WELCOME TO MY TRANSLATION MEMORY

Emily Jandt /
English-Portuguese Translator



↳ Trabalhe comigo

WHO'S EMILY?

I am a translator and proofreader with 3 years of experience. I work mainly with technical translation. Most of my work are in the medical field, although I have got experience within other areas such as language. In addition, I have already authored some scientific texts.



Level of physical activity and respiratory muslce force in healthy children.

DOI: 10.1590/1809-2950/20017728022021

ORIGINAL RESEARCH

Level of physical activity and respiratory muscle force in healthy children

Atividade física e força muscular respiratória em crianças saudáveis

Actividad física y fuerza muscular respiratoria en niños sanos

Camila de Souza Espindola[I], Rafaela Coelho Minsky[II], Juliana Cardoso[III], Izabela Cabral Xavier Sarmento de Figueiredo[IV], Camila Isabel Santos Schivinski[V]

ABSTRACT | This study aimed to verify the relationship between the level of physical activity (LPA) and age with respiratory muscle strength (RMS) parameters of healthy children, as well as to compare this data between boys and girls. Healthy schoolchildren (6 to 12 years old) from the metropolitan area of Florianópolis-Santa Catarina/Brazil were the subjects of this study. Health was controlled by questionnaire, health record and spirometric parameters. Manovacuometry was performed to evaluate the RMS parameters and a questionnaire was applied to assess the LPA. In the sequence of the Kolmogorov-Smirnov test, the Spearman's correlation test was applied to verify the relationship between variables, and U-Mann-Whitney test to compare the RMS parameters between genders and LPA (active group-AG and inactive group-IG). The level of significance adopted was 5%. In total, 76 children (10.1±1.7 years) participated in this study, with mean maximum inspiratory pressure (MIP) of -89.7±41.4cmH_2O and maximum expiratory pressure (MEP) 86.6±22.6cmH_2O. The paramaters of RMS and LPA level were not related. Values of MIP, MEP and predicted percentage of MEP were significantly related to age. AG showed a higher MIP value compared with IG. There was no difference between genders for LPA, there was only a difference for MEP in boys. RMS parameters and LPA were not related, but both were related to age. Active children had a higher MIP value compared with inactive children. Between genders, there was no difference in the LPA and boys showed higher MEP values.

Keywords | Respiratory Muscles; Physical Activity; Muscle Strength; Child.

RESUMO | Este artigo tem como objetivo verificar a relação entre a idade e o nível de atividade física de crianças não saudáveis (NAF) com parâmetros de força muscular respiratória (FMR) de crianças saudáveis e comparar os dados entre gêneros. Participaram da pesquisa escolares saudáveis de 6 a 12 anos provenientes da Grande Florianópolis (SC), Brasil. A higidez foi controlada com um questionário, um recordatório de saúde e parâmetros espirométricos. Avaliaram-se parâmetros de FMR por manovacuometria e seus valores preditos (%) e foi aplicado um questionário sobre NAF. Aplicou-se também o teste Kolmogorov-Smirnov e, na sequência, foram realizados os testes de correlação de Spearman, T e U-Mann-Whitney para comparação dos dados de FMR entre gêneros e NAF. Denominou-se GA para o grupo ativo e GI para o grupo inativo e se adotou 5% como nível de significância. Participaram da pesquisa 76 crianças (10,1±1,7 anos) com média de pressão inspiratória (PI_{MAX}) de -89,7±41,4 cmH_2O e de pressão expiratória máximas (PE_{MAX}) de 86,6±22,6cmH_2O. Os resultados mostraram que os parâmetros de FMR e NAF não apresentaram relação,

[I]Universidade do Estado de Santa Catarina (UDESC) – Florianópolis (SC), Brasil. E-mail: camilase_@hotmail.com. ORCID: 0000-0002-8176-3901
[II]Universidade do Estado de Santa Catarina (UDESC) – Florianópolis (SC), Brasil. E-mail: rafacoelho@gmail.com. ORCID: 0000-0001-7623-4852
[III]Universidade do Estado de Santa Catarina (UDESC) – Florianópolis (SC), Brasil. E-mail: juccardosoo@gmail.com. ORCID: 0000-0002-2371-8416
[IV]Universidade do Estado de Santa Catarina (UDESC) – Florianópolis (SC), Brasil. E-mail: izabelacefigueiredo@hotmail.com. ORCID: 0000-0003-3088-0823
[V]Universidade do Estado de Santa Catarina (UDESC) – Florianópolis (SC), Brasil. E-mail: cacaiss@yahoo.com.br. ORCID: 0000-0002-6319-9727

Correspondig address: Camila Isabel Santos Schivinski – R. Pascoal Simone, 358 – Florianópolis (SC), Brasil – ZIP Code: 88080-350 – E-mail: cacaiss@yahoo.com.br – Financing source: Grant Term Fapesc nº 2017/TR/845 – Conflict of interest: nothing to declare – Presentation: Aug. 05th, 2020 – Accepted for publication: July 12th, 2021 – Approved by the Ethics Committee: CAAE 38752040.0.0000.0118.

enquanto os valores de PI_{MAX}, PE_{MAX} e $\%PE_{MAX}$ se relacionaram significativamente com a idade. Além disso, o GA apresentou maior valor da PI_{MAX} em comparação ao GI e não houve diferença entre gêneros para NAF, somente maior PE_{MAX} nos meninos. Os parâmetros de FMR e NAF não se associaram, mas ambos apresentaram relação com a idade. Na comparação entre os grupos, as crianças ativas apresentaram maiores valores de PI_{MAX} que as inativas. Não houve diferença no NAF entre gêneros, mas os meninos apresentaram maiores valores absolutos de PE_{MAX}.

Descritores | Músculos Respiratórios; Atividade Física; Força Muscular; Criança.

RESUMEN | Este artículo tiene como objetivo comprobar la relación entre la edad y el nivel de actividad física de niños no sanos (NAF) con los parámetros de fuerza muscular respiratoria (FMR) de niños sanos, así como comparar los datos entre los géneros. En el estudio participaron escolares sanos de 6 a 12 años de edad de la gran Florianópolis (Brasil). Para analizar la buena salud se utilizaron cuestionario, recordatorio clínico y parámetros espirométricos. Los parámetros de FMR se evaluaron por manovacuometría y sus valores predichos (%), y se aplicó un cuestionario sobre NAF. También se aplicó la prueba de Kolmogorov-Smirnov y, posteriormente, se realizaron los test de correlación de Spearman, t y U-Mann-Whitney para comparar los datos de FMR entre géneros y NAF. Se denominó GA al grupo activo y GI al grupo inactivo, y el nivel de significación adoptado fue del 5%. En el estudio participaron 76 niños (10,1±1,7 años) con presión inspiratoria media (PI_{MAX}) de -89,7±41,4 cmH_2O y con presión espiratoria máxima (PE_{MAX}) de 86,6±22,6 cmH_2O. Los resultados mostraron que los parámetros de FMR y NAF no estaban relacionados, mientras que los valores de PI_{MAX}, PE_{MAX} y $\%PE_{MAX}$ se relacionaron significativamente con la edad. Además, el GA tuvo un valor de PI_{MAX} más alto que el GI y no hubo diferencias entre los géneros para NAF, solo mayor PE_{MAX} en los niños. Los parámetros de FMR y NAF no estuvieron asociados, pero ambos se relacionaron con la edad. Al comparar los grupos, los niños activos tuvieron valores de PI_{MAX} más altos que los niños inactivos. No hubo diferencia en NAF entre los géneros, pero los niños tuvieron valores de PE_{MAX} más altos.

Palabras clave | Músculos Respiratorios; Actividad Física; Fuerza Muscular; Niño.

INTRODUCTION

Physical activity is defined as any body movement produced by skeletal muscles that requires energy expenditure. If practiced regularly and in moderate intensity, it brings health benefits[1] such as: optimization of blood oxygenation, better weight control, and improvement of cardiorespiratory and mental functions. In children, muscle strength, flexibility, and the bone mass peak also increase[2,3]. Thus, if started early in childhood and associated with factors such as genetics, nutrition and environment, physical activity will help the full development of physical fitness and ensure a good health for growth[1].

The practice of physical activity optimizes the action of respiratory muscles even when they are not the focus of exercise, having a conditioning effect on muscles of this group, besides benefiting pulmonary function. This happens because the overload generated during physical activity causes the respiratory musculature to work with greater speed and strength to supply the body demand, which improves its function[1] and conditioning.

In young people, the study by Quirino et al. showed that the practice of physical exercise increases the maximal respiratory pressures in young people aged 18 to 30 years[4]. Dassio and Dimitriou also found an association between aerobic exercise and respiratory muscle strength (RMS) in healthy young people aged 6 to 18 years, with higher RMS in exercise practitioners when compared with non-practitioners[5].

However, it is still necessary to understand the influence of physical activity on the respiratory muscles of healthy schoolchildren, since this is usually studied exclusively in disease conditions[6,7]. This study aimed to evaluate the relationship of RMS parameters with the level of physical activity (LPA) and age of healthy children, and to compare the results, also in terms of gender.

METHODOLOGY

The cross-sectional observational analytical study included healthy students aged from 6 to 12 years old; non-athletes, i.e., not enrolled in sports federations; non-obese and non-malnourished (≥3 percentile and <85kg/m²); from educational institutions in Florianópolis metropolitan area (Santa Catarina). Parents and guardians filled out an informed consent form and the students also consented to participate.

Level of physical activity and respiratory muslce force in healthy children.

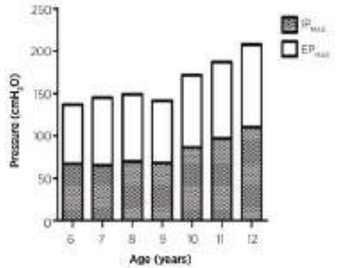
Table 2. Continuation

Characteristic	TG N=76/G: 57.9% Mean±SD (CI)	IG N=35/G: 60% Mean±SD (CI)	AG N=41/G: 56.1% Mean±SD (CI)	p-value
EP_{MAX}(cmH$_2$O)	86.6±22.5 (81.4-91.7)	83.5±25.1 (74.9-92.1)	89.2±20.1 (82.9-95.6)	0.27
FVC(%)	97.9±11.7 (95.2-100.6)	94.6±9.94 (91.2-98.0)	100.7±12.5 (96.7-104.6)	0.10
FEV$_1$(%)	92.9±10.8 (90.4-95.4)	90.8±10.1 (87.5-94.3)	94.7±11.2 (91.2-98.3)	0.11
FEV$_1$/FVC(%)	93.7±14.1 (90.4-96.9)	92.7±18.5 (86.3-99.1)	94.5±9.10 (91.6-97.3)	0.59
EFP(%)	84.2±10.0 (81.9-86.5)	85.3±11.5 (81.4-89.3)	83.3±8.58 (80.5-86.0)	0.38

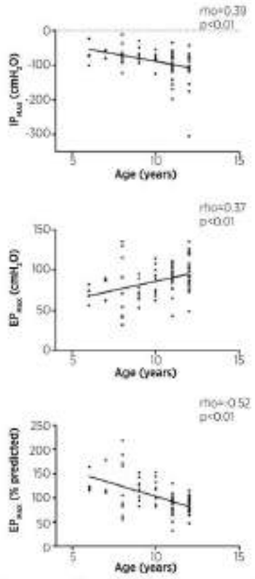
N: Sample. TG: total group. IG: inactive group. AG: active group. G: girls. SD: standard deviation. CI: 95% confidence interval. kg: kilogram. m: meters. BMI: body mass index. kg/m^2: kilogram per square meter. cmH$_2$O: centimeters of water. IP_{MAX}: maximum inspiratory pressure. EP_{MAX}: maximum expiratory pressure. %: predicted percentage. FVC%: forced vital capacity. FEV_1: forced expiratory volume in the first second. FEV_1/FVC%: FEV_1/FVC ratio. EFP%: expiratory flow peak.

LPA and RMS parameters (IP_{MAX} and EP_{MAX}) did not relate in absolute nor predicted values (p>0.05). IP_{MAX} and EP_{MAX} absolute values increased with age (Graph 1). Only $EP_{MAX\%}$ was negatively correlated with age (Table 2, Graph 2).

Analyzing the LPA according to age, there was a peak of inactivity in 8-year-olds and increase of this inactivity with age, as occurred with IP_{MAX} and EP_{MAX}. There was a higher value of IP_{MAX} in AG, in absolute value and percentage, compared with IG – p=0.04; p=0.02, respectively. Comparing RMS parameters between genders, boys presented higher EP_{MAX} absolute values (p=0.02), and LPA was equal between genders (p=0.42) (Graph 3).



Graph 1. Absolute values of IP_{MAX} and EP_{MAX} according to the age of the total sample.
IP_{MAX}: maximum inspiratory pressure. EP_{MAX}: maximum expiratory pressure. cmH$_2$O: centimeters of water.

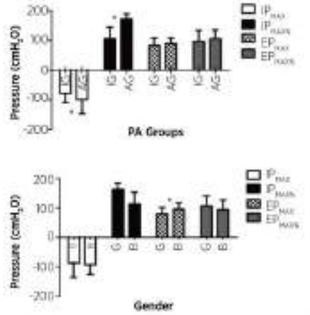


Graph 2. Linear correlation graphs between age and IP_{MAX} and EP_{MAX} values of the sample.
IP_{MAX}: maximum inspiratory pressure. EP_{MAX}: maximum expiratory pressure. cmH$_2$O: centimeters of water. %: predicted. maximum pressure in predicted percentage. rho: Spearman correlation coefficient. p: significance level.

Table 2. Result of the relationship between RMS parameters with LPA and age in the total sample

Variables	IP_{MAX}		EP_{MAX}		$IP_{MAX\%}$		$EP_{MAX\%}$	
	rho	p	rho	p	rho	p	Rho	p
PAQ-C	-0.20	0.07	0.08	0.68	0.18	0.10	0.08	0.45
Age	0.39	<0.01*	0.37	<0.01*	-0.16	0.14	-0.52	<0.01*

rho: correlation coefficient. p: significance level. IP_{MAX}: maximum inspiratory pressure in centimeters of water. EP_{MAX}: maximum expiratory pressure in centimeters of water. %MAX: maximum pressure in predicted percentage. PAQ-C: physical activity questionnaire for children. * p<0.05 in Spearman test.



Graph 3. Result of the comparisons of the parameters of IP_{MAX} and EP_{MAX}, in absolute and predicted values, between the IG and AG groups and regarding the gender of the sample.
IP_{MAX}: maximum inspiratory pressure. EP_{MAX}: maximum expiratory pressure. cmH$_2$O: centimeters of water. IP_{MAX}: maximum inspiratory pressure in predicted percentage. EP_{MAX}: maximum expiratory pressure in predicted percentage. IG: inactive group. AG: active group. PA: physical activity. G: Girls. B: Boys. * Significant results on the Mann–Whitney test or Student's t test for independent samples.

DISCUSSION

This study did not identify a relationship between LPA and indirect RMS parameters in the sample evaluated. On the other hand, comparing inactive and physically active schoolchildren, we observed a statistical higher IP_{MAX} in those with better LPA. The age range from 6 to 12 years was related to IP_{MAX} and EP_{MAX} and without difference in LPA between genders.

RMS is reflected by the pressure generated by respiratory muscles, whose pressure difference ensures pulmonary ventilation. Thus, the clinical significance of the evaluation of RMS parameters. Such musculature seems to have an influence on the practice and level of physical activity, as it stimulates the maintenance of its integrity[16]. Comparing the students according to the LPA, the AG had higher IP_{MAX} values, which may be related to the fact that physical activity increases the work of respiratory muscles to supply the oxygen demand generated by peripheral muscles[17]. In athletes, IP_{MAX} has already been related to performance[18]. Thus, performing activities based on physical training may be a way to increase the function of this musculature, since the practice of sports promotes ventilatory overload[19].

The absence of a relationship between LPA and indirect parameters of RMS in the total sample analyzed was against the previously established hypothesis, which supposed that the LPA would be directly linked to the greater stimulus and input of the respiratory muscles, resulting in the improvement of respiratory muscle resistance and strength[17,19]. This finding may have resulted from the children misunderstanding the questionnaire used for the evaluation. PAQ-C is a subjective instrument that depends on a good interpretation and memory of the responder[20], which may not be an easy task, especially in the younger age group. This may also explain the discrepant peak of physical inactivity observed at the age of eight, because the students themselves answered about their physical activity practices, that is, age can be indicated as a limitation in this study.

Although the reproducibility and validity of the PAQ-C are considered satisfactory, studies with double labeled water and calorimetry are suggested[20], because its use tends to overestimate values measured directly by accelerometry, which is a worrisome factor when establishing a relationship with children's health data[21]. Therefore, studies with direct methods of LPA evaluation in schoolchildren should be encouraged.

The evaluation of RMS through manovacuometry also requires collaboration and understanding to be performed. Increasing age can positively influence its performance, but it also increases the measure[22]. The same could be seen in the investigation that showed a direct relationship between age and IP_{MAX} and EP_{MAX} values. In a recent review, Verma et al. also observed that RMS parameters increase with age, due to the maturation of the child's respiratory system. Growth involves the development of the lung until adulthood, in addition to muscle and hormonal changes[23]. LPA also increased with age progression, which seems to suggest an improvement in inactive behavior observed with technological advances[24].

In Brazil, the percentage of active schoolchildren was 20.3% in the last national school health survey (PeNSE), and was higher among boys (28.1%) than in girls (12.9%)[24], which may justify boy's higher values of EP_{MAX}. Since during activities ventilation tends to increase, requiring greater respiratory work and predisposition to forced expiration[17], EP_{MAX} consequently increases. Added to this, boys have higher production of muscle mass starting in puberty due to hormonal aspects[25]. However, there was still no difference in LPA between genders in this study.

Level of physical activity and respiratory muslce force in healthy children.

Regarding the negative correlation between $EP_{MAX\%}$ and age, the literature has no previous studies about this relationship in healthy children. In most studies, absolute values of RMS are used in comparative analyses of groups[19]. A possible hypothesis for the result of our study is that the negative correlation may have resulted from the difference in mass and age frequency between our sample and the sample of the study that generated the equation we used[13]. Although reference values and equations are developed and validated for certain populations[14], their use in different samples may cause underestimation or overestimation of results, since these calculations are intimately related to age, mass, and height of the original samples[13].

Knowing that children who create the habit of practicing physical activities since childhood are more susceptible to keeping the habit until adulthood[17], promoting this practice is essential to decrease the high rates of sedentary lifestyle and benefit the respiratory musculature. Thus, the relationship between LPA and RMS should be further investigated within the therapeutic scope, because this knowledge enables strategies to prevent cases, to identify possible early diagnoses of disease and weakness of the respiratory muscles, besides stimulating the prescription of exercise in every circumstance.

CONCLUSION

LPA and indirect RMS parameters in the healthy schoolchildren studied were unrelated to each other, but there was a relationship between age and IP_{max}, EP_{MAX} and $EP_{MAX\%}$ values. Active children had a higher IP_{MAX} compared with inactive children. Boys had a higher EP_{MAX} value compared with girls and LPA was equal in both genders.

ACKNOWLEDGMENTS

The authors thank the Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina (Fapesc) for their financial support.

REFERENCES

1. Sociedade Brasileira de Pediatria. Grupo de Trabalho em Atividade Física. Promoção da Atividade Física na Infância e Adolescência. SBP. 2017 [cited 2021 Aug 13];1:1-14. Available from: https://bit.ly/2UlmmCs
2. Ekelund U, Luan J, Sherar LB, Esliger DW, Griew P, Cooper A. Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents. JAMA. 2012;307(7):704-12. doi: 10.1001/jama.2012.156.
3. Rodriguez-Ayllon M, Cadenas-Sánchez C, Estévez-López F, Muñoz NE, Mora-Gonzalez J, Migueles JH, et al. Role of physical activity and sedentary behavior in the mental health of preschoolers, children and adolescents: a systematic review and meta-analysis. Sports Med. 2019;49(9):1383-410. doi: 10.1007/s40279-019-01099-5.
4. Quinino CP, Teixeira GG, Leopoldino AA, Braz NF, Vitorino DFM, Lima VP. Efeitos de um protocolo de exercícios baseados no método Pilates sobre variáveis respiratórias em uma população de jovens sedentários. Fisioter Bras. 2012;13(2):131-9. doi: 10.33233/fb.v13i2.526.
5. Dassios T, Dimitriou G. Determinants of inspiratory muscle function in healthy children. J Sport Heal Sci. 2019;8(2):183-8. doi: 10.1016/j.jshs.2016.08.002.
6. Silva MJ, Martini FA, Stabelini Neto A, Corrêa RC. Associação da atividade física e prática esportiva com os fatores de risco metabólicos e força da musculatura respiratória em crianças obesas. Saude Rev. 2016;16(43):21-8. doi: 10.15600/2238-1244/SR.V16N43P21-28.
7. Vendrusculo FM, Heinzmann-Filho JP, Piva TC, Marostica PJC, Donadio MVF. Inspiratory muscle strength and endurance in children and adolescents with cystic fibrosis. Respir Care. 2016;61(2):184-91. doi: 10.4187/respcare.04231.
8. Polgar G, Weng TR. The functional development of the respiratory system from the period of gestation to adulthood. Am Rev Respir Dis. 1979;120(3):625-95. doi: 10.1164/arrd.1979.120.3.625.
9. Knudson RJ, Slatin RC, Lebowitz MD, Burrows B. The maximal expiratory flow-volume curve. Normal standards, variability, and effects of age. Am Rev Respir Dis. 1976;113(5):587-600. doi: 10.1164/arrd.1976.113.5.587.
10. Solé D, Vanna AT, Yamada E, Rizzo MC, Naspitz CK. International Study of Asthma and Allergies in Childhood (ISAAC) written questionnaire: validation of the asthma component among Brazilian children. J Investig Allergol Clin Immunol. 1998;8(6):376-82. doi: 10.1590/S0103-05822014000100018.
11. Graham BL, Steenbruggen I, Miller MR, Barjaktarevic IZ, Cooper BG, Hall GL, et al. Standardization of spirometry 2019 update. An official American Thoracic Society and European Respiratory Society technical statement. Am J Respir Crit Care Med. 2019;200(8):70-88. doi: 10.1164/rccm.201908-1590ST.
12. American Thoracic Society; European Respiratory Society. ATS/ERS Statement on respiratory muscle testing. Am J Respir Crit Care Med. 2002;166(4):518-624. doi: 10.1164/rccm.166.4.518.
13. Rosa GJ, Morcillo AM, Assumpção MS, Schivinski CI. Predictive equations for maximal respiratory pressures of children aged 7-10. Braz J Phys Ther. 2017;21(1):30-6. doi: 10.1016/j.bjpt.2016.04.002.
14. Crocker PR, Bailey DA, Faulkner RA, Kowalski KC, McGrath R. Measuring general levels of physical activity: preliminary evidence for the Physical Activity Questionnaire for Older

Speciesm in the representation of the negro in "A struggle for life" by Henry C. Lewis

Profª Drª Donesca Cristina Puntel Xhafaj

LLE 7497

01 July 2018

SPECIESISM IN THE REPRESENTATION OF THE NEGRO IN "A STRUGGLE FOR LIFE" BY HENRY C. LEWIS

Nicole Rabello

This study has the purpose of analyzing the speciesism in the characterization/description of the black character in the short story "A Struggle for Life" (1845). According to Peter Singer, speciesism describes the interests of the human being conflicting with the interests of nonhuman being (Singer 6). In the case of human beings, they perceive and defend that nonhuman beings belong to them for exploitation, this kind of prejudice can be perceived in how these people treat and use nonhuman beings to personal gain. The book Odd Leaves from the Life of a Louisiana Swamp Doctor (1845), which contains twenty-two stories, including "A Struggle for Life", approach the adventures of the Doctor Madison Tensas, in the swamps of Louisiana from 1845. This research focuses on how the visual depiction of the black character in "A Struggle for Life", made by the white unreliable narrator contributes to unveil the speciesist point of view of the narrator and how it affects the perception and construction of the image of the negro in the short story. For that, the point of view of the narrator will be analyzed with Singer (1975) and Naconecy (2010) serving as basis, with the aim of identifying speciesism in the narrative. The results may result in a discussion about how speciesism contributes to diminishing the image of the negro in "A Struggle for Life", through the analysis of the negro's physical description given by the narrator. Comparing the black character with an animal may impact the perception of the negro as a human being, belonging to that society, to the same species, instead of a wild animal as he was characterized.

Keywords: racism; speciesism; literary analysis

1. Introduction

The book "Odd Leaves from the Life of a Louisiana Swamp Doctor" is a collection of twenty-two short stories about the life of Doctor Madison Tensas in the south of the United States, written by Henry Clay Lewis. "A Struggle for life", a short story from the book, happens between the years of 1845 and 1850, few years before the civil war began in the state of Louisiana.

The adventures of a "Louisiana Swamp Doctor" who receives a call from a slave, that is a black dwarf with deformed physical characteristics, to assist the mother of his master. During the story, the doctor compares the black boy with an animal from the moment he met with him until the outcome, distorting the image of the negro and treating him as if from an inferior "species",

just because the black boy has not the same physical aspects as a "human being". This misconception creates a relationship between human and animal instead of between two human beings with different skin colors and ethnicities, developing speciesism in their relationship. Speciesism is, as Singer (2003) defines it, "an attitude of bias against a being because of the species to which it "belongs" — in short, discrimination against nonhuman animals."(6). The comparison of the black dwarf with animals is the focus of the research; identify speciesism and how it affects the image of the negro, interiorizing his humanity and emphasizing the racism and the segregation of them by the settlers.[1]

One of the characteristics of speciesism is to observe differences in the physical aspects between humans and animals, treating animals as inferior physically and mentally, and, in the case of speciesism against other humans, also morally. In this anthropocentric perspective, the pain, desire, and rights of other species are not as important or valid as the ones of humans. For Singer (18), this is a form of speciesism, since it stems from the belief that "human life, and only human life, is sacrosanct".

Naconecy further describes speciesism as "prejudiced discrimination based on the notion of species (biological), clearly against the animals, (nonhuman beings), result in oppression. The term speciesist was coined to communicate the idea that the speciesism practitioners show a moral insensibility, more coarse and brutal than the racists"(170).[2]

2. The Visual Depiction

The black character of the short story "A Struggle for Life" has a visual depiction according to the point of view of a white and unreliable main character that describes the black boy as if he was an animal. Even after he greeted him verbally and vocalized an introduction, the main character still sees him as a primate and refers to the figure as "it". At the beginning of the

[1] The Shorter Oxford Dictionary defines 'settler' as 'one who settles in a new country; a colonist' (1695) and 'generally: one who settles in a place as a resident' (1815).

[2] My translation for "Entende-se como especismo a discriminação preconceituosa baseada na noção de espécie (biológica), notadamente contra os animais (não-humanos), acarretando sua opressão. O termo especista foi cunhado para comunicar a ideia de que os praticantes do especismo exibem uma insensibilidade moral tão ou mais tosca e brutal que a dos racistas." (Naconecy 170)

Speciesm in the representation of the negro in "A struggle for life" by Henry C. Lewis

short story the main character, Dr. Madison Tensas, is next to a swamp, sits down in an oak and then hears a yell calling for him. Then he describes the figure that he saw:

> "Looking over, and answering the hail, I discerned first a mule, and then something which so closely resembled an ape or an ourang outang, that I was in doubt whether the voice had proceeded from it, until a repetition of the hail, this time coming unmistakably from it, assured me that it was a human." (ASFL1)[3]

The Doctor Madison Tensas does not think at first that a human was calling for him but associates the figure with an animal, an ourang-outang, that does not even live near that place and he defined the black character as "it", an animal and not a human as he could refer to using "he" or "she". However, the depiction of the black character became more animalistic during the development of the short story, as the black character is getting closer to the white character, along the story, the depiction is more detailed with a rude, offensive, brutal, coarse, insolent and speciesist point of view from the white unreliable narrator, as the quote below describes:

> "He was a negro dwarf of the most frightful appearance; his diminutive body was garnished with legs and arms of enormously disproportionate length; his face was hideous: a pair of tushes projected from either side of a double hare-lip; and taking him altogether, he was the nearest resemblance to the ourang-outang mixed with the

[3] The abbreviation of A Struggle for Life

> devil that human eyes ever dwelt upon. I could not look at him without feeling disgust."(ASFL 1)

The fact that the white character associates the physical form of the black character with animals reinforces speciesism. The deception of the arms and legs are very similar to an ape, that has these members longer than the body. In the face, he defines the teeth of the black character as tushes - very specific canine teeth from the horses - and also emphasizes the hare-lip as it was double because of it an open area in the mouth resembling the mouth of a horse. All these physical resemblances were related with an animal, these POV[4] of the character are strategies to put way any similarities with a human.

In the short story A Struggle for Life, the unreliable narrator gives the reader a foreshadowing[5] of the next moments between him and the black boy, as he says that his only companion is a drunken dwarf and then after adds that he is "assailed by wild beasts".

> "It was evident that I would have to pass the night in the swamp, my only companion the drunken dwarf. I had nothing to eat, and no weapons to protect myself if assailed by wild beasts (...) was about to restore it to its place, and commend myself to slumber, when, glancing at the dwarf, I saw his eyes fixed upon me with a demoniac expression that I shall never forget." (ASFL 4)

This foreshadowing is being slowly constructed by the character that along the short story drinks and gives alcohol to the black boy. During this state of drunkenness of both characters, the unreliable narrator constructs a visual deception of a demon and wild beast. Then, when the climax of the short story reached its peak the discussion between the two characters

[4] Abbreviation of Point of View
[5] Vocabulary.com Dictionary "Foreshadowing is an advance sign or warning of what is to come in the future.", https://www.vocabulary.com/dictionary/foreshadowing. Accessed 04 June. 2018.

Speciesm in the representation of the negro in "A struggle for life" by Henry C. Lewis

about the "brandy", a type of drink, ends with the black character attacking the white character and being defined as a demon "I will kill you, he again screamed, his fangs clashing, and the foam flying from his mouth, his long arms extended as if to clutch me, and the fingers quivering nervously" (ASFL 4). The deception of the black character changes in comparison with the previous analysis of him. In this context, the black character is in a situation of power in relation to the white character. He is using his power, humanity, and intelligence to get what he wants, the black character himself, in his state of drunkenness, forgets or does not follow, anymore, the social construction of inferiority and surveillance that existed during all the short story. These uncivilized actions of the black character against the white character materialize the personal conception of the white character about the black character, that he was an animal. The deception that the black boy has fangs like animals to bite instead of "tushes" of a horse clearly points to a wilderness of this black character, "foam flying from his mouth" as he was a rabid dog or another sick animal, with the long arms to clutch him.

The unreliable narrator uses speciesism to put away the humanity of the black character and so avoids feeling anything, not even antipathy or pity. As Wolfe says in his book Old Orders for New: Ecology, Animal Rights and the Poverty of Humanism (1998) "Our humanist concept of subjectivity is inseparable from the discourse and institution of 'speciesism' since the 'human' is by definition the not animal or 'animalistic" (Wolfe).

3. Conclusion

This research analyzed the point of view of the white character, the black character does not have the same morphological aspects as a human; the physical aspect of the black character is animalized to separate him from a human, giving the white character a clean consciousness. Treating him like an animal and also underestimating his mental and physical aspects, comparing him to a wild beast is natural because animals do not need to feel, think, or being pitied. The construction of the visual aspects of the black character along the short story is speciesist, the white unreliable narrator uses his point of view and also the personal and cultural environment to depict the black person as an animal to separate him from the image of a negro slave.

This comparison of black people to animals was seen as natural by racism and slavery. Degrading and diminishing people of color as an object, a product for exploitation and, unfortunately, an animal, created a culture of stigmatizing the black as the not intelligent, the ugly, the thief. Nowadays speciesism still happen in relation to the visual depictions of the black people in cartoons and also in relation to black soccer players and black students that are being called as monkeys and being lowered by people throwing bananas in their direction as was recently reported in a newspaper, this speciesism in the visual depictions of the negro could result in further researches of how the speciesism continues to affect the image black people.

Immediate effect of huffing on cystic fibrosis respiratory mechanics

ERS
INTERNATIONAL CONGRESS 2021
virtual

Immediate effect of huffing on cystic fibrosis respiratory mechanics

T. Castilho (Florianópolis, Brazil), P. Keil (Florianópolis, Brazil), R. Wamosy (Florianópolis, Brazil), J. Cardoso (Florianópolis, Brazil), C. Schivinski (Florianópolis, Brazil)

Background: The huffing technique (HT) is one of the interventions used by physiotherapists and individuals with cystic fibrosis (CF) to promote airway clearance, and it is an alternative to substitute coughing. However, it is necessary to investigate the repercussion of this technique on respiratory mechanics. Objectives: To investigate the immediate effect of HT on respiratory mechanics of children/adolescents with CF. Methods: a cross-sectional analytical study. There were included children/adolescents with CF between 6 to 15 years old, clinically stable. The individuals performed 5 low volume HT, followed by 3 high volume HT. The main outcomes measures were the Impulse Oscillometry System parameters evaluated pre and post the intervention. The following parameters were analyzed: impedance (Z5), total (R5) and central (R20) airway resistance, and reactance (X5), also, they were presented as absolute values and predicted percentage. Results: Participated in 43 children and adolescents, with a mean age of 10.44±2.64 years old, and mean FEV1 of 78.51±23.28%. The comparison between the pre and post-HT moments showed a significant increase in the IOS parameters after HT, which was observed in absolute values (Z5:$p<0.001$, R5:$p<0.001$, R20:$p<0.001$. X5:$p=0.008$) and in predicted percentage (Z5%:$p<0.001$, R5%:$p<0.001$, R20%:$p<0.001$, X5%:$p=0.006$). Conclusions: The HT increased the airway resistance in children/adolescents with CF, which means that immediately after the intervention the respiratory mechanics worsened. Further investigation is necessary to verify if HT leads to less increase in airway resistance than coughing.

Validation of the child effort percepetion scale in a maximal potential exercise test

ERS
INTERNATIONAL CONGRESS 2021
virtual

Validation of the child effort perception scale in a maximum potential exercise test

T. Castilho (Florianópolis, Brazil), J. Cardoso (Florianópolis, Brazil), R. Wamosy (Florianópolis, Brazil), C. Schivinski (Florianópolis, Brazil)

Background: Effort perception scales are important instruments used to evaluate the exercise limiting factors such as fatigue and dyspnoea in field exercise testing. However, there are few scales with validated psychometrics for children in Brazilian Portuguese language, which makes the effort symptoms measurement difficult during exercise in children. Objectives: To validate the Brazilian version of the perceived exertion scale for children (PES-C) during an exercise test in healthy children and with cystic fibrosis (CF). Methods: There were included two groups, healthy children (GHC) and CF (GCF), between 6 to 14 years old. There was applied the modified Borg scale (mBORG) and the PES-C during a modified shuttle walk test (MSWT): before the test (PES-Cb), minute 4 (PES-C4), minute 8 (PES-C8), and the end (PES-Ce). Results: participated in 32 children in GHC and 30 in GFC, with a mean age of 10.14±2.33 and 10.25±2.20 years old, respectively. In both groups, there was a moderate to a high correlation between the scales. The ICC two-way mixed model at PES-C8 was moderate in GHC(ICC=0.69/p=<0.001), with good internal consistency(α=0.82). In GCF, all moments presented low to moderate reproducibility (PES-Cb:0.48; PES-C4:0.35; PES-C8:0.57; PES-Ce:0.49; p<0.005), with low internal consistency. There were high values of the pattern error in both groups. Conclusions: the PES-C showed correlation with mBORG, with evidently linear progression during the MSWT, in both groups. The PES-C on GHC seems reliable and valid in moments that require more demand during the MSWT. Regarding the GCF, this scale showed better reproducibility with the test progression.

Relationship between peripheral muscle strength, exercise capacity and body composition in children and adolescents with cystic fibrosis

PHYSIOTHERAPY THEORY AND PRACTICE
https://doi.org/10.1080/09593985.2021.1973163

Taylor & Francis
Taylor & Francis Group

Check for updates

Relationship between peripheral muscle strength, exercise capacity and body composition in children and adolescents with cystic fibrosis

Juliana Cardoso MSc, PT[a], Janaina Scalco MSc, PT[a], Francieli Mucha MSc, PT[a], Fabrizio Caputo PhD[b], and Camila Schivinski PhD, PT[a]

[a]Physiotherapy Department, State University of Santa Catarina, Florianópolis, SC, Brazil; [b]Department of Physical Education, State University of Santa Catarina, Florianópolis (Sc), Brazil

ABSTRACT

Study Design: This was a transversal analytical study.
Background: Exercise capacity is usually decreased in cystic fibrosis, impacting the disease prognosis. As well, peripheral muscle strength and nutritional status seem to be related to exercise capacity (EC).
Objective: To verify the relationship between peripheral muscle strength, pulmonary function and body composition with EC in children and adolescents with CF.
Methods: The study included CF children/adolescents that were clinically stable. The disease's severity was classified according to the Schwachman-Doerschuk score. Initially the subjects underwent bioimpedance and spirometry tests. Quadriceps muscle strength (QMS) and handgrip strength (HG) were evaluated by dynamometry. The Modified Shuttle Walk Test (MSWT) was conducted along with gas analysis in order to measure EC.
Results: Twenty-five children/adolescents (10.30 ± 2.33 years old) participated in the survey. 72% were eutrophic, with a mean FEV1 of 68.59%, predicted percentage of the MSWT walked distance (%WD) was 70.91%, and QMS 65.80%. QMS presented significant correlations with absolute WD ($r = 0.54$), oxygen peak consumption ($r = 0.72$), lean body mass (LM) ($r = 0.83$), and body mass index (BMI) ($r = 0.69$). HG was related with BMI ($r = 0.45$) and LM ($r = 0.65$). There was a difference in the %WD between the groups with higher/lower strength ($p = .02$).
Conclusion: There was no correlation between HG and EC in this studied sample. Early involvement of QMS was observed even in individuals with low disease severity. This finding reinforces the importance of including this QMS assessment in CF reference centers to monitor, prevent and prescribe adequate exercise training for these individuals.

ARTICLE HISTORY
Received 28 August 2020
Revised 16 April 2021
Accepted 18 July 2021

KEYWORDS
Cystic fibrosis; child; muscle strength; nutritional status; exercise capacity

INTRODUCTION

Reduction in exercise capacity (EC) occurs commonly in individuals with cystic fibrosis (CF) and it is identified through the reduction in oxygen consumption (VO_2) during maximum exercise tests. This condition is closely related to a lower life prognosis, higher mortality rates, and reduced quality of life in this population (Hulzebos et al., 2014; Vendrusculo et al., 2019). At the literature, the decline in pulmonary function, nutritional status deficit, physical deconditioning and reduction in peripheral muscle strength are presented as possible exercise limiting mechanisms (Bongers et al., 2014; Button et al., 2016; De Meer et al., 1995; Lima et al., 2018).

Peripheral muscle dysfunction is based on the nutritional deficits mechanism and chronic arterial hypoxemia, as well as Cystic Fibrosis Transmembrane conductance regulator (CFTR) factors in cells gene; in which these affect the calcium flow impairing the cellular potential action. Furthermore, chronic inflammation, oxidative stress and drug therapy, such as the use of corticosteroids, may also be related to muscle strength decline in these individuals (Almajed and Lands, 2012; Gruet, Troosters, and Verges, 2017; Lamhonwah et al., 2010).

Aerobic and anaerobic capacities impairment might impact directly daily activities performances due to muscle strength reduction (Gruet, Troosters, and Verges, 2017). Thereby, the evaluation of peripheral muscle strength by isokinetic evaluation, indicated as a gold standard, or with more straightforward features such as pressure dynamometry and scaling (Beenakker, Van der Hoeven, Fock, and Maurits, 2001; Fagher, Fritzson, and Drake, 2016) may help in the early identification of impairment at this outcome; consequently, it could mediate and evaluate different therapeutic procedures (Gruet, Troosters, and Verges, 2017).

CONTACT Camila Schivinski, PhD, PT camiss@yahoo.com.br Physiotherapy Department, State University of Santa Catarina, Florianópolis SC, Brazil
© 2021 Taylor & Francis Group, LLC

This type of evaluation has been carried out in adult populations with chronic obstructive pulmonary disease (COPD), what led into making possible to improve the prognosis, once it allowed early and appropriate interventions (Maltais et al., 2014). Thus, the study objective was to verify if there is a relationship between peripheral muscle strength, pulmonary function and body composition to EC in children and adolescents with CF. As well as a secondary aim there were compared groups with lower to higher QMS, and older to youngers.

METHOD

This is an analytical cross-sectional quantitative study, carried out at a reference center in CF in Florianópolis/SC – Brazil, and at the Physiotherapy School clinic of CEFID/UDESC in the university extension project "Brincando de Respirar," between October 2016 to June 2018. The research has been approved by the research ethics committee of the Children's Hospital Joana de Gusmão (CAE 052/20140000).

This study included children and adolescents from 6 to 14 years old, with CF diagnosis (Athanazio et al., 2017), in a regular follow-up by a multidisciplinary team at the reference center. There were included non-exacerbated students who participated in data collection at the time, by the application of Cystic Fibrosis Clinical Score (CFCS) (Kanga et al., 1999) with scores less than 25 points, and Cystic Fibrosis Foundation Score (CFFS) (Ramsey and Boat, 1994) with scores <4 points. In addition, they could not have rheumatic, neurological, neuromuscular diseases, hearing, and visual deficits that could interfere in any evaluation procedure. The exclusion criteria were failure to understand the execution of the tests or an inability to properly perform any stage of the evaluation proposed by the researcher.

The terms of Free and Informed Consent and Term of Consent to the minor were duly signed, by the guardians and eligible patients, respectively. The statistical analysis power was estimated by applying a formula proposed by Hulley et al. (2015). Adopting a sample error of 5%, sample power set at 90% and correlation coefficient of 0.6, 25 individuals were calculated as sufficient for the final sample composition.

Procedures for data collection

After non-exacerbation confirmation, the data were collected. Patients were characterized according to the disease severity, through the Schwachman-Doerschuk Score (S-D score), it was scored by medical team (Doerschuk et al., 1964). S-D score was recorded to classify CF disease clinical severity as excellent (between 86 and 100 points), good (71–85 points), medium (56–70 points), moderate (41–55 points) or severe (less than 40 points). Pathogens colonization data, genetic mutation and classes were obtained by medical records analysis.

Data collection order of tests was as following: anthropometry; body composition; and spirometry data were initially measured. Afterward, tests were performed in order to measure peripheral muscle strength; first quadriceps, followed by hand grip strength. Finally, after a break, the two tests of EC with gas analyzes were performed. In the following topics, they are described in detail about the procedure for each of the stage.

Assessment of anthropometric measures, body composition and spirometry

The children/adolescents were evaluated for anthropometric measures: the body mass was measured by the Ultra Slim W903 Wiso® scale; the height was measured by the Sanny® stadiometer and the body mass index (BMI) calculation was executed through the Ministry of Health Telehealth program (Ministério da Saúde, 2012). The body composition was assessed by the bioimpedance test (BIA 450®, Biodynamics, USA). Spirometry (EasyOne®, Fleximed, USA) was then performed following The American Thoracic Society (ATS) standards (Graham et al., 2019). The spirometric parameters analyzed were: forced vital capacity (FVC), expiratory volume at 1 second (FEV_1), forced expiratory flow between 25–75% of FVC (FEF_{25-75}) and peak expiratory flow (PEF), as well as the predicted percentage for all parameters according to Polgar and Weng (1979) and Knudson, Slatin, Lebowitz, and Burrows (1976), as well as z-score values according to the Global Lung Initiative – GLI (Quanjer et al., 2012).

Assessment of peripheral muscle strength

For quadriceps muscle strength (QMS) analysis, the digital pressure dynamometer (Lafayette Manual Muscle Testing System®, Lafayette Instrument, USA) was used. The device was fixed on the distal portion of the tibia and then the child/teen was instructed to perform maximum and sustained extension of knee, for a period of five seconds, with an interval of 1 minute between attempts. The muscle strength test was performed in both limbs, with a maximum of six maneuvers, and three reproducible maneuvers were required, with less than 10% variation (Beenakker, Van der Hoeven, Fock, and Maurits, 2001). For statistical analysis, the highest value of the highest strength measurement between limbs, expressed in Newton (QMS_N), normalized by body mass ($QMS_{N/kg}$), BMI ($QMS_{N/kg/m2}$) and percentage of predicted ($QMS_{\%}$) was

Relationship between peripheral muscle strength, exercise capacity and body composition in children and adolescents with cystic fibrosis

adopted. The quadriceps isometric muscle strength reference values used followed the classification of Beenakker, Van der Hoeven, Fock, and Maurits (2001). The sample was stratified into two groups for subsequent comparisons: a group with lower QMS (GLS), and group with a higher QMS (GHS), respecting the cutoff bridge of 65% of the predicted, organized by frequency analysis (50th percentile). Beyond these subgroups, there was adopted age, independently from strength, to younger (6 to 10 years old) and older (11 to 14 years old) analysis.

Handgrip strength (HG) was evaluated with a hydraulic dynamometer (SAEHAN®, Saehan Corporation, Korea) in the dominant hand, by the recommendations of the American Society of Hand Therapists (Fess, 1992). The handgrip exercise was kept for 5 seconds, with 1 minute interval between each bout. Up to six attempts were allowed, and three reproducible values were required (variation below 10%). Statistical analysis was conducted with the highest values of strength obtained in the dominant limb, expressed in kilogram of force (kgf). Normal values for palmar grip according to Ramírez-Vélez et al. (2017) were adopted. Resting time between QMS and HG tests was 10 minutes. The child remained in rest for 15 minutes between strength and EC evaluation. All the maneuvers were performed by the same evaluator, previously trained, who applied strong and motivating verbal command during all the maneuvers.

Exercise capacity assessment

For the EC evaluation, the child/adolescent performed the modified shuttle walk test (MSWT) protocol proposed by Bradley, Howard, Wallace, and Elborn (1999). The MSWT was performed twice, with a 30-minute interval at least between them, or until the cardiorespiratory parameters return close to baseline values. This is an incremental test, externally cadenced by sound signals, in which they were instructed to walk/run at increasing speeds, in a 10-meter corridor. The cardiorespiratory parameters as respiratory rate (RR), heart rate (HR), pulse oxygen saturation (SpO2), blood pressure (BP) and sensation of dyspnea were evaluated before the test, immediately after the test was completed, and after a 15-minutes rest. The HR and SpO2 were monitored at each minute during the test (Bradley, Howard, Wallace, and Elborn, 1999). To calculate the predicted walked distance (%WD) in MSWT, the reference values proposed by Lanza et al. (2015) were applied.

During the execution of the two MSWT, the child/adolescent carried a telemetric gas analyzer (K4b2, Cosmed®, Rome, Italy) for the cardiovascular, ventilatory and metabolic responses measurement. Before the test start the child was familiarized with the mask and the equipment for such measurements. The physiological variables RR, HR, tidal volume (V_T), minute volume (V_E), oxygen consumption (VO_2), carbon dioxide production (VCO_2), respiratory exchange ratio (RER), SpO_2 and metabolic equivalent (METS) were obtained through the breath-by-breath technique before, during and after the two tests. For analysis, we used the mean of the final 15 seconds of variables recording at rest and of the last complete level of the best performance test. For maximum HR (HRmáx) calculation, we applied the formula: "HRmáx = 208 – (age x 0.7)," validated for Brazilian children (Machado and Denadai, 2011).

Statistical analysis

The statistical analysis was performed using IBM Statistical Package for the Social Sciences (SPSS®, Chicago-IL, USA) 20.0 software. Descriptive and frequency statistics were used, and the data were expressed as means and standard deviation. Data distribution was verified by means of the Shapiro-Wilk test, and the Spearman or Pearson tests were utilized to verify the correlation of the studied variables, being that this second one classifies the correlation strength according to Dancey and Reidy (2018), in which a correlation of 0.10 to 0.30 is low, of 0.40 to 0.60 is moderate, and of 0.70 to 1.0 is considered. For comparison between groups (GLS x GHS and age group), the Student t-test for independent samples was used. For all tests a significance level was set at 5%.

RESULTS

Twenty-five children/adolescents with CF participated in this study, 64% of them were boys; no patient was excluded during data collection. The complete sample characterization is described in Tables 1 and 2. About 40% presented deltaF508 homozygous genotype, 32% deltaF508 heterozygous, classified as Class II for CFTR mutations, and 28% with other mutations. About 92% of the participants had bacterial colonization (Staphylococcus aureus, Pseudomonas aeruginosa or other bacteria), about 68% showed a decrease in EC, evidenced by lower %WD in the test, with values below the expected for age (< 75% predicted). Approximately 80% of the participants presented QMS reduction and 33% for HG, with values lower than predicted of the total sample.

Analyzing the individuals according to the QMS (GLS, n = 12; and GHS, n = 13) it was observed that the GLS presented lower performance in the MSWT (%WD: 63.5% vs 79.5%, p = .02), besides lower values of $\%HR_{max}$ (87.7%

Table 1. Sample characterization regarding disease severity, age, anthropometric variables, pulmonary function and peripheral muscle strength.

Variable/Parameter	Mean (±sd) or Median (±IQR)	CI 95%
Age (years)	10.3 (±2.83)	9.34–11.2
BMI (kg/m2)	15.3 (±1.52)	14.7–15.9
Lean body mass (kg)	25.11 (±6.75)	22.2–27.9
Lean body mass (%)	82.33 (±5.50)	80.0–84.6
Body fat (kg)	5.24 (±1.95)	4.41–6.06
Body fat (%)	17.66 (±5.50)	15.3–19.9
5-D score **	87.0 (±8.0)**	82.5–91.5**
Spirometry values		
FEV_1 (L)	1.40 (±0.46)	1.21–1.59
FVC (L)	1.81 (±0.44)	1.62–1.99
FEF_{25-75} (L/s)	1.33 (±0.74)	1.02–1.63
PEF (L/s)	207.4 (±62.1)	181.8–233.1
Spirometry values predicted by Polgar and Weng (1979); Knudson, Slatin, Lebowitz, and Burrows (1976)		
FEV_1 (%)	68.5 (±20.6)	60.1–77.1
FVC (%)	80.0 (±20.7)	71.5–86.6
FEF_{25-75} (%)	51.0 (±25.6)	40.4–61.6
PEF (%)	68.2 (±17.3)	61.0–75.4
GLI Equations (2012)		
FEV_1 (z_score)	−2.27 (±1.80)	−3.02 – (−1.53)
FVC (z-score)	−1.58 (±1.84)	−2.34 – (−0.82)
FEF_{25-75} (z-score)	−2.28 (±1.59)	−2.94 – (−1.62)
FEV_1 (%)	72.5 (±21.8)	63.5–81.6
FVC (%)	81.9 (±20.8)	73.4–90.5
FEF_{25-75} (%)	55.3 (±27.7)	43.9–66.8
QMS (N)	190.8 (±38.8)	124.7–156.8
QMS (N/kg)	4.68 (±0.77)	4.36–5.01
QMS (N/kg/m²)	9.09 (±2.04)	8.25–9.94
QMS (%)	65.8 (±17.3)	58.6–72.9
HG (kgf)**	14.6 (±9.0)**	11.3–18.0**

sd – standard deviation; IQR- interquartile range; CI – confidence interval; BMI- body mass index; 5-D score – Schwachman-Boerschuk Score; FEV_1 – forced expiratory volume in the first second; % – percentage of predicted; FVC – forced vital capacity; FEF 25–75% – forced expiratory flow at 25/75%; PEF – Peak expiratory flow; QMS – quadriceps muscle strength; HG – handgrip strength; kg – kilograms; m – meters; L – liters; L/s – liters per second; L/min – liters per minute; kg/m2 – kilogram per square meter; kg – kilogram; N – Newton; kgf – kilogram of force; ** Data with non-parametric distribution ($p > 0.05$) according to Shapiro-Wilk test, expressed in median and interquartile range – Median (±IQR). The other variables were parametric and expressed in as mean and standard deviation – Mean (±sd).

Table 2. Characterization of the sample regarding the performance in modified Shuttle walk test (MSWT), variations of the physiological variables and cardiorespiratory parameters.

Variable/Parameter	Mean (±sd) Median (±IQR)	CI 95%
WD (m)	751.2 (±194.2)	670.8–831.6
WD (%)	71.8 (±18.4)	64.2–79.4
Full level**	9.44 (±2.50) **	8.79–10.0 **
VO_{2PEAK} (ml/min)	1274.7 (±344.5)	1132.4–1416.9
VO_{2PEAK} (ml/min/kg)	42.1 (±7.27)	39.1–45.1
HRmáx (%)	90.4 (±6.46)	87.7–93.1
HRrest (bpm)	107.8 (±13.8)	102.0–113.5
RER	1.07 (±0.11)	0.73–1.26
ΔRR (BPM)	33.3 (±9.25)	29.5–37.1
ΔV_T (l)	0.33 (±0.17)	0.25–0.40
ΔV_E (l/min)	34.6 (±13.0)	29.3–40.0
ΔVO_2 (ml/min)	967.2 (±295.7)	845.1–1089.2
ΔVCO_2 ml/min)	1074.8 (±376.5)	919.4–1230.2
ΔRER	0.09 (±0.09)	0.05–0.13
ΔHR (bpm)	73.3 (±19.8)	65.1–81.5
ΔSpO_2 (%) **	−3.57 (±6.13)**	−5.44 – (−1.70)**
ΔMETS (cal/min)	9.11 (±1.97)	8.30–9.93

sd – standard deviation; IQR- interquartile range; CI – confidence interval; WD – walked distance; % – percentage of predicted; VO_{2PEAK} – peak of oxygen consumption; HRmáx – maximum heart rate; HRrest – resting heart rate; RER – respiratory exchange ratio; Δ – variation delta; ΔRR – respiratory rate delta; ΔV_T – volume tidal delta; ΔV_E – minute volume delta; ΔVO_2 – oxygen consumption delta; ΔVCO_2 – delta of carbon dioxide production; ΔRER – delta of the respiratory exchange ratio; ΔHR: heart rate delta; ΔSpO_2 – peripheral oxygen saturation delta; ΔMETS – delta of metabolic equivalent; l – liters; l/min – liters per minute; bpm – beats per minute; BPM – breaths per minute; ml/min/kg – millilitre per pound of weight; ml/min – milliliters per minute; cal/min – calories per minute; ** Data with non-parametric distribution ($p > 0.05$) according to Shapiro-Wilk test, expressed in median and interquartile range – Median (±IQR). The other variables were parametric and expressed in as mean and standard deviation – Mean (±sd).

vs 92.9%, p = .03) in comparison to the GHS. Regarding VO_{2PEAK} (ml/kg/min) there was no significant difference between the groups. In the secondary analysis by age, the group from 6 to 10 years old (n = 12) presented similar %DW (73.1% versus 70,7%, p = .75) and QMS_N (69.2% versus 62.5%, p = .35) compared to the older age group.

The QMS_N related moderately and positively to absolute WD in the MSWT. In addition, there were positive correlations of moderate to strong magnitudes between the QMS with HRrest, V_E, HG, BMI and lean body mass. When analyzing the $QMS_{N/kg}$, there was no correlation with MSWT test variables and lung function. However, there were observed moderate correlation between $QMS_{N/kg/m2}$, WD, V_E and FVC. There have been also in evidence significant correlation between QMS_N with V_E and HRmáx. There was no significant relationship between spirometry parameters, in predicted percentage, with the QMS_N or $QMS_{N/kg}$.

The HG was not related to WD (absolute and %). Significant relationships were observed between HG with body composition variables, V_E and HRrest. All the correlations between muscle strength and the studied variables are presented in Table 3. As complementary analysis, it was observed that FVC and FEV_1 presented relations of moderate magnitude with WD. The BMI also showed a positive relationship with the absolute WD and V_E.

DISCUSSION

The evidence from this present investigation is relevant to the CF management, since it demonstrates that children/adolescents who present an average or mild severity of the disease, already have impaired quadriceps muscle strength and exercise capacity assessed by MSWT. It confirmed that the condition of peripheral muscles is strongly associated with BMI and lean body mass in this population.

Relationship between peripheral muscle strength, exercise capacity and body composition in children and adolescents with cystic fibrosis

Table 3. Correlation matrix between the variables of peripheral muscle strength of lower and upper limbs, ventilatory, body composition and lung function.

Variable/ Parameter	QMS (N)	QMS (N/kg)	QMS (N/ kg/m²)	QMS (%)	HG (kgf)	WD (m)	WD (%)	VO_{2PEAK} (ml/ min/kg)	V_E (L/ min)	HRrest (bpm)	FEV_1 (%)	FVC (%)	BMI (Kg/m²)	Lean body mass (kg)
QMS (N)	1.00	0.58*	0.93*	0.54*	0.67¶	0.54*	0.24	0.15	0.70*	−0.40*	−0.22	−0.34	0.69*	0.83*
QMS(N/kg)	0.58*	1.00	0.70*	0.60*	0.30	0.11	−0.43	0.15	0.15	−0.21	0.003	0.62	0.09	0.07
QMS(N/kg/ m²)	0.93*	0.70*	1.00	0.51*	0.63¶	0.49*	0.16	0.19	0.59*	−0.33	−0.19	−0.27	0.40*	0.68*
QMS (%)	0.54*	0.60*	0.51*	1.00	0.12	0.30	0.32	0.25	0.39*	−0.30	0.09	0.02	0.44*	0.23
HG (kgf)	0.67¶	0.30	0.63¶	0.12	1.00	0.23	0.05	0.01	0.70¶	−0.45¶	−0.31	−0.38	0.45¶	0.65¶
WD (m)	0.54*	0.11	0.49*	0.30	0.23	1.00	0.81*	0.41*	0.72*	−0.36	0.57*	0.50*	0.45*	0.63*
WD (%)	0.23	−0.43	0.16	0.32	0.05	0.81*	1.00	0.33	0.53*	−0.33	0.49*	0.41*	0.37	0.29
VO_{2PEAK} (ml/ min/kg)	0.15	0.15	0.19	0.25	0.01	0.41*	0.33	1.00	0.38*	−0.18	0.02	−0.002	0.04	0.10
V_E (L/min)	0.70*	0.15	0.59*	0.39*	0.70¶	0.72*	0.53*	0.38*	1.00	−0.31	0.50*	0.51*	0.64*	0.87*
HRrest (bpm)	−0.40*	−0.21	−0.33	−0.30	−0.45¶	−0.36	−0.33	−0.18	−0.31	1.00	−0.18	−0.10	−0.45*	−0.28
FEV_1 (%)	−0.22	0.003	−0.19	0.09	−0.31	0.57*	0.49*	0.02	0.50*	−0.18	1.00	0.91*	0.32	0.44*
FVC (%)	−0.34	0.62	−0.27	0.02	−0.38	0.50*	0.41*	−0.002	0.51*	−0.10	0.91*	1.00	0.29	0.46*
BMI (Kg/m²)	0.69*	0.09	0.40*	0.44*	0.45¶	0.45	0.37	0.04	0.64*	−0.45*	−0.001	−0.05	1.00	0.74*
Lean body mass (kg)	0.83*	0.07	0.68*	0.23	0.65¶	0.63*	0.29	0.10	0.87*	−0.28	0.44*	0.46*	0.74*	1.00

QMS – quadriceps muscle strength; HG – handgrip strength; WD – walked distance; VO_{2PEAK} – Peak oxygen consumption; V_E – minute volume; HRrest – resting heart rate; bpm – beat per minute; FCV – forced vital capacity; FEV_1 – forced expiratory volume in the first second; BMI- body mass index; % – percentage of predicted; m – meters; ml/min/kg – milliliter per pound of weight; L/min – liters per minute; kg/m2 – kilogram per square meter; kg – kilogram; N-Newton; kgf – kilogram of force; * – Significant correlations through the Pearson test ($p < 0.05$); ¶ – Significant correlations through the Spearman test ($p < 0.05$).

Similar results were presented by Ozipek et al. (2020), who found a less peripheral muscle strength in children with CF mild compared to a group of healthy children ($p = 0.03$). In CF, a systematized measure of QMS is relevant at the patient's follow-up, as there is an important involvement of this muscle with the progression of the disease, evidenced by a decrease in the muscle cross-sectional area, as well as a reduction in the lean body mass (Vaidya et al., 2018). Thus, patients are more susceptible to muscle fatigue and the continuity of an inactivity cycle which results in successive limitations (Papalexopoulou et al., 2018).

Studies have shown reduction on lower limbs muscular strength that may impact functional capacity (Troosters et al., 2009) and EC (Almajed and Lands, 2012). Once a reduction in lean body mass as well as changes in peripheral muscles due to physical deconditioning (i.e. reduction of capillaries numbers, mitochondrial density and oxidative enzymes concentration) impairs oxygen uptake and use in muscle during exercise. This event compromises oxidative capacity and favors a change into an anaerobic metabolism, showed as lower VO_2 (ml/min/kg) values (Almajed and Lands, 2012; Urquhart and Vendrusculo, 2017).

At this present study, there was no significant relation between peripheral muscle strength and oxidative capacity, expressed by VO_{2PEAK} (ml/min/kg). However, it has been seen relation between muscle strength and VO_{2PEAK}, only, when analyzed in absolute values, what indicates lean body mass role in VO_{2PEAK} (ml/min/kg) prediction, as discussed by other studies (Troosters et al., 2009; Vendrusculo et al., 2020). There must be emphasized that aerobic fitness and strength variables normalized by body composition correct the influence of of nutritional status over the real correlation measures. Or else, showing these outcomes in predicted percentage, which adjusts the variables to weight, age and sex, also minimizes these conditions influence. These adjusts become relevant at the current investigation once it has been observed that body composition measures are directly related to MSWT performance and peripheral muscle strength. This indicates that growth, weight and height development are related to muscle strength and EC in children with CF.

At the current study $QMS_{\%}$ e EC, expressed by %DW and VO_{2PEAK} (ml/min/kg), are related to ventilatory (V_E) e cardiovascular (HRrest) variable. These findings raise that individuals with mild disease severity ventilatory and cardiovascular factors contribute to exercise limitation. Once in effort situation, as in exercise, individuals need to adapt their cardiorespiratory system due to the metabolic demand uprise, as consequence a possible increase in respiratory work may be also seen (Campos et al., 2020; Urquhart and Vendrusculo, 2017). In adults with moderate CF QMS relates to function capacity and has been able to explain 59% of performance variation of these individual in 6-minute Walk Test. On the other hand, aerobic fitness variance, expressed by $VO2_{PEAK}$ (ml/kg/min) and obtained by cardiopulmonary test, was not explained by QMS, but for pulmonary function and anthropometric conditions (Troosters et al., 2009). In the same way, Vendrusculo et al. (2020) in their investigation around EC determinants, during MSWT protocol, showed as main DW influencers precisely HRrest, BMI, age and pulmonary function, expressed by FEV_1.

Concerning age, yet this has not been showed any significant statistic difference between groups, %DW and $QMS_{\%}$ have showed numerically higher in younger children (6 to 10 years old). If we consider that CF affects individuals progressively the cardiorespiratory, metabolic and skeletal muscle systems, this finding would be expected, since aging increases disease severity and capacities degradation (Gruet, Troosters, and Verges, 2017). However, the small number of individuals evaluated here in the subgroups in relation to QMS and age can be considered a limitation of current study and deserves further investigation.

Although greater weakness in lower musculature is expected, the assessment of upper limb muscle groups should also be performed to determine whether exercise strategies for that musculature also require specific interventions (Gruet, Troosters, and Verges, 2017). Unlike what is observed in adults with respiratory diseases (Calik-Kutukcu et al., 2017; Kaymaz et al., 2018), HG does not seem to be related to limitations in functional and exercise capacity in children and adolescents with CF (Arikan et al., 2015). A possible hypothesis for the absence of relationship is due to the fact that most of the activities of daily life common in childhood, such as games and plays, do not require the realization of movements with the use of much strength of upper limbs. Thus, the measure of palmar grip may not be as representative in this population and thus not impact or be impacted by the functional and exercise capacity (Arikan et al., 2015; Calik-Kutukcu et al., 2017; Kaymaz et al., 2018).

In summary, the current research found early involvement of QMS was observed, even in individuals, on average, with little severity of the disease. In addition, a relationship between QMS, EC, as well as the body composition of children and adolescents with CF seems to be a determining factor for both exercise capacity and muscle strength. HG seems to be unrelated to these same outcomes in this population. Thus, the importance of including the peripheral muscle strength and exercise capacity evaluation at the care centers of the disease is reinforced, in a programmed way, personalizing the exercise prescription, monitoring the disease evolution and elaborating measures to prevent and intensify the multidisciplinary team care.

Acknowledgments

This study was supported by the Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina, FAPESC/ Brazil (PAP UDESC. Chamada Pública Nº 533/2017, Termo de Outorga 2017TR645).

Disclosure statement

The authors declare no conflict of interest.

Funding

This work was supported by the Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina (FAPESC) [Nº 533/2017, Termo de Outorga 2017TR645].

ORCID

References

Almajed A, Lands LC 2012 The evolution of exercise capacity and its limiting factors in cystic fibrosis. Paediatric Respiratory Reviews 13: 195–199 10.1016/j.prrv.2012.01.001

Arikan H, Yatar I, Calik-Kutukcu E, Aribas Z, Saglam M, Vardar-Yagli N, Savci S, Inal-Ince D, Ozcelik U, Kiper N 2015 A comparison of respiratory and peripheral muscle strength, functional exercise capacity, activities of daily living and physical fitness in patients with cystic fibrosis and healthy subjects. Research in Developmental Disabilities 45-46: 147–156 10.1016/j.ridd.2015.07.020

Athanazio RA, da Silva Filho LV, Vergara AA, Ribeiro AF, Riedi CA, Procianoy EF, Adde FV, Reis FJ, Ribeiro JD, Torres LA, et al. 2017 Brazilian guidelines for the diagnosis and treatment of cystic fibrosis. Jornal Brasileiro De Pneumologia 43: 219–245.

Beenakker EA, Van der Hoeven JH, Fock JM, Maurits NM 2001 Reference values of maximum isometric muscle force obtained in 270 children aged 4-16 years by hand-held dynamometry. Neuromuscular Disorders 11: 441–446 10.1016/S0960-8966(01)00193-6

Bongers BC, Werkman MS, Arets HG, Takken T, Hulzebos HJ 2014 A possible alternative exercise test for youths with cystic fibrosis: The steep ramp test. Medicine and Science in Sports and Exercise 47: 485–492 10.1249/MSS.0000000000000440

Bradley J, Howard J, Wallace E, Elborn S 1999 Validity of a modified shuttle test in adult cystic fibrosis. Thorax 54: 437–439 10.1136/thx.54.5.437

Button BM, Wilson C, Dentice R, Cox NS, Middleton A, Tannenbaum E, Bishop J, Cobb R, Burton K, Wood M, et al. 2016 Physiotherapy for cystic fibrosis in Australia and New Zealand: A clinical practice guideline. Respirology 21: 656–667. 10.1111/resp.12764

Calik-Kutukcu E, Arikan H, Saglam M, Vardar-Yagli N, Oksuz C, Inal-Ince D, Savci S, Duger T, Coplu L 2017 Arm strength training improves activities of daily living and occupational performance in patients with COPD. Clinical Respiratory Journal 11: 820–832 10.1111/crj.12422

Campos NE, Vendrusculo FM, Gheller MF, de Almeida IS, Becker NA, Heinzmann-Filho JP, Ruiz MP, Donadio MV 2020 Association of peripheral muscle strength with exercise capacity and use of antibiotics in patients with cystic fibrosis. Journal of Cystic Fibrosis 19: S139 10.1016/S1569-1993(20)30625-1

5-6/6

Which factor can influence the number of forced expiratory manoeuvers on spirometry in schoolchildren?

Received: 8 June 2020 | Accepted: 13 January 2021
DOI: 10.1111/ijcp.14028

ORIGINAL PAPER
PEDIATRICS

THE INTERNATIONAL JOURNAL OF CLINICAL PRACTICE WILEY

Which factors can influence the number of forced expiratory manoeuvres on spirometry in schoolchildren?

Rafaela Coelho Minsky[1] | Janaina Cristina Scalco[1] | Roseane Rebelo Silva Meira[2] | Tatiana Godoy Bobbio[3] | Camila Isabel Santos Schivinski[1]

[1]Universidade do Estado de Santa Catarina Centro de Ciencias da Saude e do Esporte. CEFID, Florianópolis, Brazil
[2]Pontifical Catholic University of Campinas, Campinas, Brazil
[3]University of Saint Augustine for Health Sciences, Saint Augustine, FL, USA

Correspondence
Camila Isabel Santos Schivinski, Rua Pascoal Simone, 358. Coqueiros, Florianópolis, SC. CEP: 88080-350, Brazil.
Email: cacaiss@yahoo.com.br

Funding information
State University of Santa Catarina (UDESC); FAPESC 533/2017 (Grant number: N 2017TR645).

Abstract

Introduction: Spirometry is of great value for understanding respiratory function and management of lung diseases. Adaptations in the exam were made to meet paediatric population since the forced expiratory manoeuvres (FEM) present in the exam require effort and cooperation; therefore, its use should be reconsidered.

Objective: To analyse factors that may influence the number of FEM required for successful spirometry in schoolchildren.

Method: Healthy children aged between 6 and 12 years were tested. FEM were conducted according to the American Thoracic Society/European Respiratory Society guideline. The children were divided into three groups according to the number of attempts: G3M if child completed the test in three FEM; G4M if child completed in four attempts FEM; and G5/8M if child completed the test in five to eight FEM. Factors that potentially influenced the number of FEM included: age; impulse oscillometry parameters; slow vital capacity; respiratory muscle strength; orofacial motor function, school performance, physical activity level and quality of life. The Kolmogorov–Smirnov test was performed, followed by the Chi-Square, repeated measures ANOVA and Kruskal–Wallis tests; thereafter, a multinomial logistic regression was applied.

Results: One hundred and forty-nine schoolchildren (80 girls) with mean age of 9.13 years (±1.98) were included, age was related to the required number of FEM ($F = 3.38(2)$, $P = .03$) and children with poor school performance had a 2.84-fold greater chance of completing the exam in more than five attempts.

Conclusion: Age and school performance influenced the number of FEM required for a successful spirometry in schoolchildren.

1 | INTRODUCTION

Pulmonary function tests are crucial to understand respiratory physiology and disease management.[1] In children, they allow monitoring pulmonary growth and development, as well as changes in respiratory mechanics. Additionally, they are involved in epidemiological and clinical researches and indicated for evaluation, control and long-term treatment of children with respiratory diseases[2-4]; the exam is inexpensive and simple which supports its application.[1,5] However, subject's participation influences considerably the quality of spirometry,[6,7] as it involves understanding commands that reproduce specific respiratory manoeuvres, requiring association between motor function and cognitive performance.[8-10] There is a consensus among clinicians and health professionals on the difficulty in conducting successful spirometry testing in children from 6 to 10 years old.[10-12]

During childhood lung disorders are most frequently of obstructive type such as asthma, cystic fibrosis, recurrent wheezing, bronchopulmonary dysplasia, bronchiolitis obliterans, plastic bronchitis among

© 2021 John Wiley & Sons Ltd

others.[10,14] Therefore, reliable information of lung volumes and capacity through the forced expiratory manoeuvres (FEM) is extremely necessary and relevant for schoolchildren symptomatic or not. However, parameters with values below predicted are commonly observed, even in the absence of diseases.[8]

In the same context, a reliable FEM in the spirometry requires child's ability[15-17] and that should be relevant to investigate all factors that may interfere with FEM is acknowledge. Among other factors, it is wondered whether respiratory muscle strength (RMS) could interfere in the test execution, as muscle weakness may change motor functions and lead to unsatisfactory expiratory manoeuvres.[18] When respiratory muscles weakness is present in children, the abdominal muscle and diaphragm can be affected. Therefore, because of the abdominal weakness some FEM parameters such as peak of expiratory flow (PEF) and the maximum voluntary ventilation (MVV) could be underestimated. Regarding the primary inspiratory muscles, the inspiratory flow volume prior to FEM can be decreased compromising the FEM.[19]

Moreover, children´s way of life and interaction, habits, level of physical activity (LPA) and quality of life (QOL)[19] may primarily affect their motor and cognitive aspects and, only secondarily, the execution of a technique or examination, such as spirometry. In addition to the abovementioned factors, orofacial motor function and respiratory mechanics are likely to influence exam performance. Concerning the orofacial motricity, muscles and functional imbalance can be related to poor leap seal, difficulty to blow the air to the mouthpiece and swallowing, what could compromised FEM child's performance. Likewise, healthy airways, pulmonary capacity enough to mobilise flows, as well as minimum volumes indicated in the test may also be considered as essential factors.[20]

Therefore, it is relevant to analyse the relationship of these factors with the quality of FEM. Among other aspects, quality can be assessed through the required number of FEM, flow volume curves, as well as the children's ability to perform maximal inspiration before the beginning of the test and to expire satisfactorily without hesitation and with maximum effort.[11,21] Thus, this study aimed to analyse factors that may influence the number of FEM performed by healthy schoolchildren and identify the possible subject related barriers when performing a spirometry test.

What's known

- Regarding spirometry in children, it is known that the recommendations and the way to perform the exam were adapted based on information and research carried out in adult population.
- However, in many studies and in clinical practice it is difficult to perform this test in the paediatric population, making tests invalid or pointing out questionable results.

What's new

- This study contributes to the literature by pointing out the main difficulties in carrying out spirometry tests in the paediatric population, as showing outcomes of influence.
- This knowledge is important to understand what the child's needs are regarding the spirometric exam, respecting their development, motor coordination and understanding of commands for the test.
- This information collaborates with both clinical practice and future research.

2 | METHODS

2.1 | Study design

This is an analytical, observational and cross-sectional study conducted from October 2015 to April 2016. It was approved by the Ethics Committee under the Resolution nº 1.006.003 – (CAAE: 38770314.1.0000.0118) and registered in the National Commission of Ethics in Research with Human Beings.

2.2 | Participants

The study included healthy children aged 6-12 years, attending public and private schools in Florianópolis, Santa Catarina/Brazil. They agreed to participate in the study by signing an Informed Assent Document for Children/Minors and their parents/guardians also signed an Informed Consent Document. The following schoolchildren were selected: healthy children, non-athletes (not enrolled in high-performance sports federations), non-obese children (body mass index (BMI) <25 kg/m^2) and non-undernourished children (BMI > 18.5 kg/m^2) according to the World Health Organization criteria for BMI classification for each age group.[22]

Sample size was calculated based on the most suitable regression model without difference between sexes. In this model, seven variables were considered as potentially influential for the number of FEM in school children (age, RMS, respiratory system parameters, orofacial motor function, QOL, LPA and school performance). The sample size amounted to 140 school children, estimating at least 20 children for each influence factor, considering the total of seven factors.[23-25]

2.3 | Health check

Schoolchildren's health was checked according to the International Study of Asthma and Allergies in Childhood (ISAAC)[26]; analysis of health history (prepared by the researchers); and spirometry performed according to the American Thoracic Society/European Respiratory Society (ATS/ERS) guidelines[2,3,27] following the children criteria[3] (forced expiratory volume in 1 second [FEV_1] and forced vital capacity [FVC] above 80% of predicted.[28,29] The Z score was also applied in all the spirometric values.[30] A JAEGER™ MasterScope IOS™ spirometer was used, properly calibrated, considering the environmental conditions

Which factor can influence the number of forced expiratory manoeuvers on spirometry in schoolchildren?

(temperature and relative humidity of the air were controlled by means of a digital hygrometer by the Incoterm 7663® brand), the spirometer measurement verification of the flow rate and the sensitivity of the device using a 3 L calibration syringe was executed.

The children who failed to complete the test in up to eight FEM were excluded from the study. According to the number of attempts required for a successful tests, the participants were divided into three groups: G3M if child completed the test in three FEM which correspond to the minimum number of manoeuvres for the criteria of acceptability and repeatability; G4M if child completed the test in four FEM which is half of the number of recommended manoeuvres[16]; and G5/8M if child completed the test in five to eight FEM which is the number of attempts commonly needed for this age group.

2.4 | Procedure

First, weight and height were measured with an Ultra Slim W903 Wiso® digital scale and a Sanny® stadiometer, respectively. Then, the Physical Activity Questionnaire for Older Children (PAQ-C)[31] and *Auto-Questionnaire de Qualité de vie Enfant Imagé* (AUQUE)[32] were applied; these both questionnaires have been validated for use in Brazilian children. Thereafter, the Impulse Oscillometry System (IOS) and spirometry (First IOS, followed by slow vital capacity (SVC) and FVC) were conducted by a single examiner, blinded to the questionnaires already applied. lastly RMS was assessed. An interview with the schoolteacher was conducted to verify school performance; and orofacial motor function was evaluated.

2.5 | Spirometry

The spirometry manoeuvres were performed by the same examiner, previously trained, in a reference laboratory for a period of 1 year; all commands were standardised and the test was conducted according to ATS/ERS.[21,27] During the spirometric manoeuvre, the examiner was responsible to look at the shape of the flow-volume curve in real time while comparing with volume-time curve.[27,33] All manoeuvres were recovered to allow the examiner analyse the flow-volume curve in each manoeuvre independently, before next trial. If any errors and artefacts in the spirometry procedures such as cough, premature glottic closure, absence of PEF and abrupt finishing of the curve were detected by looking the shape of the flow-volume curve, the manoeuvre was not considered.[27,33] In addition, values such as FVC, FEV_1 and PEF in each manoeuvre were available. The test was repeated until eight times with the minimum of three attempts following Jat (2013) recommendation.[2] For the extrapolated volume (EV), the curve was analysed again but not necessary excluded from the records[27] whether the value was greater than 80ml or 12.5% of the FVC. Children who were not able to perform the minimum of three satisfactory manoeuvres but meet the acceptability criteria have had the test considered in the present study.

To be successful in the examination the children underwent a process of familiarisation with the procedure. The evaluator carefully demonstrated the phases involved in the FEM and in the slow manoeuvre; the child simulated each of them twice. The test was closed monitor by the examiner to ensure the quality and avoid errors such as leak through the mouthpiece and poor effort. Computer generated spirometer incentive graphs were used in all manoeuvre, simulating specific games from the equipment, to encourage children to perform the FEM; incentives graphs were flow driven and volume driven.[2]

Children position during test was sitting with feet on the ground and a nose clip was used in accordance with ATS/ERS.[27] The acceptability and repeatability criteria were at least two acceptable manoeuvres out of eight trials with the two highest values of FVC and FEV_1 differing <0.15 L and PEF < 10% or 0.5 L/s.[27,33,34] even if these values were not in the same curve, the initial value for FEV_1 was obtained by the EV.[2,27] After acceptability and repeatability were checked, the highest FVC and FEV_1 values were registered in all acceptable curves. For the mid expiratory flow (FEF_{25-75}) value, it was considered the manoeuvre that presented the highest values in the sum between FEV_1 and FVC.[27]

In cases where these levels were not achieved, such as early cessation of expiratory flow and difficulty in reaching peak flow in FEM, the child was encouraged to prolong expiratory time (for longer than 6 seconds)[31,35] and perform a strong expiration, respectively.

2.6 | Measurement of SVC and respiratory mechanics

For SVC, the child was instructed to completely inhale to total lung capacity, followed by a slow expiration to residual volume, the inspiratory capacity (IC) and expiratory reserve volume (ERV)[19] were determined after that. Respiratory mechanics was assessed by IOS spirometer, following the ATS/ERS guidelines[33]; the child should rest for 10 minutes prior to testing. During the test, the child remained seated, using a nose clip and had the cheeks gently pressed by the examiner's hands. The child was instructed to breathe normally for 30 seconds, followed by 30 seconds of rest, repeating this procedure three times.[3] Respiratory impedance (Z), resistance to 5Hertz (R5) and 20Hertz (R20), reactance (X), reactance area (AX), peripheral capacitive reactance (X5), resonance frequency (Fres) were further assessed.

2.7 | Evaluation of RMS

RMS was measured with the digital manovacuometer MVD 300® (Globalmed®). For the maximum inspiratory pressure (MIP) the schoolchildren was asked for three tidal breaths in and out and to exhale deeply. The patient was then asked a sustained and maximum inspiration close to the vital capacity. During instructions to children, a maximum inspiration similar to total lung capacity followed by a maximum expiration similar to residual volume was asked to measure the maximum expiratory pressure (MEP).[34,37]

At first, MIP was measured with a maximum of five manoeuvres and with a 1-minute interval between each measurement. After a 5-minute interval, MEP was also measured with a maximum of five manoeuvres. At least three manoeuvres were acceptable, and two manoeuvres met repeatability criteria. If the highest value was recorded at the fifth manoeuvre, the test proceeded up to seven manoeuvres.[36]

2.8 | Orofacial motor function evaluation

A questionnaire based on the Orofacial Myofunctional Evaluation Protocol (MBGR)[38] was applied and administered in the local language. It covers the following items: time of breastfeeding or use of bottles; difficulties in introducing solids; characteristics of mastication; frequency of choking, reflux and coughing during eating. It also analyses oral habits (use of pacifier, finger and thumb sucking and time for speech acquisition); the parents/guardian answered all the items according to the child's history. The examiners, trained in this protocol, evaluated the following items through physical observation: analysis of lip, saliva, dental occlusion, mobility, cheeks and tonus.

2.9 | Evaluation of cognitive skills

Evaluation of cognitive skills relied on measures of school performance based on interviews between the researcher and the schoolteacher. The schoolteacher who had more years of experience in teaching was selected and trained to this evaluation; the child was evaluated according to three criteria: (a) grades/descriptive words, (b) participation in the classroom, (c) ability to learn. The grades/descriptive words were determined by a coefficient of performance, represented by average achievement scores during the school term; scores equals or higher than 5 represent satisfactory school performance in accordance with Caemmerer et al[39]. Participation in the classroom and ability to learn were evaluated by the teacher, who had the opportunity to communicate daily to the schoolchildren. For each analysed criterion, the child received a YES score if (a) they had grades/descriptive words equal to or higher than 5 points in the gradebook, showing quality class participation and efficient learning skills. The child was given a NO score when (a) they showed grades lower than 5 or insufficient scores, discreet class participation and inefficient learning skills. At the end of the evaluation, the schoolchildren who received 2 or 3 YES scores were classified as satisfactory performance; those with only 1 or no YES score, as unsatisfactory performance.

2.10 | Evaluation of the LPA

For the LPA evaluation, the PAQ-C was applied, it investigates the frequency and performance of moderate and intense physical activity in children/adolescents 7 days prior to its implementation; children are classified as active (score higher than or equal to three) or sedentary (score lower than three).[31]

2.11 | Assessment of QOL

QOL was identified using the AUQUE,[32] designed for children aged 4-12 years; this questionnaire evaluates children's satisfaction in six domains. The answers produce a score representing children's QOL, where 0 = very unhappy, 1 = unhappy, 2 = happy and 3 = very happy.

2.12 | Statistical analysis

Central tendency and dispersion data were reported, normal data distribution was assessed by the Kolmogorov-Smirnov test. To observe the differences between groups G3M, G4M and G5/8M one-way analysis of variance (ANOVA) or Kruskal-Wallis test were applied. Chi-square test was used to investigate intergroup association and categorical variables. Then, multinomial logistic regression, a multivariate analysis, was applied to observe the association between the number of repetitions, academic performance and age. The manoeuvres number, using three groups (G3M, G4M and G5/8M), was considered as the dependent variable, in which G3M was selected as the reference category. In order to facilitate interpretation, results were expressed using odds ratio (OR) and 95% confidence interval (CI). All statistical analyses were performed with the Statistical Package for the Social Sciences SPSS®20.0., the significance level was set at $P < .05$.

3 | RESULTS

Out of the 186 participants, 37 schoolchildren were excluded because they could not perform FEM in up to eight attempts. The children were excluded due premature glottic closure (12 children), cough during FEM (5 children), no cooperation (13 children) and premature finishing (7 children).

3.1 | Sample characteristics and association with the number of FEM

The total sample was homogeneous in terms of sex (53.6% girls), height and weight, the same homogeneity was found between groups. No difference was observed among the groups regarding QOL and LPA; however, ANOVA analysis showed a difference among the groups related to age. A post-hoc test showed that age difference was between G5/8M and G4M. The G5/8M presented lower mean age as compared with G3M and G4M; data can be observed in Table 1. Analysing age distribution between groups, the majority of schoolchildren in the

3-4/9

Which factor can influence the number of forced expiratory manoeuvers on spirometry in schoolchildren?

TABLE 1 Sample characteristics according to the number of FEM

Variable	3 Manoeuvres M ± SD	4 Manoeuvres M ± SD	5-8 Manoeuvres M ± SD	P
Sample	59 (36 girls)	53 (29 girls)	37 (21 girls)	.43[a]
Height (m)	1.41 ± 0.12	1.44 ± 0.12	1.40 ± 0.12	.33[b]
Weight (kg)	34.25 ± 10.9	37.96 ± 11.5	34.71 ± 12.8	.20[b]
Age (y)	9.24 ± 1.89	9.62 ± 1.95	8.57 ± 1.80	.03[b,*]
Quality of life	51.51 ± 4.85	49.52 ± 5.75	49.03 ± 5.86	.12[b]
Level of physical activity	2.98 ± 0.54	2.87 ± 0.72	2.94 ± 0.69	.67[b]

Abbreviations: FEM, forced expiratory manoeuvres; M, mean; SD, standard deviation.
[a]Chi-square test.
[b]One-way ANOVA.
*P < .05.

G5/8M were 6, 7 and 10 years old and only two were 12 years old. In the G3M the majority of the schoolchildren were 9 and 12 years old; and in the G4M 11-12 years old.

A significant association between the number of FEM and academic performance was observed. The group of schoolchildren who performed fewer manoeuvres seemed to perform better in school than those who performed more manoeuvres. In G4M and G5/8M, 41.5% and 48.6% of schoolchildren, respectively, presented unsatisfactory school performance, whereas only 23.7% of G3M children.

The orofacial motor function analysis showed no association between the number of FEM and the investigated variables: lip position, salivation, eating solids difficulty, mastication, reflux, nasal reflux, cough during eating, thumb sucking, breastfeeding, bottle-feeding, pacifier, delay in speech, switching words and choking.

According to the analysis of respiratory characteristics, SVC showed no difference among the groups, as well as IC and ERV, and respiratory mechanics variables also did not differ among the three groups. Table 2 shows the mean value of respiratory variables for each group, and Table 3 shows the orofacial motricity characteristics according to the number of FEM.

3.2 | Influence on the number of performed FEM

For the multiple logistic regressions, only the aforementioned variables with a significant difference among the groups were introduced into the model. Children with unsatisfactory school performance compared with children with satisfactory school performance were 2.34 times more likely to perform four FEM and 2.88 times more likely to require five to eight FEM (Table 4, Figure 1).

4 | DISCUSSION

The aim of the present study was to analyse factors such as school performance, age, orofacial motricity, RMS, oscillometry parameters, SVC, QOL and LPA and their influence on the number of FEM performed by healthy schoolchildren. Regardless the age difference found between groups, only the school performance showed some influence in the number of FEM. Notably, performing the spirometry test in schoolchildren can be really challenging and involves repeated manoeuvres, mistaken diagnosis and exclusion of cases because of failure to meet all performance criteria.[2,8,11,17]

According to Ladosky et al,[40] the main exclusion criteria in epidemiological studies that use spirometry in children include early termination of expiration, closure of the glottis, cough and poor cooperation; these are inabilities that may be directly related to the child's understanding of the test. This difficult to perform spirometry at this paediatric age group, perhaps, may explain the FEM 87% below of predicted in the studied children. The sample was composed by children without pulmonary disease, however, when they performed the exam for the first time, some of them did not reach values that high on the analysed parameters.

This study showed that age and school performance, assessed by the cognitive analysis, are factors that influenced the number of required FEM. Age is a determinant of the child's success in performing spirometry tests, as cognitive and motor development is closely related to growth and skills acquisition.[42] Beydon et al[33] discussed that the stage of neuropsychomotor development and the child's emotional state determine the amount of time a child needs to get accustomed to breathing into the apparatus and the success of a spirometry. The present study found that the mean age in the G5/8M was lower as compared with the groups that performed fewer FEM. Regardless the fact that age is usually not associated with the number of FEM, the logistic regression analysis showed that younger children may have more difficulty when performing the FEM as compare to older children. Perhaps, therefore, young children ought to be allowed to perform more than eight attempts.

Performing correct spirometry involves the ability to learn, moreover, younger children are likely to need more attempts to complete the test. Burity et al[8] reported the need of 12 repetitions of FEM to achieve acceptable and repeatability curves in children aged 3-6 years. According to the authors, this number did not present any damage to the quality of the test or the child's well-being. As stated by the ATS/ERS 2019 update,[27] when testing children, more than eight attempts may be required once each attempt may not be a full satisfactory manoeuvre. The current study considered the test to be repeated until eight times because of the repercussion of the FEM on airways as proposed by Zach.[43] For this author, the airway is dynamically compressed during the FEM, changing the respiratory mechanic; therefore, fewer FEM seems to maintain the airway stability and assure spirometry quality.

Spirometry is currently indicated for children over 5 years old[11]; however, there are still many questions regarding age and participation in paediatric clinical trials. Admittedly, success rate of spirometry increases with age.[8] Gaspar et al[42] investigated asthma in children and observed a significant relationship between age and exam success, namely an 85% increase in the success rate in children older than 8 years. Heinzmann and Donadio[44] evaluated the success rate for the manovacuometry test in children aged 4 to 12 years, test which also requires FEM for their MEP measurement. They also observed lower performance for manovacuometry test in preschool children as in spirometry. These data support the results of this study, which found an association between age and the number of performed spirometry manoeuvres.

School performance was another factor that showed a strong relation to the number of manoeuvres, that is, children with higher performance required a lower number of manoeuvres to complete the test. This finding reinforces the fact that the execution of spirometry depends on the understanding of verbal commands and learning components.[8] Many studies have pointed to relationship between cognitive tests and school performance. Several outcomes, such as attention, perception, memory, language, reasoning and executive functions may represent learning skills, which are directly related to the school skills assessed by teachers.[45] Thus, school performance, assessed by the cognitive analysis, can provide relevant technical aspects to the execution of the test in children. A possible

TABLE 2 Respiratory characteristics of the groups according to the number of FEM

Variable	3 Manoeuvres M ± SD	4 Manoeuvres M ± SD	5-8 Manoeuvres M ± SD	P
FVC (%)	95.19 ± 15.4	98.37 ± 12.22	99.15 ± 16.99	.45[b]
FVC (Z- score)	0.29 ± 1.31	0.01 ± 1.39	−0.11 ± 1.23	.32[b]
FEV_1 (%)	91.35 ± 15.58	90.12 ± 15.76	88.92 ± 23.35	.58[b]
FEV_1 (Z- score)	0.11 ± 1.47	0.02 ± 1.17	−0.14 ± 1.09	.61[b]
PEF (%)	86.77 ± 14.89	81.35 ± 10.98	86.78 ± 15.81	.44[b]
FEF_{25-75} (%)	88.75 ± 24.8	84.06 ± 23.49	89.11 ± 16.22	.56[b]
FEF_{25-75} (Z- score)	−0.19 ± 1.20	0.30 ± 1.46	−0.38 ± 1.23	.42[b]
SVC%	91.78 ± 9.94	93.66 ± 12.67	93.10 ± 13.1	.753[b]
IC%	78.10 ± 12.8	77.40 ± 10.5	84.00 ± 20.8	.314[b]
ERV%	113.70 ± 18.10	111.94 ± 20.3	107.03 ± 22.8	.333[b]
Z5 (cmH_2O/(L/s))	6.32 ± 1.54	6.13 ± 1.46	6.56 ± 1.4	.362[b]
R5 (cmH_2O/(L/s))	6.04 ± 1.48	5.84 ± 1.42	6.26 ± 1.38	.353[b]
R20 (cmH_2O/(L/s))	4.64 ± 1.04	4.46 ± 1.04	5.01 ± 1.02	.070[b]
X5 (cmH_2O/(L/s))	1.79 ± 0.58	−1.81 ± 0.55	−1.88 ± 0.60	.720[b]
Fres (1/s)	18.4 ± 4.43	18.30 ± 4.35	18.80 ± 4.47	.752[b]
AX	12.0 ± 7.49	12.00 ± 7.56	12.10 ± 7.51	.995[b]
MIP (cmH_2O)	82.42 ± 32.15	85.68 ± 43.64	80.97 ± 29.04	.947[b]
MIP %	130.61 ± 45.09	113.86 ± 35.45	131.72 ± 41.88	.873[b]
MEP (cmH_2O)	93.47 ± 20.27	83.15 ± 22.47	82.32 ± 24.51	.969[b]
MEP %	116.08 ± 36.31	98.89 ± 29.92	116.21 ± 33.56	.759[b]

Abbreviations: %, percentage of predicted; AX, reactance area; ERV, expiratory reserve volume; FEF_{25-75}, mid expiratory flow; FEM, forced expiratory manoeuvres; FEV_1, forced expiratory volume in 1 second; Fres, resonance frequency; FVC, forced vital capacity; IC, inspiratory capacity; M, Mean; MEP, absolute value of maximum expiratory pressure; MIP, absolute value of maximum inspiratory pressure; PEF, peak expiratory flow; R20, respiratory resistance at 20HZ; R5, respiratory resistance at 5 Hz; SD, standard deviation; SVC, slow vital capacity; X5, respiratory reactance at 5 Hz; Z5, respiratory impedance at 5 Hz.
[a]One-way ANOVA test.
[b]Krunkal-Wallis.

5-6/9

Which factor can influence the number of forced expiratory manoeuvers on spirometry in schoolchildren?

TABLE 3 The orofacial motor function characteristics of the groups according to the number of FEM

Variable	3 Manoeuvres N (%)	4 Manoeuvres N (%)	5-8 Manoeuvres N (%)	Chi-square	P
Lip position					
Closed	46	36	31	3.57	.461
Open	13	17	6		
Salivation					
Reduced	54	45	35	3.24	.512
Excessive	5	8	2		
Difficulty eating solids					
No	44	34	29	8.65	.194
Yes	15	19	8		
Mastication					
Normal	45	39	29	1.03	.905
Abnormal	13	13	8		
Reflux					
Yes	51	40	28	3.42	.180
No	7	13	9		
Nasal reflux					
Yes	55	52	36	0.98	.615
No	3	1	1		
Cough during eating					
Yes	50	44	31	0.23	.891
No	8	9	6		
Thumb sucking					
Yes	24	22	22	1.30	.572
No	6	9	5		
Breast feeding					
Yes	6	7	6	3.80	.437
No	52	46	30		
Bottle-feeding					
Yes	16	13	11	0.31	.851
No	42	40	26		
Pacifier					
Yes	8	11	6	1.31	.521
No	21	19	20		
Delay in speech					
Yes	54	50	32	1.99	.369
No	4	3	5		
Switching words					
Yes	50	45	30	0.46	.793
No	8	8	7		
Choking					
Yes	49	47	49	1.21	.54
No	9	6	3		

Abbreviations: FEM: forced expiratory manoeuvres; N (%): percentage of respondents per group, according to the number of manoeuvres.

Variables	G3M vs G4M OR (CI 95%)	P	G3M vs G5/8M OR (CI 95%)	P
Age	1.13 (0.92-1.38)	.23	0.88 (0.68-1.06)	.17
School performance				
Satisfactory	1.00		1.00	
Unsatisfactory	2.34 (1.03-0.31)	.04*	2.84 (1.16 - 6.92)	.02*

TABLE 4 Number of FEM, age and school performance

Abbreviations: CI, confidence interval; FEM, forced expiratory manoeuvres; G3M, group 3 manoeuvres; G4M, group 4 manoeuvres; G5/8M, group 5-8 manoeuvres; OR, Odds ratio.
*$P > .05$.

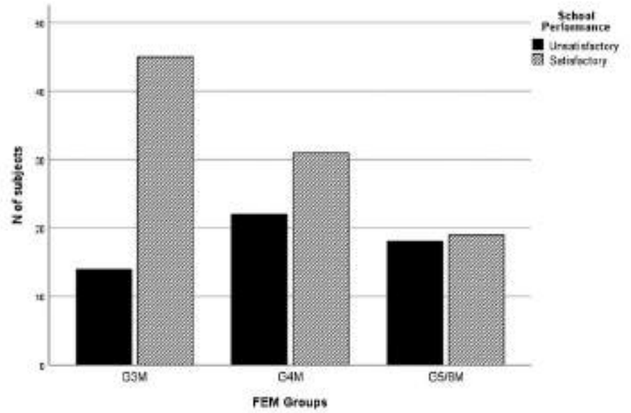


FIGURE 1 School Performance by FEM groups. FEM, Forced expiratory manoeuvres; G3M, group 3 manoeuvres; G4M, group 4 manoeuvres; G5/8M, group 5-8 manoeuvres

limitation for this research is the non-application of a more specific instrument for cognitive assessment, such as Wechsler Intelligence Scale for Children.[39]

Notably, child development entails biological and environmental aspects, this study considered other factors as potential influencers of spirometry, such as orofacial motor function, since the ability to blow is essential to perform the exam. Blowing out the air activates vital functions, once the muscles are used for breathing, sucking, mastication, swallowing and phono-articulation.[46] In this study, this outcome had no influence on the number of repetitions of the spirometry manoeuvres, this finding may be related to the sample characteristic, which showed no signs of immaturity or impairment. The analysed health history showed few cases of choking during eating, excessive saliva, lack of mastication, nasal reflux, fingers sucking and delayed speech.

The sample characteristic may have inhibited the possible relationship between QOL and the number of manoeuvres. In all groups, AUQUE's domains of health and body function showed a maximum score, which represents high QOL. These results may be explained because all schoolchildren were healthy; therefore, it was difficult to detect dissatisfaction through the questionnaire. LPA is another health-related outcome, the relationship between physical activity and health has been increasingly established, as this is also associated with ventilatory capacity improvement.[47] Individuals who participated in physical activity were expected to show higher RMS and, consequently, better test performance. RMS is measured by pressure, which makes it dependent on mechanical characteristics of the rib cage and abdominal wall, as well as on the interaction of the surrounding muscles.[21] Despite the relationship with respiratory biomechanics, there was no association of LPA and RMS with the performed number of FEM.

Impulse oscillometry was used to investigate if after repetitive expiratory manoeuvres some parameters such as X5 e R5 could be affected.[43] Furthermore, the IOS has been considered a promising test to assess respiratory mechanic in paediatric patients. Although baseline oscillometry parameters assessed by airway resistance are

7-8/9

Which factor can influence the number of forced expiratory manoeuvers on spirometry in schoolchildren?

thought to interfere with the number of FEM, this influence could not be observed. Likewise, SVC, when related to FVC, becomes a resource to evaluate the dynamic compression of the airways.[26] Thus, a possible relationship between changes in respiratory mechanics and the baseline SVC predicted values for schoolchildren had to be evaluated.

Admittedly, spirometry is of utmost importance for the evaluation of pulmonary function; however, individual's performance has great influence on the quality of the results.[2] A relationship of school performance, assessed by the cognitive analysis, and age with the number of attempts to perform spirometry could be observed. Therefore, this study is relevant for clinical practice, as it provides information about the factors that influence the number of manoeuvres required for an accurate execution of the test. This allows a more careful management of spirometry in schoolchildren, respecting their limitations, avoiding or reducing the risk of respiratory disease wrong diagnosis (obstructive or restrictive) caused by schoolchildren unsatisfactory performance during the test.

Some limitations should be noted, instead of using z-score (>−1.64), the study considered predicted values by Polgar and Promadhat[27] as the inclusion criteria based on the spirometry. According to Quanjer et al study, from 1995,[28] the prediction equation by Polgar may present bias on scoring predicted values in the adolescence beginning, once there was not considered growth spurt as the equation was developed. Moreover, the study used self-reported questionnaires, such as QOL, PAQ-C and MBGR to gather information about participants LPA, QOL and oral habits. Although self-reported questionnaires are a widely used assessment strategy, they may lead to subjectivity and they rely on participant's recall creating a memory bias. Therefore, the use of more objective and sensitive assessment tools, such as the accelerometer to assess the LPA should be considered in future studies. In addition, further studies should be conducted, especially about cognitive analysis and its possible relationship with other factors; such as friendly resources for playful therapy, visual stimuli and specific execution commands for children.

According to the literature,[2,8,17,31] some adaptation of the spirometry test was made to meet the paediatric population requirements as following: (a) changes in the time of FEV which in the adults is the FEV in 1 second and in children FEV in 0.5 may be used; (b) the test may takes only 3 seconds instead of 6 seconds; (c) and more numbers of attempts from 8 to 12. Despite the acceptable adaptations, this study maintained FEV in the first second, and the expiratory time in 6 seconds. Moreover, incentives and prior training were introduced in the children's follow-up to improve test comprehension and performance. However, since the FEM needs children both comprehension and cooperation, it is crucial to assess children performance during the test.

The present study found that school performance played a major role in the number of FEM by healthy schoolchildren. Children with poor school performance were twice as likely to need more than five FEM to complete the spirometry test. In addition, younger children may need more numbers of attempts to perform a satisfactory spirometry test.

DISCLOSURE

The authors have no financial relationships relevant to this article to disclose.

ORCID

Rafaela Coelho Minsky https://orcid.org/0000-0001-7423-4852

REFERENCES

1. Welsh L, Kathriachchige G, Raheem T, Grobler AC, Wake M, Ranganathan S. Lung function: population epidemiology and concordance in Australian children aged 11–12 years and their parents. *BMJ Open*. 2019;9:53-62.
2. Jat KR. Spirometry in children. *Prim Care Respir J*. 2013;22:221-229.
3. Komarow HD, Skinner J, Young M, et al. A study of the use of impulse oscillometry in the evaluation of children with asthma: analysis of lung parameters, order effect, and utility compared with spirometry. *Pediatr Pulmonol*. 2012;47:18-26.
4. Piccioni P, Tassinari R, Carosso A, Canena C, Buglani M, Bono R. Lung function changes from childhood to adolescence: a seven-year follow-up study. *BMC Pulm Med*. 2015;15:31.
5. Lum S. Lung function in preschool children: aplications in clinical and epidemiological research. *Paediatr Respir Rev*. 2006;7:S30-S32.
6. Aurora P, Stocks J, Oliver C, et al. Quality control for spirometry in preschool children with and without lung disease. *Am J Respir Crit Care Med*. 2004;169:1152-1159.
7. Lum S, Bountziouka V, Sonnappa S, Cole TJ, Bonner R, Stocks J. How, "healthy" should children be when selecting reference samples for spirometry? *Eur Respir J*. 2013;45:1576-1581.
8. Bunty EF, Pereira CAC, Rizzo JA, Brito MCA, Sarinho ESC. Reference values for spirometry in preschool children. *J Pediatr*. 2013;89:374-380.
9. Pamela K, Tamara T, Perry AB. Comparison of quality of pediatric spirometry via telemedicine and in-person modalities. *Respir Care*. 2018;63:3025622.
10. Anandi S, Tullu MS, Lahiri K. Evaluation of symptoms & spirometry in children treated for asthma. *Indian J Med Res*. 2016;144:124-127.
11. Masekela R, Gray D, Verwey C, Halkas A, Jeena P. Paediatric spirometry guideline of the South African Thoracic Society: part 1. *South African Med J*. 2013;103:1036-1041.
12. Gatto F, Bedregal P, Ubilla C, Barrientos H, Caussade S. Development of a quality scale for the interpretation of spirometry in preschool children. *Rev Chil Pediatr*. 2017;88:66-72.
13. Pesant C, Santschi M, Praud JP, Geoffroy M, Niyonsenga T, Vlachos-Mayer H. Spirometric pulmonary function in 3- to 5-year-old children. *Pediatr Pulmonol*. 2007;42:263-271.
14. Ribeiro JD, Fischer GB. Chronic obstructive pulmonary diseases in children. *Jornal de Pediatria*. 2015;S11-25.
15. De Assumpção MS, Ribeiro JD, Wamosy RMG, Parazzi PLF, Schivinski CIS. Impulse oscillometry and spirometry in schoolers submitted to the six-minute walk test. *Rev Paul Pediatr*. 2018;36:474-481.
16. Scalco JC, Minsky RC, Schivinski CIS. Spirometry in schoolchildren during field studies: does testing on different days change the test result? *Rev Paul Pediatr*. 2017;34:25-30.
17. Ayuk AC, Uwaezuoke SN, Ndukwu CI, Ndu IK, Iloh KK, Okoli CV. Spirometry in asthma care: a review of the trends and challenges in pediatric practice. *Clin Med Insights Pediatr*. 2017;11:1-6.
18. Zeren M, Cakir E, Gurses HN. Effects of inspiratory muscle training on postural stability, pulmonary function and functional capacity

Coughing and diaphragmatic breathing exercise: What is the repercussiom on respiratory mechanics of children and adolescents with cystic fibrosis?

Accepted Article

Article type : Original Paper

COUGHING AND DIAPHRAGMATIC BREATHING EXERCISE: WHAT IS THE REPERCUSSION ON RESPIRATORY MECHANICS OF CHILDREN AND ADOLESCENTS WITH CYSTIC FIBROSIS?

ABSTRACT

Introduction: the aim of this study was to investigate the immediate effect of coughing episodes and diaphragmatic breathing exercise (DBE) on respiratory mechanics of children/adolescents with cystic fibrosis (CF). **Methods:** It is a cross-sectional analytical study that occurred in a reference center for children with CF. Forty-five children/adolescents with CF [60% male; mean age 10,22±2,84 years old; mean forced expiratory volume in 1 second (FEV_1) 73,74±21,38 % predicted] were divided in 3 groups according to the R5 parameter response to the DBE: G1 (increased R5), G2 (no change R5) and G3 (decreased R5). The children/adolescents performed 5 successive coughs and 10 DBE. The main outcome measures were the IOS parameters evaluated before, during and after the interventions. **Results:** In the total sample, the IOS parameters (Z5, R5 and R20) were worse after coughing and they did not change after the DBE. In the G1, the parameters were progressively worsening during the interventions. In the G2, they worsened after coughing and after the DBE. And, in the G3, they worsened after coughing; however, after the DBE the IOS parameters have improved and returned close to the baseline. **Conclusions:** the children/adolescents with CF airway resistance got worse after coughing episodes, and 10 DBE repetitions did not affect the respiratory mechanics in most of the sample. Meanwhile, in the group with older children the DBE worsened the respiratory mechanics, yet in the younger group it improved.

This article is protected by copyright. All rights reserved

Accepted Article

COUGHING AND DIAPHRAGMATIC BREATHING EXERCISE: WHAT IS THE REPERCUSSION ON RESPIRATORY MECHANICS OF CHILDREN AND ADOLESCENTS WITH CYSTIC FIBROSIS?

Abbreviated Title: Coughing and Diaphragmatic Breathing in Cystic Fibrosis

Tayná Castilho[1], Renata Maba Gonçalves Wamosy[2], Juliana Cardoso[1], Francieli Camila Mucha[3], Uriel Jandt[4], Camila Isabel Santos Schivinski[5]

1. Physical Therapist, Master´s Degree in Physical Therapy from the University of the State of Santa Catarina (UDESC), Florianópolis-SC/ Brazil.
2. Physical Therapist, Ph.D. in Human Movement Science from the University of the State of Santa Catarina (UDESC), Florianópolis-SC/ Brazil.
3. Physical Therapist, Doctorate Student in Human Movment Science from the University of the State of Santa Catarina (UDESC), Florianópolis-SC/ Brazil.
4. Physical Therapy Undergraduate Student from the University of the State of Santa Catarina (UDESC), Florianópolis-SC/ Brazil.
5. Physical Therapist, PhD in Child and Adolescent Health from the University of Campinas (UNICAMP), Full Professor of the Undergraduate and Graduate Programs of Physical Therapy at UDESC, Florianópolis-SC/ Brazil.

Institutions where the study was performed: Centro de Ciências da Saúde e do Esporte (CEFID) da Universidade do Estado de Santa Catarina (UDESC) and Hospital Infantil Joana de Gusmão (HIJG)– Florianópolis, Santa Catarina, Brazil.

Conflicts of Interest: none.

Source of Funding: This study was supported by the Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina, FAPESC/Brazil (PAP UDESC, Chamada Pública Nº 04/2018, Termo de Outorga 2019TR658). Coordination of the Improvement of Higher Level Personnel (CAPES).

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/IJCP.14879

This article is protected by copyright. All rights reserved

Coughing and diaphragmatic breathing exercise: What is the repercussiom on respiratory mechanics of children and adolescents with cystic fibrosis?

Key-words: Cystic fibrosis. Child. Physiotherapy. Oscillometry

What's already known about this topic?

The cough and the diaphragmatic breathing exercise (DBE) are therapeutic techniques widely used in physiotherapy clinical practice for individuals with Cystic Fibrosis, and they are recommended by several CF guidelines. The coughing has the purpose to promote mucociliary clearance and the DBE is used to minimize airway instability and prevent bronchospasm and oxygen desaturation.

What does this article add?

This paper contributes to understanding of the immediate effects of coughing and diaphragmatic breathing exercise (DBE) in children/adolescents with cystic fibrosis (CF). These therapeutic techniques are used in clinical practice and this paper data showed the real impact of coughing in airways of children with CF, increasing the airway resistance. The DBE effect on airways showed that some subjects, probably younger children are more stable after this technique, and in older children/adolescents the DBE could be acting as an airway clearance technique.

INTRODUCTION

Coughing is a physiological event that protects airways and consists of three phases: inspiratory, compressive and expulsive, which must be performed completely to ensure its effectiveness.[1] In patients with cystic fibrosis (CF) coughing is recurrent, and its increase is seen as an acute pulmonary exacerbation sign.[2] On the other hand, coughing is used by physiotherapists as a therapeutic resource to remove inferior airway sputum[4,5], and it must be used carefully; once, these patients airways mechanics and pulmonary tissue structure are compromised.[6] These conditions result in an equal pressure point in regions even more distal, that, theoretically, increases the air flow resistance and air trapping.[6]

Diaphragmatic breathing exercise (DBE) might be performed to prevent or minimize the airway instability after coughing episodes.[3] This exercise is one component of the airways clearance techniques such as the Active Cycle of Breathing Technique (ACBT) and Forced Expiration Technique (FET).[5,7–9] Moreover, this proposes preventing bronchospasm and oxygen desaturation, besides minimizing the patient fatigue[3,7–9]. However, it is necessary to understand the DBE effect on potential airway dynamic compression after coughing, and whether its performance promotes airway stability and functional respiratory mechanics.

Furthermore, impulse oscillometry system (IOS) is a method used to evaluate respiratory mechanics changes, as in coughing episodes, and it does not require patient effort.[10] In addition, this device has been used in individual with CF as a pulmonary complementary function evaluation.[11,12]

Therefore, we hypothesize that the DBE used after coughing episodes would have improved respiratory mechanic parameters. This study aimed to identify the immediate effects of coughing episodes and DBE on respiratory mechanics of children/adolescents with CF. As a secondary aim, we compared the respiratory mechanics parameters in groups stratified according to the DBE response.

METHOD

Study Design and Subjects

This is a cross-sectional analytical study performed in a CF reference center in Santa Catarina -Brazil, from June 2018 to October 2019. The reference center ethic committee approved the study protocol (CAEE: 80800217.4.0000.5361) and it was registered in the Clinical Trial Brazilian Register (REBEC) (RBR-4stzq4). Written informed consent was obtained from the patients and their guardians.

This study included children/adolescents between 6 to 15 years old with confirmed CF diagnosis.[13] At the evaluation moment, the *Cystic Fibrosis Clinical Score* (CFCS)[14] and *Cystic Fibrosis Foundation Score* (CFFS)[15] were applied and the participants were not included if there was a presence of acute pulmonary exacerbation.

Sample Characterization

At the medical records the clinical markers obtained were: bacterial colonization (colonization of at least one bacteria), genetic mutation (presence of at least one allele with F508del mutation); the disease severity was categorized in excellent, good, average, poor and severe according to *Schwachman-Doershuk* Score (SDS).[16] Also, we recorded the most recent spirometry parameters of forced expiratory volume in the first second (FEV_1) and forced expiratory flow at 25% to 75% of forced vital capacity (FEF_{25-75}) over the last three months before evaluation. The spirometry was performed following the *American Thoracic Society* (ATS) recommendation[17] and was presented as predicted percentages (pred%) according to Polgar e Promadhat[18] to FEV_1, Knudson et al. to FEF_{25-75},[19] and the Global

This article is protected by copyright. All rights reserved.

This article is protected by copyright. All rights reserved.

Accepted Article

Accepted Article

Coughing and diaphragmatic breathing exercise: What is the repercussiom on respiratory mechanics of children and adolescents with cystic fibrosis?

Accepted Article

Lung Function Initiative (GLI)[20] equations were used as a reference values for both parameters and presented as z-score. Anthroponometric measures as weight and height were collected; thereafter, the body mass index (BMI) was calculated and categorized as above, below or equal to the 3rd percentile.[21]

Intervention

The intervention included two stages: over the first one the children/adolescents were oriented to perform five effective coughings[3]; to the second one, they executed 10 DBE repetitions, which was adapted from Yamaguti et al. study.[22] In DBE, subjects had to perform a nasal inspiration in tidal volume while they were moving the abdomen forward avoiding moving the thorax superior region. During this exercise, the researcher placed her hand in the subject's abdominal region as a proprioceptive stimulus, and the expiration must had been oral and passive.

Impulse Oscillometry (IOS) Evaluation

The respiratory mechanics evaluation was performed through pneumatograph Master Screen IOS (Erich Jaeger, Würtzburg, Germany®) according to the ATS recommendation.[23] The registered oscillometric parameters were: impedance at 5Hz (Z5), total (R5) and central (R20) airway resistance and reactance at 5Hz (X5). They were presented in absolute and as predicted percentages (pred%) values according to the Assumpção et al. reference equation.[10]

Its evaluation occurred in three moments: 1) pre-coughing (PrC); 2) immediate post-coughing (PsC); 3) immediate post-DBE (PD), and before this last IOS evaluation the researcher oriented the subjects to avoid coughing, whether possible. At the PrC moment there were registered three IOS measurements that the R5 parameter did not change more than 10% and, for the analysis, it was chosen the evaluation with the lower value. At the PsC and PD moments there was registered only one IOS measurement in order to guarantee the intervention's immediate effect.

Afterwards, the total sample was stratified into three groups: G1: children/adolescents that increased more than 10% of R5(pred%) parameter in PD moment in comparison to the PsC moment; G2: subjects that did not have changes in R5(pred%) parameter between PD and PsC moment; G3: subjects that decreased more or equal to 10% of R5(pred%) parameter in PD moment in comparison to the PsC moment.

This article is protected by copyright. All rights reserved

Accepted Article

Statistical Analysis

The data was analyzed using the *IBM SPSS* version 20.0© software and GraphPad Prism 5, and it was presented in graphics and tables. The Shapiro–Wilk test was used to verify data distribution, and then the repeated measures ANOVA with Bonferroni correction and Friedman test were used for intragroup analysis (PrC, PsC, PD). For the intergroup analysis (G1, G2, G3) the one-way ANOVA and Kruskall-Wallis test were executed, it was set at a 5% significance level for all tests. Also, the Student's T test was conducted for the age group analysis, in which those between six to ten years old were compared to the group with age between eleven to fifteen years old.

Sample Size

The sample size was calculated for repeated measure ANOVA, within factors. Using data from a pilot study that included 12 children/adolescents at the G*Power software, the R5 (pred%) parameter was chosen for this analysis, which showed a partial Eta squared of 0.162 and an effect size of 0.44. The calculation pointed to a 45 children/adolescents sample with a power set at 95% and a significance level of 5%. There was necessary 50 subjects to compose the final sample, once it was added up a 10% sample comforting.

RESULTS

Fifty-one children/adolescents were eligible to participate in this study. However, two subjects presented pulmonary exacerbation and they were not included, while four subjects coughed before the last IOS evaluation, and they were excluded. Therefore, 45 children/adolescents participated in this study, where 12 of them were in G1, 20 were in G2 and 13 in G3. The table 1 presents the sample characteristics.

Table 1. Total sample and groups characteristics.

In the total sample, 13.3% subjects had abnormal R5(pred%) and 82.2% had abnormal X5(pred%). The Z5, R5 and R20 parameters - in absolute and pred% values - got worse ($p<0.005$) at the PsC moment and they had remained the same in PD moment. The X5 (absolute and pred%) parameter did not present significant alterations between the three moments (figure 1).

This article is protected by copyright. All rights reserved

Coughing and diaphragmatic breathing exercise: What is the repercussiom on respiratory mechanics of children and adolescents with cystic fibrosis?

Accepted Article

G3, which indicates worsening. The variation between the PrC and the PD moments (ΔPrC-PD) showed statistical difference, and the G1 had the greater variation, also indicating worsening at the Z5 (in absolute and pred%) parameter. Finally, between the PsC and the PD moments (ΔPsC-PD) all oscillometric parameters showed statistical differences, once G2 had the lower variation; thus the G1 variation indicated worsening and the G3 variation indicated oscillometric parameter improvement.

Table 2. Oscillometric parameters (in absolute) intragroup variation between PrC, PsC and PD moments through one-way ANOVA and Kruskall-Wallis tests.

Table 3. Oscillometric parameters (in pred%) intragroup variation between PrC, PsC and PD moments through one-way ANOVA and Kruskall-Wallis test.

DISCUSSION

We emphasize this research importance for physiotherapy once the present study investigates the coughing and the DBE repercussions in CF patient's airways. We identified that oscillometric parameters related to airway resistance (R5 and R20) worsened after coughing and remained the same after the DBE in children/adolescents with CF.

In the group analysis, we stand out the R5 parameter as determinant for the groups' stratification, once this parameter reflects total airway resistance and it could be related to coughing. The G1 presented worsening in the oscillometric parameters only at the PD moment, and had the greatest variation between the PrC and the PD moments. On the other hand, at the G2 some IOS parameters worsened after coughing and other parameters worsened only after the DBE. At the G3, the IOS parameters worsened at the PsC moment and they improved after the DBE, moreover, it was the group with the greatest variation between the PrC and the PsC moments. Regarding the PsC and PD moment variation, G1 and G3 showed opposite behavior, which means, the first one worsened and the second one improved at the end of the intervention protocol.

This pattern difference between the groups could be explained by the fact that the G3 included younger children, which may have smaller airway caliber and alveoli quantity than adolescents and adults, resulting in greater airway resistance.[27] This could be observed in the

This article is protected by copyright. All rights reserved

Accepted Article

Figure 1. Oscillometric parameters comparison between PrC, PsC and PD moments through repeated measures ANOVA and Friedman test. Horizontal bar: statistical significance at p≤0,05 between the moments.

Regarding age group analysis, R5 and R20 parameters were statistically greater (p≤0,05) in the group with younger children (between six to ten years old) compared to the older group (between eleven to fifteen years old).

There was no difference in the comparison between the groups, regarding the presented parameters in table 1 and the oscillometric parameters in PrC moment. Most of the sample of the G1 (66.7%) were between 11 and 15 years old and, at the baseline, 8.3% of the subjects showed abnormalities in R5 and 91.7% had abnormal X5. The Z5, R5 and R20 parameters - in absolute and pred% values - got worse in PD moment in comparison to PrC (p<0.005) and PsC (p<0.005) (figure 2); only X5 parameter did not present statistical differences.

At the G2 group, 50% of the sample was between 11 and 15 years old, in addition, 15% of the subjects had abnormal R5 and 85% had abnormal X5. The Z5 and R20 (in absolute) got worse in the PD moment in comparison to the PrC (p<0.005) (figure 2). However, the R5 (in absolute) and R20 (pred%) got worse in the PsC moment (p<0.005) and had remained the same in PD moment (figure 2).

Regarding the G3 group, most of the sample was younger than the other groups, once 69.2% of the individuals were between six and ten years old. About 15.4% of the sample had abnormal R5 and 69.2% had abnormal X5. The Z5 (in absolute), R5 and R20 (in absolute and pred%) got worse in the PsC moment (p<0.005) and, at the PD moment, all of them decreased close to baseline values (figure 2).

Figura 2. Oscillometric parameters intragroup analysis at the PrC, PsC and PD moments through repeated measures ANOVA and Friedman test. Horizontal bar: statistical significance at p≤0,05 between the moments.

In table 2 and 3 are presented the oscillometric parameters variation in the three evaluation moments in each group. Between PrC and PsC moments (ΔPrC-PsC) there was a statistical difference in Z5 parameter (in absolute value), and the greater variation occurred in

This article is protected by copyright. All rights reserved

7-8/9

Coughing and diaphragmatic breathing exercise: What is the repercussiom on respiratory mechanics of children and adolescents with cystic fibrosis?

Accepted Article

improve the respiratory mechanics stabilizing the airways or as an airway clea+rance technique; according to age group, the patient's clinic or preference.

The children/adolescents with CF, evaluated in this study, presented (A) increase in airway resistance immediately after coughing episodes, which was observed in R5 and R20 parameters. However, (B) 10 DBE repetitions did not affect the respiratory mechanics in most of the sample. And, in group analysis (C) some individuals responded and others did not respond to the DBE whereas the group with older subjects worsened the respiratory mechanics and the younger group showed improvement.

REFERENCES

1. Canning BJ, Chang AB, Bolser DC, Smith JA, Mazzone SB, McGarvey L. Anatomy and Neurophysiology of Cough: CHEST Guideline and Expert Panel Report. Chest. 2014;146(6):1633–48.
2. Zach MS. The physiology of forced expiration. Paediatr Respir Rev. 2000;1(1):36–9.
3. Skolnik K, Quon BS. Recent advances in the understanding and management of cystic fibrosis pulmonary exacerbations. F1000Research. 2019;8:1–10.
4. Button BM, Wilson C, Dentice R, Cox NS, Middleton A, Tannenbaum E, et al. Physiotherapy for cystic fibrosis in Australia and New Zealand: A clinical practice guideline. Respirology. 2016;21(4):656–67.
5. Cystic Fibrosis Trust. Standards of Care and Good Clinical Practice for the Physiotherapy Management of Cystic Fibrosis. Cyst Fibros Our Focus. 2017;(April 2017):265.
6. Ranganathan SC, Hall GL, Sly PD, Stick SM, Douglas TA. Early Lung Disease in Infants and Pre-school Children with Cystic Fibrosis: What Have We Learnt and what Should We do About it? 2016;1–21.
7. Pryor JA, Webber BA, Hodson ME, Batten JC. Evaluation of the forced expiration technique as an adjunct to postural drainage in treatment of cystic fibrosis. Br Med J. 1979;2(6187):417–8.
8. Lewis LK, Williams MT, Olds TS. The active cycle of breathing technique: A systematic review and meta-analysis. Respir Med [Internet]. 2012;106(2):155–72. Available from: http://dx.doi.org/10.1016/j.rmed.2011.10.014

This article is protected by copyright. All rights reserved

RECOMMENDATION LETTERS

UDESC | Cefid Universidade do Estado de Santa Catarina
Centro de Ciências da Saúde e do Esporte

A quem interessar possa,

Venho através deste documento recomendar fortemente os trabalhos de tradução de Emily Jandt. Esta recomendação baseia-se em diversos artigos traduzidos pela Emily para meu grupo de pesquisa e para o Programa de Pós Graduação em Ciências do Movimento Humano do qual fui coordenador até o dia 28.fev.2022. De todos os artigos traduzidos nunca houve uma única sugestão de modificação da tradução, pelo contrário, recebemos vários elogios dos editores e avaliadores. Alguns dos artigos traduzidos foram: "Selection and standardization forms of data in the assessment of internal and external rotators of the shoulder of young beach volleyball athletes through isometric dynamometry" e Strategies used in the Olympic weightlifting and psychological aspects: factors that contemplate sports performance.

Fico totalmente a disposição para quaisquer esclarecimento

Atenciosamente,

Helio Roesler
Professor Titular

Florianópolis, 02 de dezembro de 2021.

RECOMMENDATION LETTERS

A quem possa interessar,

Trabalho com a Emily Jandt há um pouco mais de 2 anos, com tradução de artigos para a publicação em revistas científicas internacionais. Juntas, publicamos os seguinte os trabalhos:

- impact of forced exhalation maneuvers during spirometry.

- Which factors can influence the number of forced expiratory maneuvers on spirometry in schoolchildren?

- Comparison of the physiological responses induced by different pediatric exercise field tests in children.

Além de uma profissional extremamente competente, ela sempre cumpriu prazos de trabalho. Já trabalhei com muitos tradutores porém, a Emily foi a única profissional que a tradução era de tamanha qualidade que as revistas internacionais não pediam revisão do inglês. Isto se justifica pois as traduções estão de acordo tanto com a normativa gramatical da língua, quanto a contextualização cultural.

Coloco-me a disposição para qualquer informação.
Cordialmente,

Rafaela Coelho Minsky
Fisioterapeuta (CREFITO - 152263-F)
Mestre em Fisioterapia
PhD em Ciências do Movimento Humano

RECOMMENDATION LETTERS

A quem possa interessar,

Tenho aulas de inglês com a Emily Jandt desde fevereiro de 2020 e temos realizado uma parceria muito interessante devido aos serviços de tradução de artigos científicos prestados por ela.

Gosto de trabalhar com a Emily, pois suas traduções são muito eficientes, visto que nunca mais obtive problemas em relação a escrita da língua inglesa nos artigos científicos desenvolvidos no grupo de pesquisa do qual faço parte.

Ela sempre foi exigente com a estrutura dos textos durante o processo de tradução. Sempre se preocupou para que o texto fosse realmente traduzido para o contexto da língua inglesa e não somente a tradução de palavra por palavra da versão em português para o inglês.

Além das traduções dos artigos científicos, ela me auxiliou na preparação e apresentação de resumos que foram apresentados no European Respiratory Society Congress em 2021.

A Emily sempre se mostrou muito respeitosa, competente e exigente com o trabalho, continuo utilizando de seus serviços e continuarei por bastante tempo.

Coloco-me a disposição para qualquer informação.

Cordialmente,

Tayná Castilho
Fisioterapeuta
Mestre em Fisioterapia pela UDESC
Doutoranda em Saúde da Criança e do Adolescente da UNICAMP

GET IN TOUCH

Emily Jandt

Adress

Rua Padre Roberto Landell de Moura, 22, Blumenau, Santa Catarina, Brazil.

E-mail

emilyjandt@gmail.com

Telephone

(+55)4892000-0166