts (showing higher IOP values during an academic exam than in the control session, and higher before than after the exam, which could point to IOP as an indicator of stress),[9] or even the use of a smartphone (especially in low light conditions, probably due to mechanism of accommodation and convergence, the external ocular muscles contraction, the psychophysiological stress, or the neck-flexion posture).[10]

There are also a few studies that have found an increase in IOP while playing a wind instrument, showing a different level of IOP variation concerning the tonal frequency or intensity during playing [11,12]; some authors have suggested that the IOP rising could be related to an involuntary Valsalva maneuver.[13] As a consequence of the amount of time that musicians spend playing or practicing with their instruments, in most cases since childhood, this activity could be a risk factor for ocular hypertension development or even pathologies such as glaucoma. Previous reports have found a greater incidence of visual field defects in wind musicians, correlated with cumulative practice time.[14] However, several of these studies included a small or inadequately defined sample population, encompassing a wide age range, both professional and amateur musicians, and individuals with and without glaucoma; moreover, in some studies, measurements of IOP were conducted in non-representative positions during instrument play.[15-17] Based on the hypothesis that playing wind instruments could cause fluctuations in IOP, the current study aimed to evaluate such fluctuations during the playing different tones and to investigate other potential factors influencing these changes, while exclusively examining young, non-glaucomatous, professionally trained musicians in a natural posture for instrument playing.

METHODS

Participants

For the sample size calculation, PS Power and Sample Size Calculations Software Version 3.1.2 (Copyright © by William D. Dupont and Walton D. Plummer) was used. Data from previous studies with a similar design to the present study indicate that the mean standard deviation (SD) of repeated IOP measures is normally distributed with a value of 2 mmHg; in order to have a 90% power for a significance level of $\alpha = 0.05$ (Type I error associated) with a confidence level of 95% to detect an anticipated mean difference of 1.5 mmHg, the minimum numbers of participants required was 21.[18] Since all the final participants recruited were volunteers from various courses at the Professional Music College of A Coruña (CSM A Coruña, Galicia, Spain), the sample size was expanded beyond the initially calculated value to enhance representativeness and minimize potential biases in the study. This adjustment aimed to ensure that the study encompassed a broader spectrum of musicians.

The initial recruitment process was conducted by the management team of the Professional Music College of A Coruña, who received the information about the study and disseminated it to all students, regardless of the year of enrolment at the institution. Once the initial sample was recruited, the researchers conducted a rigorous evaluation of the inclusion and exclusion criteria for the voluntary participants. Only those who met these criteria were subsequently enrolled to participate in the study. Enrolment was done one by one, following a sequential enrolment list, until the estimated sample size of 30 participants was reached. All other volunteers, both those who have not meet the inclusion and exclusion criteria and those who exceed the pre-determined recruitment number, were excluded. This approach ensured that there was no preselection or bias based on research predisposition or human factors.

Participants were included if they were wind instrument players enrolled at the Professional Music College of A Coruña (Table 1 shows instruments included in the study), had a refractive error between - 8.00 and + 4.00 dioptres, an absence of previous diagnosis of any retinal pathology, have not been diagnosed with ocular infection at the time of the study, not being under treatment with corticosteroids, or have not undergone corneal surgery.[11,19] All participants were informed of the procedures and gave their written informed consent to be included in the study. The study protocol complies with the Declaration of Helsinki and was approved by both the Institutional and Regional Research Ethics Committees (CEIC2013/360).

Outcome measurements

Part 1: Questionnaire

A researcher-administered questionnaire about factors that could affect IOP, personal musical history and habits was self-reported by each participant. The first part of the questionnaire included open-ended questions about the date of birth, height, weight, biological sex, and an anamnesis asking about the presence of systemic and ocular health and drug intake. In addition, dichotomous (yes/no) questions about family history of glaucoma and practice of physical activity more than 2 days per week were asked. The second part of the questionnaire deals with personal musical history: instrument played, years of musical training, daily time playing the instrument and academic year attended at the Professional Music College of A Coruña. Table 2 summarizes the questions and type of the questionnaire.

Part 2: IOP measurements

IOP was measured with the ICare IC100 tonometer (Tiolat Oy, Helsinki, Finland) following the manufacturer's instructions.[20] The ICare IC100 is a rebound portable tonometer with high repeatability that does not require the use of topical anesthesia.[20] This device takes six consecutive measurements automatically, discards the highest and lowest readings, and averages the remaining four providing the mean IOP in mmHg, which was used as the final IOP value. While sitting in a normal playing position, participants were requested to fixate their sight on a straight target; a total of four IOP measurement points were established in the protocol. First, one measurement was taken before playing the instrument (Basal). Then, the second and third measurements were performed while the participants were playing the instrument for 8 seconds on a low (LP) and high pitch (HP) respectively with moderate loudness (see Table 1). The low pitch was the lowest A of the instrument's tessitura, and the high pitch was an A two octaves above the previous one. Previous to the measurement, the tone was given by a piano or a tuner phone app prior to playing to ensure that the pitch played was correct. Finally, the last measurement was recorded immediately after stopping playing (AP) the HP. IOP measurements were repeated six times on each pitch. Measurements were only performed in one eye of each participant; if the instrument allows access to both eyes, one eye was randomly selected, nevertheless, if the selected eye was difficult to be correctly measured because of the specific features of the respective instrument and the accessibility of the examiner, the other one was elected.[11]

All measurements were taken in the morning and afternoon (10.30 a.m. to 3.30 p.m.)[21] by only one examiner to avoid the possible inter-observer variation.[22] To ensure the musicians' comfort and maintain their playing posture the examiner received specialized training at the university optometry clinic previous to the study. Moreover, the examiner was instructed to check with the musicians if they experienced any discomfort during the procedure and to adjust as necessary.

Statistical analysis

SPSS statistical software v. 25.0 for Windows (SPSS Inc., Chicago, United States) was used for data analyses. Significance was set at a $p \leq 0.05$ for all the statical analyses. Previous to the analysis, the normal distribution of the IOP results was checked using the Shapiro-Wilk test; parametric tests were applied in all the analyses.[23]

Differences between IOP results obtained on each measuring point were assessed using the Greenhouse-Geisser or Huynh-Feldt correction based on Mauchly's W test of Sphericity, while the Sidak test was used to detect significant pairwise differences.[23] IOP fluctuation was analysed with respect to weekly physical activity using a t-test for independent samples; participants were divided into two groups based on the frequency of physical activity reported in the questionnaire (see Table 2): those who engaged in physical activity more than twice a week and those who have not. For graphical purposes, Bland and Altman procedures were used; this method describes the agreement between two variables, representing averages versus differences.[23,24] The 95 % limits of agreement (95 % LoAs) were calculated (Mean difference ± 1.96 x SD), as well as the exact 95% Confidence Intervals (95% CI) for Upper and Lower LoAs considered as a pair (Mean difference ± $c_{t0.025}$ x SD; Mean difference ± $c_{t0.975}$ x SD).[23,25]

Relationships were assessed through Pearson's correlation for parametric data. The correlations between basal, LP, HP, and AP IOP values were calculated. Furthermore, the impact of the studied environmental and demographic factors on the increase in IOP during HP playing was also analysed (the increase in IOP was calculated as the difference between IOP HP and Basal IOP, expressed as ΔIOP = IOP HP - Basal IOP). Correlation between variables was described as weak (0.20 – 0.40), moderate (0.41 – 0.60), good (0.61 – 0.80) or strong (0.81 – 1.00).[26]

RESULTS

The sample consisted of 30 eyes (56.67 % were right eyes) of 30 participants (22 men and 8 women) with a mean ± SD age of 23.0 ± 3.20 years (range from 19 to 30 years), mean ± SD height of 176.7 ± 9.33 cm and mean ± SD weight of 77.1 ± 17.13 kg. Only one participant had a family history of glaucoma. Regarding their musical history, participants had been playing their wind instrument for a mean ± SD of 13.8 ± 2.88 years, with an average daily dedication of mean ± SD of 3.3 ± 1.32 hours.

Differences between IOP values

A statistical difference in IOP values between each measurement point was found (Mauchly's W: $p < 0.001$, $\varepsilon = 0.570$; Greenhouse-Geisser, all $p < 0.001$). Pairwise comparisons are reported in detail in Table 3. Figure 1 provides a Bland-Altman plot of means against the differences between the data obtained at each measurement point. On the paired analysis, there were no significant differences between Basal IOP and LP (Sidak post-hoc, $p = 1.000$) (Table 3, Fig. 1A). Significant differences were observed between all other values obtained in each measurement point: Basal IOP vs. HP (Fig. 1B) or vs. AP (Fig. 1C), LP vs. HP (Fig. 1D) or vs. AP (Fig. 1E), and HP vs. AP (Sidak post-hoc, all $p \leq 0.019$) (Fig. 1F).

Correlation between IOP values

There was a good positive correlation between Basal IOP and all other IOP values (Pearson's correlation, all $r \geq 0.711$, $p \leq 0.001$) and between LP and AP (Pearson's correlation, $r = 0.831$, $p < 0.001$). There was also a positive but described such as a moderate correlation between LP and HP, and between HP and AP (Pearson's correlation, all $r \geq 0.505$, $p \leq 0.004$).

Analysis of the relationship between the increase in IOP and environmental or demographic factors

IOP fluctuation was weakly negatively correlated with the years of musical training (Pearson's correlation, $r = -0.396$, $p = 0.030$). There were found no statistically significant correlations between IOP fluctuation and gender, age, weight, height, or daily time playing the instrument (Pearson's correlation, all $p \geq 0.058$). There was also found no significant difference in IOP fluctuation between the group that performed physical activity more than two days per week and the group that did not (Unpaired t-test, $p = 0.680$).

DISCUSSION

In the present study, the fluctuation of IOP on professional wind musicians during playing different tones was studied, as well as the possible influence of other factors on these fluctuations. The increase in IOP and its fluctuations are frequently related to the development of some ocular pathologies, such as glaucoma, which causes an irreversible visual field reduction due to the mechanical stress and ischemic effects of IOP on the retinal nerve fibre layer.[1] Previously, Schuman et al.[13] reported a significant correlation between playing high-resistance wind instruments and abnormal visual fields. This finding was later confirmed by Lin et al.,[14] who also observed an association between mean visual field defect and practice time.

Specifically, they found that there was a 0.07 dB increase in the mean visual field defect for every 1,000 cumulative hours of practice and playing time.

Results obtained here showed a mean Basal IOP and LP in normal lower values (16.1 ± 0.68 and 16.3 ± 0.64 mmHg respectively) with no significant difference between them (Fig. 1A). Contrary, while HP, the IOP rises to a mean value of 20.0 ± 0.99 mmHg, which was significantly different to the Basal or LP value (Fig. 1B and D); moreover, it was also found a significant difference in the IOP value at the end playing (14.7 ± 0.67 mmHg) (Fig. 1F). In addition, significant differences have also been observed between AP and Basal or LP values (Fig. 1C and E). All these results showed that IOP fluctuations during normal playing are related to the HP: there is an increase during HP, which decreases to regular or even lower values after stopping playing the high-pitched note. These findings are in agreement with previous research in which an IOP increase related to the tone frequency played (greater in high-pitched tones), especially when playing at high intensity (*fortissimo*) was also found.[11,12,27] As a reinforcement of this idea, there was found a positive correlation between IOP values: the higher the basal IOP, the higher the LP, HP, and AP IOP.

It has been hypothesized that the increase in IOP during playing could be generated by the Valsalva maneuver,[12,13] although this hypothesis is controversial. On the one hand, this hypothesis has been disputed because to obtain a good quality sound playing a wind instrument, it is necessary to use diaphragmatic breathing with open glottis, a condition that does not occur during a Valsalva maneuver.[28] It should be noted that in the present study only professionally trained musicians from the Professional Music College of A Coruña were recruited, who presumptively have good breath control; nevertheless, an IOP increase was also found. Besides, de Crom et al.[16] found a higher increase in the IOP of professional musicians versus amateurs, which is difficult to explain by the hypothesis of an involuntary Valsalva manoeuvre due to bad breathing techniques. In a separate study, Schuman et al.[13] measured IOP and uveal thickness before and during playing, revealing a positive correlation between uveal volume increase and the musician's IOP; this relationship can be explained by the rise in intrathoracic pressure and compression of the intrathoracic venous system, which is transmitted through veins to the choroid, leading to an increase in choroidal volume and an increase in IOP. However, a standardized Valsalva manoeuvre did not produce an increase in uveal volume.[29]

On the other hand, also according to Schuman et al.[13] the pattern of IOP increase during playing a high-resistance wind instrument is similar to that seen in a Valsalva manoeuvre. However, Markoff[28] suggested that the categorization of instruments as high or low resistance was imprecise, since the authors did not take into account certain characteristics of the instruments that affect the amount of lung volume and air velocity required to play. A finding of the present study that could also support the theory of the Valsalva manoeuvre as responsible for the increase in IOP while playing was that IOP fluctuation was negatively correlated with years of musical training; the more years of playing the instrument, the lower the IOP increase. This could be related to the fact that the more professional the musician, the more controlled the breathing, although the relationship was weak and therefore of poor predictive quality. To enlighten this controversy, novel studies which control if the Valsalva manoeuvre occurs while playing are necessary. One way to test this phenomenon may be through otoscopic examinations during playing time: the Valsalva manoeuvre can be objectively detected by otoscopy, as the increased pressure in the middle ear through the Eustachian tube causes the movement of the tympanic membrane.[30] Therefore, the relationship between both IOP fluctuations and the Valsalva manoeuvre can be clarified by evaluating the IOP value and the tympanic movements while playing a wind instrument.

One of the main limitations of the present study was that musicians were asked to play at medium intensity (*mezzoforte*), but the volume was not measured objectively by a sound level meter. The literature found that the IOP increase was greater when playing louder,[11-13] therefore, it may be differences between the IOP fluctuation in the participants due to the intensity and not to the tonal frequency. In addition, only professionally trained musicians were measured; a "control" group with no professional musicians should be recruited during future studies to perform comparisons. Moreover, future studies should consider the child population, since people usually start to play an instrument between 3 and 10 years old.

To conclude, in normal conditions of playing, the impact of playing a wind instrument on the IOP of professional musicians depends on the note played, with HP being responsible for the IOP peaks. These peaks could be risk factors for the development of some ocular pathologies, therefore, regular ocular fundus evaluation and visual campimetry should be routine tests in the visual exam of wind musicians for a preventive early diagnosis of any possible pathology. Further research to establish the mechanism of IOP increase while playing is needed.

REFERENCES:

1 Machiele R, Motlagh M, Patel BC. Intraocular pressure. City; 2022. Available from: https://pubmed.ncbi.nlm.nih.gov/30335270/.

2 Høvding G, Aasved H. Prognostic factors in the development of manifest open angle glaucoma: A long-term follow-up study of hypertensive and normotensive eyes. *Acta ophthalmol* 1986; 64: 601-608.

3 McMonnies CW. The significance of intraocular pressure elevation during sleep-related postures. *Clin Exp Optom* 2014; 97: 221-224.

4 Aptel F, Weinreb RN, Chiquet C *et al.* 24-h monitoring devices and nyctohemeral rhythms of intraocular pressure. *Prog Retin Eye Res* 2016; 55: 108-148.

5 Huang J, Katalinic P, Kalloniatis M *et al.* Diurnal intraocular pressure fluctuations with self-tonometry in glaucoma patients and suspects: A clinical trial. *Optom Vis Sci* 2018; 95: 88-95.

6 Kim YW, Park KH. Exogenous influences on intraocular pressure. *Br J Ophthalmol* 2019; 103: 1209-1216.

7 Saimaiti A, Zhou DD, Li J *et al.* Dietary sources, health benefits, and risks of caffeine. *Crit Rev Food Sci Nutr* 2022: 1-19.

8 Roddy G, Curnier D, Ellemberg D. Reductions in intraocular pressure after acute aerobic exercise: A meta-analysis. *Clin J Sport Med* 2014; 24: 364-372.

9 Jimenez R, Vera J. Effect of examination stress on intraocular pressure in university students. *Appl Ergon* 2018; 67: 252-258.

10 Ha A, Kim YK, Park YJ *et al.* Intraocular pressure change during reading or writing on smartphone. *PLoS One* 2018; 13: e0206061.

11 Kappmeyer K, Lanzl IM. Intra-ocular pressure during and after playing high and low resistance wind instruments. *Ophthalmologe* 2010; 107: 41-46.

12 Schmidtmann G, Jahnke S, Seidel EJ *et al.* Intraocular pressure fluctuations in professional brass and woodwind musicians during common playing conditions. *Graefes Arch Clin Exp Ophthalmol* 2011; 249: 895-901.

13 Schuman JS, Massicotte EC, Connolly S *et al.* Increased intraocular pressure and visual field defects in high resistance wind instrument players. *Ophthalmology* 2000; 107: 127-133.

14 Lin S-C, Zheng CX, Waisbourd M *et al.* Visual field changes in professional wind versus non-wind musical instrument players in the philadelphia orchestra. *J Ophthalmic Vis Res* 2018; 13: 224.

15 Matthe E, Schlief MC, Georgii S *et al.* Central retinal venous pressure is higher than intraocular pressure during amateur trumpet playing. *Graefes Arch Clin Exp Ophthalmol* 2019; 257: 1467-1472.

16 de Crom R, Webers CAB, van Kooten-Noordzij MAW *et al.* Intraocular pressure fluctuations and 24-hour continuous monitoring for glaucoma risk in wind instrument players. *J Glaucoma* 2017; 26: 923-928.

17 O'Hare F, Turner AW, Crowston JG *et al.* Trumpet tension. *BMJ Case Rep* 2009; 2009.

18 Patyal S, Bhadauria M, Yadav A *et al.* Intraocular pressure changes and anterior chamber angle findings in wind instrument players. *PAPIREX-Indian Journal of Research* 2016; 5.

19 Aydin P, Oram O, Akman A *et al.* Effect of wind instrument playing on intraocular pressure. *J Glaucoma* 2000; 9: 322-324.

20 Sanchez Pavon I, Cañadas P, Martin R. Repeatability and agreement of intraocular pressure measurement among three tonometers. *Clin Exp Optom* 2020; 103: 808-812.

21 Quaranta L, Katsanos A, Russo A *et al.* 24-hour intraocular pressure and ocular perfusion pressure in glaucoma. *Surv Ophthalmol* 2013; 58: 26-41.

22 Krummenauer F, Sagri D, Bestges BB *et al.* Prospective reliability trial to assess inter and intra observer reliability of rebound tonometry in the eyes of healthy probands. *Klin Monbl Augenheilkd* 2015; 232: 1274-1278.

23 Armstrong RA, Davies LN, Dunne MC *et al.* Statistical guidelines for clinical studies of human vision. *Ophthalmic Physiol Opt* 2011; 31: 123-136.

24 Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet* 1986; 1: 307-310.

25 Carkeet A. Exact parametric confidence intervals for bland-altman limits of agreement. *Optom Vis Sci* 2015; 92: e71-80.

26 Dunn G. Design and analysis of reliability studies: The statistical evaluation of measurement errors. New York, London: Oxford University Press: Edward Arnold Publishers, 1989.

27 Lanzl IM, Kappmeyer K, Kotliar KE. Intraocular pressure during wind instrument playing. *Invest Ophth Vis Sci* 2012; 53: 4174.

28 Markoff JI. High-resistance wind instruments and IOP. *Ophthalmology* 2001; 108: 635.

29 Kim YW, Girard MJ, Mari JM *et al.* Anterior displacement of lamina cribrosa during valsalva maneuver in young healthy eyes. *PLoS One* 2016; 11: e0159663.

30 Vorwerk U, Steinicke G, Begall K. Observation of eardrum movements during quasi-static pressure changes by high-speed digital imaging. *Audiology Neurotology* 1999; 4: 150-155.

Instrument (n)	**LP**	**HP**
Saxhorn (1)	55 Hz	220 Hz
Tuba (1)	55 Hz	220 Hz
Tenor saxophone (1)	110 Hz	440 Hz
Trombone (5)	110 Hz	440 Hz
Horn (1)	110 Hz	440 Hz
Piccolo trumpet (3)	110 Hz	440 Hz
Clarinet (5)	220 Hz	880 Hz
Alto saxophone (1)	220 Hz	880 Hz
Trumpet (6)	220 Hz	880 Hz
Oboe (2)	440 Hz	1568 Hz
Transverse flute (4)	440 Hz	1760 Hz

Table 1. Frequencies played by each instrument. LP = Low Pitch; HP = High Pitch.

Question	Answer type
1. Birth date	Open question
2. Biological sex	Dichotomous (Men/Women)
3. Height	Open question (in cm)
4. Weight	Open question (in kg)
5. General health: Hypertension	Dichotomous (Yes/No)
6. General health: Diabetes	Dichotomous (Yes/No)
7. General health: Cardiac insufficiency	Dichotomous (Yes/No)
8. General health: Sleep apnoea	Dichotomous (Yes/No)
9. General health: Other pathology	Open question
10. Drugs intake	Open question
11. Ocular health: Glaucoma	Dichotomous (Yes/No) to each eye
12. Ocular health: Ocular surgery	Dichotomous (Yes/No) to each eye
13. Ocular health: Other pathology	Open question
14. Refractive error: Myopia	Open-ended question to each eye
15. Refractive error: Hyperopia	Open-ended question to each eye
16. Refractive error: Astigmatism	Open-ended question to each eye
17. Family history of glaucoma	Closed question: I don't know / No / Yes (what relative?)
18. Physical exercise more than 2 days per week	Dichotomous (Yes/No)
19. Instrument played	Open question
20. Years playing the instrument	Open question
21. Time per day playing the instrument	Open question
22. Academic year attended at the Professional Music College	Closed question: 1º, 2º, 3º, 4º

Table 2. Diagram of the questionnaire.

	Mean ± SD	Mean difference ± SD	p	95 % LoAs		95 % CI of LoAs	
				Lower	Upper	Lower	Upper
Basal	16.1 ± 3.72	-0.17 ± 2.601	1.000	-5.26	4.93	-4.28 / -7.15	3.94 / 6.82
LP	16.3 ± 3.49						
Basal	16.1 ± 3.72	-3.93 ± 3.823	<0.001	-11.43	3.56	-9.98 / -14.20	2.11 / 6.33
HP	20.0 ± 5.43						
Basal	16.1 ± 3.72	1.37 ± 2.326	0.019	-3.19	5.93	-2.31 / -4.88	5.04 / 7.61
AP	14.7 ± 3.68						
LP	16.3 ± 3.49	-3.77 ± 4.470	<0.001	-12.53	4.99	-10.83 / -15.77	3.30 / 8.24
HP	20.0 ± 5.43						
LP	16.3 ± 3.49	1.53 ± 2.096	<0.001	-2.58	5.64	-1.78 / -4.10	4.85 / 7.16
AP	14.7 ± 3.68						
HP	20.0 ± 5.43	5.30 ± 4.779	<0.001	-4.07	14.67	-2.25 / -7.53	12.85 / 18.13
AP	14.7 ± 3.68						

Table 3. Descriptive statistics and differences of IOP values between measurement points. All values in mmHg. n = 30. SD = Standard Deviation. IOP = intraocular pressure. 95 % LoAs = 95 % Limits of Agreement. 95 % CI of LoAs = 95 % Confidence Interval of Limits of Agreement. LP = Low Pitch; HP = High Pitch; AP = After Playing.

FIGURE LEGENDS

Figure 1. Mean versus differences (Bland-Altman plot) between the values obtained in each measurement point in n = 30 participants. The thick solid horizontal line indicates the mean difference while the closely dashed horizontal lines the 95% LoAs (Mean difference ± 1.96xSD). The widely dashed horizontal lines indicate the 95% Confidence Interval of the LoAs. A) Basal vs. Low pitch, B) Basal vs. High pitch, C) Basal vs. After playing, D) Low pitch vs. High pitch, E) Low pitch vs. After playing, F) High pitch vs. After playing. 95% LoAs = 95% Limits of Agreement. 95% CI = 95% Confidence Interval.