

Impact that positive reinforcement during spirometry has on the measurement of VC in healthy volunteers*

Impacto da utilização de reforço positivo na mensuração da CV por espirometria em voluntários saudáveis

Vanessa Sales Logrado, Erieli Mota Sena, Renato Júlio dos Santos Matos, Tássia Menezes Leite da Silva, Tuliane Ribeiro de Oliveira, Kristine Menezes Barberino Mendes, Kátia de Miranda Avena

Abstract

Objective: Physiologically, VC can vary according to gender, age, body weight and posture, as well as ethnic and anthropometric characteristics. In addition, various diseases can alter VC. In order to measure VC, it is necessary to motivate the patient, to make the instructions understandable, to provide clear information and to have a capable examiner. The objective of this study was to determine the impact that positive reinforcement during spirometry has on the measurement of VC in healthy volunteers. **Methods:** A randomized clinical trial involving 105 healthy volunteers, randomly allocated to one of two groups: control and intervention. In both groups, VC was assessed as baseline (VC1) and again 15 days later (VC2). Positive reinforcement was provided only to patients in the intervention group and only during the determination of VC2. **Results:** There were no significant differences between the groups regarding the baseline characteristics. Females predominated in both groups. There was an increase in VC2 in both groups ($p < 0.01$), and VC2 was higher in the intervention group than in the control group ($p < 0.01$). **Conclusions:** These findings demonstrate the importance of using the behavioral strategy in combination with traditional practice in order to obtain better results. The use of positive reinforcement during the determination of VC has proven to be an effective, simple and easily applied strategy.

Keywords: Vital capacity; Reinforcement, verbal; Respiratory function tests.

Resumo

Objetivo: A CV pode variar fisiologicamente em função do gênero, idade, peso, postura, características étnicas e antropométricas, além de poder ser alterada por diversas doenças. Para a realização dessa mensuração, são necessárias a motivação e a compreensão do paciente, a clareza nas informações transmitidas e a habilidade do investigador. O objetivo deste estudo foi analisar o impacto do reforço positivo na mensuração da CV por espirometria em voluntários saudáveis. **Métodos:** Ensaio clínico randomizado, realizado com 105 voluntários saudáveis, alocados randomicamente em dois grupos: grupo controle e grupo intervenção. Os grupos foram submetidos à avaliação da CV basal (CV1) e, após 15 dias, foram reavaliados (CV2), sendo que apenas o grupo intervenção recebeu o reforço positivo durante a determinação da CV2. **Resultados:** Não foram observadas diferenças significantes quanto às características basais dos voluntários entre os grupos. Houve predomínio do gênero feminino em ambos os grupos. Observou-se um aumento da CV2 em ambos os grupos ($p < 0,01$), sendo que a CV2 foi maior no grupo intervenção do que no grupo controle ($p < 0,01$). **Conclusões:** Este estudo demonstra a importância da utilização da estratégia comportamental associada à prática tradicional para a obtenção de melhores resultados. A utilização do reforço positivo durante a mensuração da CV demonstrou-se como uma estratégia eficaz, simples e de fácil aplicabilidade na abordagem ao paciente.

Descritores: Capacidade vital; Reforço verbal; Testes de função respiratória.

* Study carried out at the *Centro Universitário Jorge Amado* – UNIJORGE, Jorge Amado University Center – Salvador, Brazil.

Correspondence to: Kátia de Miranda Avena. Instituto Sócrates Guanaes, Rua Saldanha Marinho, 77, Caixa D'Água, CEP 40.323-010, Salvador, BA, Brasil.

Tel 55 71 3505-8539. E-mail: katiaavena@hotmail.com

Financial support: Kátia de Miranda Avena is the recipient of a scholarship from the *Fundação de Amparo à Pesquisa do Estado da Bahia* (FAPESB, Foundation for the Support of Research in the state of Bahia).

Submitted: 27 August 2009. Accepted, after review: 17 November 2009.

Introduction

It has been shown that VC can be measured slowly, during exhalation, beginning at TLC, or during inhalation, beginning at RV. This represents the greatest volume of air mobilized,^(1,2) corresponding to the sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

The measurement of VC can be performed during pulmonary function tests.⁽¹⁾ Physiologically, VC, similarly to other variables related to volume and lung capacity, can vary according to gender, age, body weight and posture, as well as ethnic and anthropometric characteristics, in addition to the fact that it can be altered by various pathological processes.^(3,4) Factors such as the motivation and understanding of the patient, the calibration of the instrument, the use of verbal commands by the examiner and the provision of clear information to the patient can affect the measurement of VC.^(2,4-6)

Various studies have described the use of strong verbal encouragement during the determination of VC, the purpose of such encouragement being to stimulate the patient at the beginning of the maneuver and ensure that the effort is maintained long enough for VC to be determined.^(1-5,7)

A strategy of behavioral management, known as positive reinforcement, is used in order to provide such encouragement. This strategy is defined as a series of behaviors that result in the provision of encouragement, increasing the probability of a response.^(8,9) It is known that motivation is essential not only for learning but also for efficient performance of motor tasks.⁽¹⁰⁾ It is true that, for measuring VC and for performing other similar measurements, the use of techniques that stimulate the patient to perform better on the test is recommended. Therefore, it is possible to improve VC response by implementing the use of positive reinforcement in the measurement.

In our review of the literature, we found no clinical trials that compared VC measurement with and without the aid of positive reinforcement. Therefore, the objective of this study was to determine the impact that positive reinforcement during spirometry has on the measurement of VC in healthy volunteers.

Methods

This was a randomized clinical trial carried out at the *Centro Universitário Jorge Amado* (UNIJORGE, Jorge Amado University Center) Physical Therapy Clinic, in the city of Salvador, Brazil, between August of 2008 and April of 2009.

This study was approved by the UNIJORGE Research Ethics Committee, in accordance with Resolution 196/96 of the Brazilian National Health Research Ethics Council, and registered in the Australian New Zealand Clinical Trials Registry as ACTRN12609000798268.

We selected 105 healthy health care students, of either gender, at the UNIJORGE, all of whom agreed to participate in the study and gave written informed consent.

Volunteers with postural changes affecting the respiratory mechanics were excluded from the study, as were those with neuromuscular changes, obstructive and restrictive lung diseases, hypertension or heart diseases, as well as those who smoked and those with a BMI > 25 kg/m².

The volunteers included in the study were randomly allocated to one of two groups: control group and intervention group. Randomization was performed with the use of a table of random numbers. Although VC was measured in the two groups, positive reinforcement was provided only to patients in the intervention group (Figure 1).

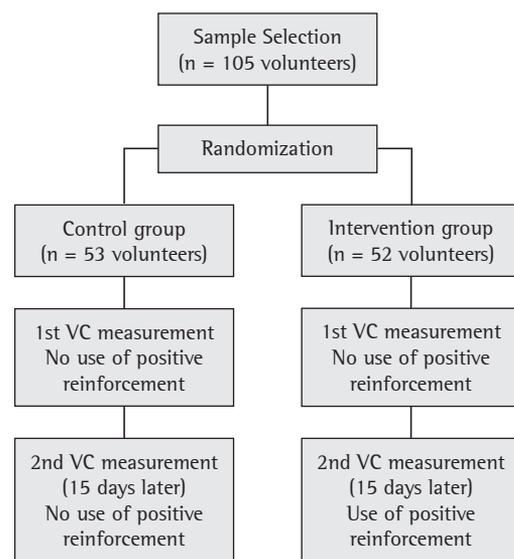


Figure 1 - Study protocol and distribution of volunteers.

The volunteers were evaluated regarding general health status, physical conditioning and postural changes.

Postural changes were evaluated with a framed grid designed for that purpose (Sanny; American Medical do Brasil Ltda., São Bernardo do Campo, Brazil). Volunteers stood barefoot in front of the equipment (sagittal and frontal view), at a standard distance of 20 cm. The visual assessment was made by a rater who was positioned at a distance of 2 m from the volunteer.

Prior to the beginning of the test, all volunteers were instructed regarding the procedures that would be performed. In accordance with the recommendations of the Brazilian Thoracic Association,⁽¹⁾ the volunteers remained at rest for 5 min before VC was measured.

A Wright spirometer (Mark 8; Ferraris Respiratory, Louisville, CO, USA), adapted to the expiratory port of a unidirectional valve and to a silicone face mask, was used in order to assess VC. We decided to use a facial mask since it has been demonstrated that its use does not affect the results obtained, as does the use of a mouthpiece.⁽¹¹⁾

The volunteers were positioned on a chair with a fixed back and seat, allowing a hip flexion angle of 90°. In accordance with the recommendations of the American Thoracic Society,⁽³⁾ measurements were taken in triplicate, 1 min apart, and the highest value obtained was registered.

For all participants, baseline VC (VC1) was assessed with the use of the following verbal command: "Inhale deeply and exhale as much as possible." Fifteen days later, a second assessment of VC (VC2) was made in both groups. However, positive reinforcement was provided only to patients in the intervention group. To that end, the following phrases were used: "Come on! Inhale deeply!"; "Breathe in, breathe in, breathe in!"; "Exhale slowly . . ."; and "Breathe out, breathe out, breathe out, breathe out completely!" The measurements were taken by the same technician who provided the verbal encouragement.

Statistical analysis was performed with the aid of the Statistical Package for the Social Sciences, version 12.0 for Windows (SPSS Inc, Chicago, IL, USA). Descriptive analysis of the data was performed. Numerical variables are presented as arithmetic means and standard deviations, since

they had normal distribution. Categorical data are presented as absolute numbers, and category frequency is expressed as percentages. The Student's t-test was used in order to compare the groups. The level of significance was set at $p < 0.05$ or 5%.

Results

We evaluated 105 volunteers, of whom 53 were randomized to the control group and 52 were randomized to the intervention group. The baseline characteristics of the volunteers are presented in Table 1.

There were no significant differences between the groups in terms of the baseline characteristics. Females predominated in both groups ($p = 0.03$). In view of this predominance, we decided to analyze the VC1 results separately by gender. However, there were no significant differences when males and females were compared, which made it possible to perform the subsequent analyses regardless of gender.

As can be seen in Table 2, no significant differences were found between the groups regarding VC1 ($p = 0.31$). Intra-group comparison of VC1 and VC2 showed an increase in VC2 in both groups ($p = 0.01$). Values of VC2 were significantly higher in the intervention group than in the control group ($p = 0.01$).

Table 1 - Baseline characteristics of the volunteers evaluated.^a

Characteristic	Group		p
	Control (n = 53)	Intervention (n = 52)	
Female gender, n (%)	45 (85)	35 (67)	0.03
Age, years	22 ± 2.7	22 ± 2.9	0.94
Weight, kg	61 ± 10	63.6 ± 11	0.28
Height, m	1.65 ± 0.08	1.69 ± 0.09	0.07
BMI, kg/m ²	22.4 ± 2	22 ± 2	0.37
SBP, mmHg	115 ± 11	116 ± 14	0.65
DBP, mmHg	74 ± 7	73 ± 9	0.56
HR, bpm	79 ± 9	77 ± 9	0.27
RR, breaths/min	15 ± 2	16 ± 3	0.12

SBP: systolic blood pressure; and DBP: diastolic blood pressure.^aValues expressed as mean ± SD, except where otherwise noted.

Table 2 – Measurement of VC.

Group	Baseline VC, mL	VC 15 days later, mL	p
Control	2.682.3 ± 514.7	2.970.9 ± 673.8	0.01
Intervention	2.691.4 ± 884.7	3.455.6 ± 865.4 ^a	0.01

^aVC 15 days later was significantly higher in the intervention group than in the control group (p < 0.01).

Discussion

Our findings demonstrate the impact that positive reinforcement has on the measurement of VC. In both groups studied, VC increased 15 days after the first measurement. However, in the intervention group, VC increased by 28.4% in relation to baseline VC, which can be attributed to the use of positive reinforcement. In the control group, VC increased by only 10%, and this might be associated with the learning effect of the technique.⁽⁹⁾

One group of authors,⁽¹²⁾ through the mapping of the brain regions involved in the processing of positive and negative stimuli, demonstrated that emotionally charged stimuli have a strong modulatory effect on the cortex and on the subcortical structures. However, there is still controversy regarding the effects of the strategy of positive reinforcement. Some studies have shown that the use of positive reinforcement brought significant results when compared to those obtained without the use of encouragement, verbal or otherwise.^(13,14) Other authors have failed to demonstrate that there is a significant improvement in performance after positive reinforcement,^(10,15) and these results might be associated with the methodology used and the sample size.

In the present study, there were no significant differences between the control group and the intervention group regarding age, body weight, BMI, systolic blood pressure, diastolic blood pressure, HR or RR. Nor were there any significant differences between the groups regarding patient baseline pulmonary status. Regarding gender, the predominance of females in both groups can be explained by the fact that this study involved students in the area of health care, an area in which this predominance is evident.

The results of the present study suggest that positive reinforcement is effective when used during the assessment of VC in healthy volunteers, allowing the measured VC value to be closer to the true VC value in such individuals.

Therefore, it can be suggested that, when positive reinforcement is not used, the measured VC value is underestimated.

It is believed that, in patients who are bedridden or present concomitant diseases, the use of positive reinforcement reveals an even greater difference, since, with the use of verbal encouragement, it is expected that patient self-esteem and cooperation will increase, and, therefore, patients will be able to demonstrate their true ability to perform any activity requiring their cooperation.

Our findings demonstrate the importance of using the behavioral strategy in combination with traditional practice in order to obtain better results. The use of positive reinforcement during the determination of VC has proven to be an effective, simple and easily applied strategy.

Therefore, we suggest that, in physical therapy and in other health care areas, this behavioral strategy be combined with techniques that elicit patient cooperation and build patient self-esteem.

References

1. Sociedade Brasileira de Pneumologia e Tisiologia. I Consenso Brasileiro sobre Espirometria. *J Pneumol.* 1996;22(3):105-64.
2. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, et al. Standardisation of spirometry. *Eur Respir J.* 2005;26(2):319-38.
3. Standardization of Spirometry, 1994 Update. American Thoracic Society. *Am J Respir Crit Care Med.* 1995;152(3):1107-36.
4. Pellegrino R, Viegi G, Brusasco V, Crapo RO, Burgos F, Casaburi R, et al. Interpretative strategies for lung function tests. *Eur Respir J.* 2005;26(5):948-68.
5. Costa D, Jamami M. Bases fundamentais da espirometria. *Rev Bras Fisioter.* 2001;5(2):95-102.
6. Wohlgemuth M, van der Kooi EL, Hendriks JC, Padberg GW, Folgering HT. Face mask spirometry and respiratory pressures in normal subjects. *Eur Respir J.* 2003;22(6):1001-6.
7. Domingos-Benício NC, Gastaldi AC, Perecin JC, Avena KM, Guimarães RC, Sologuren MJ, et al. Medidas espirométricas em pessoas eutróficas e obesas nas posições ortostática, sentada e deitada. *Rev Assoc Med Bras.* 2004;50(2):142-7.
8. Sampaio AA. Skinner: sobre ciência e comportamento humano. *Psicol Cienc Prof.* 2005;25(3):370-83.

9. Skinner BF. *Ciência e Comportamento Humano*. São Paulo: Martins Fontes; 2004.
10. Vieira AP, Woodart H, Andrews S. Os efeitos do reforço positivo na performance de habilidades motoras. *Rev Min Educ Fis*. 1998;6(1):29-34.
11. Fiore Júnior JF, Paisani DM, Franceschini J, Chiavegato LD, Faresin SM. Maximal respiratory pressures and vital capacity: comparison mouthpiece and face-mask evaluation methods. *J Bras Pneumol*. 2004;30(6):515-20.
12. Moll J, Oliveira-Souza R, Miranda JM, Bramati IE, Veras RP, Magalhães AC. Efeitos distintos da valência emocional positiva e negativa na ativação cerebral. *Rev Bras Psiquiatr*. 2001;23(Suppl 1):42-5.
13. Possobon RF, Moraes AA, Ambrozano GM, Costa AL. O comportamento de crianças em tratamento odontológico: intervenção psicofarmacológica. *Psicol Estud*. 2004;9(1):29-35.
14. Marianno AC, Guilhardi HJ. Terapia por contingências de reforçamento: um estudo de caso sobre depressão infantil e “fala alucinatoria”. *Psicol Teor Prat*. 2005;7(1):167-83.
15. Lauretti GR, Ramos MB, Mattos AL, Oliveira AC. Efeito do reforço auditivo positivo na recuperação pós-anestésica em pacientes submetidos à infusão contínua de cetamina. *Rev Bras Anestesiol*. 1996;46(5):329-34.

About the authors

Vanessa Sales Logrado

Physical Therapist. *Centro Universitário Jorge Amado* – UNIJORGE, Jorge Amado University Center – Salvador, Brazil.

Erieli Mota Sena

Physical Therapist. *Centro Universitário Jorge Amado* – UNIJORGE, Jorge Amado University Center – Salvador, Brazil.

Renato Júlio dos Santos Matos

Physical Therapist. *Centro Universitário Jorge Amado* – UNIJORGE, Jorge Amado University Center – Salvador, Brazil.

Tássia Menezes Leite da Silva

Physical Therapist. *Centro Universitário Jorge Amado* – UNIJORGE, Jorge Amado University Center – Salvador, Brazil.

Tuliane Ribeiro de Oliveira

Physical Therapist. *Centro Universitário Jorge Amado* – UNIJORGE, Jorge Amado University Center – Salvador, Brazil.

Kristine Menezes Barberino Mendes

Professor. *Centro Universitário Jorge Amado* – UNIJORGE, Jorge Amado University Center – Salvador, Brazil.

Kátia de Miranda Avena

Doctoral Student in Medicine and Human Health. *Escola Bahiana de Medicina e Saúde Pública* – EBMS, Bahia School of Medicine and Public Health – Salvador, Brazil.