BMC Pulmonary Medicine

CORRESPONDENCE Open Access

Why a large percentage of Tunisian women aged 40 years and more has a reduced forced vital capacity? The implication of parity

Helmi Ben Saad*

Abstract

The investigation of the link between reduced forced vital capacity (FVC) and risk factors and health variables in women aged ≥ 40 years is encouraged since a reduced FVC was related to all-cause mortality. The high frequency of women with a reduced FVC, observed in some studies, could be related to the impacts of parity on lung. In the literature, the association between parity and health consequences is discussed in terms of "selection pressure", and the trade-off between longevity and fertility described by scientists is termed the "longevity determination" or "biological warranty period". The respiratory system could be influenced by parity. Above all, it is the respiratory system, who endures the repercussions of the numerous physio-pathological experiences of the woman life. The probable effects of parity on lung function data, including FVC, make parity a key predictor to be stressed and evaluated. Parity is a promising original direction for physiological and pathophysiological research, particularly for low- and lower-middle- income countries. Thus, upcoming epidemiological and clinical studies of lung function data in women would need to include information about their parity status.

Keywords: Childbearing, Parity, FVC, Spirometry, Low-income country

Dear editor,

I read with great interest the paper entitled "Reduced forced vital capacity is independently associated with, aging, height and a poor socioeconomic status: a report from the Tunisian population-based BOLD study" [1]. The investigation of the link between reduced forced vital capacity (FVC) and risk factors and health variables in an urban population of subjects aged ≥40 years and living in a low-income country, such as Tunisia, is encouraged since a reduced FVC was related to all-cause mortality [2]. In their paper, Hsan et al. [1] were surprised to note that 89.6% of women who had never smoked had a reduced FVC. They reported the following sentence "surprisingly, a large percentage of subjects with reduced FVC were never smokers (60.8%). This appears clearly especially in women with a reduced FVC since 89.6% of them had never smoked" [1]. The high frequency of women with a reduced FVC could be related to the impacts of parity (*ie*; the number of offspring a woman has borne) on lung [3]. On the one hand, contrary to high-income countries such as North American/European ones, parity is a particular topic in low- and lower-middle-income countries such as African ones [4]. For example, during 2015, while the mean of parity was 1.616 in European, it was 4.589 in Africa [4]. On the other hand, in the literature, the association between parity and health consequences is discussed in terms of "selection pressure" [5]. The respiratory system could be influenced by parity [3]. Above all, it is the respiratory system who endure the repercussions of the numerous physio-pathological experiences of the woman life [3]. It is surprising

*Correspondence: helmi.bensaad@rns.tn

Laboratory of Physiology, Faculty of Medicine of Sousse, Farhat HACHED Hospital, Sousse, Research Laboratory Heart Failure, LR12SP09, University of Sousse, Street Mohamed KAROUI, 4000 Sousse, Tunisia

Table 1 Studies including healthy women and evaluating the effects of parity on lung function data

1st author	**Harik-Khan [11]**	**Ben Saad [6]**	**Ben Saad [7]**	**Ben Saad [8]**	**Ketfi [9]**
Parity groups or classes	**2 groups** G_1:0:35[a] G_2:≥ 1: 65[a] **4 *classes*** C_1:0: 48.70[a] C_2:1: 15.3[a] C_3:2: 19.7[a] C_4: ≥3:16.2[a]	**2 groups** G_1:≤ 4: 22[a] G_2:> 4: 78[a]	**2 groups** G_1:≤3: 49.1[a] G_2:≥4: 50.9[a] **3 *classes*** C_1:< 2: 12.0[a] C_2:3–4: 58.3[a] C_3:> 4: 29.7[a]	**2 groups** G_1:≤5: 50[a] G_2:≥6: 50[a]	**2 groups** G_1:1–6: 51.5[a] G_2:7–14: 48.5[a] **3 *classes*** C_1:1–4:22.7[a] C_2:5–8:42.4[a] C_3:9–14:34.8[a]
Comparisons	**G_2 vs. G_1** .Higher FEV_1 (%) **C_4 or C_3 or C_2 vs. C_1** .Higher FEV_1	**G_2 vs. G_1** .Similar FVC .Lower FEV_1, FEV_1/FVC, MMEF, PEF	**G_2 vs. G_1** .Similar values in women aged 45–49 or 50–54 or 55–59 years .Penchant to a bronchial obstruction (decrease of FEV_1/SVC and FEV_1/FVC) **C_2 and C_3 vs. C_1** .Penchant to a bronchial obstruction (decrease of FEV_1/FVC and Gawtot) without an associated restriction	**G_2 vs. G_1** .Similar spirometric data (absolute values)	**G_2 vs. G_1** .Similar values of FVC, FEV_1, MMEF, $FEF_{x\%}$, PEF, sRaw, FEV_1/FVC; FEV_1/SVC, RV/TLC .Higher TGV, RV, TLC **C_1 vs. C_2 and C_3** .Similar values of MMEF, $FEF_{x\%}$, PEF, TGV, ERV, IRV, FEV_1/FVC; FEV_1/SVC, RV/TLC **C_2 vs. C_1** .Higher FEV_1, FVC, SVC, TLC, IC, sRaw **C_3 vs. C_1** .Higher TLC and RV

C_x Class number x, *ERV* Expiratory-reserve-volume, G_x Group number x, $FEF_{X\%}$ Forced-expiratory-flow when X% of FVC has been exhaled, FEV_1 Forced-expiratory-volume in one second, *FVC* Forced-vital-capacity, *Gawtot* total-airway-conductance, *IC* Inspiratory capacity, *IRV* Inspiratory-reserve-volume, *MMEF* Maximal mid-expiratory flow, *PEF* Peak expiratory flow, *RV* Residual volume, *sRaw* Specific airway resistance, *SVC* Slow-vital-capacity, *TGV* Thoracic-gas-volume, *TLC* total-lung-capacity

[a] Data were percentage

Table 2 Studies including unhealthy women or mixed population of unhealthy and healthy women and evaluating the efects of parity on the spirometric data

1st author	Krzyzanowski [12]	Horne [13]	Tang [14]	Moll [15]		
Parity groups or classes	**5 groups** G_1:0:14.7[a] G_2:1:21.4[a] G_3:2:40[a] G_4:3:16.5[a] G_5:≥ 4:7.4[a] **COPD: 5 classes** C_1:0:19.6[a] C_2:1:11,8[a] C_3:2:45.1[a] C_4:3:9.8[a] C_5:> 3:13.7[a]	**Parity** .2.4[b]: non-S Pi MZ .2.6[b]: non-S Pi M .2.6[b]: ever-S Pi MZ .2.8[b]: ever-S Pi M .2.5[b]: Pi MZ .2.7[b]: Pi M	**2 groups** G_1:0:15.0[a] G_2:≥1:85[a] **5 classes** C_1:0:15.0[a] C_2:1:12.2[a] C_3:2:34.4[a] C_4:3:25.3[a] C_5:> 3:13.2[a]	**2 groups** G_1:0:(control:23.5[a], PRISm:11.4[a], COPD:17.4[a]) G_2:≥1:(control:76.5[a], PRISm:78.6[a], COPD:82.6[a]) **3 classes** C_1:≤1:(control:23.5[a], PRISm:21.4[a], COPD:17.4[a]) C_2:2:(control:34.4[a], PRISm:27.3[a], COPD:33.4[a]) C_3:≥3:(control:42.1[a], PRISm:51.4[a], COPD:49.2[a])	**COPDGene** **2 groups** G_1:0:(never-S:12.1[a], LSE:11.3[a]) G_2:≥1:(never-S:87.9[a], LSE:88.7[a])	**NHANES 2011–2012 dataset** **3 classes** C_1:≤1:(never-S:12.1[a], LSE:11.3[a]) C_2:2: (never-S:38.9[a], LSE:39.2[a]) C_3:≥3: (never-S:48.9[a], LSE:49.5[a])
Results	**Comparison between the 5 groups** .Similar initial mean FEV_1 .Similar rate of FEV_1 decline (mL/Y) **Regression analysis** .Faster FEV_1 decline in women reporting a greater parity (regression coefficient = 1.6) **COPD incidence** .Similar incidence between the 5 classes	.Parity/Healthy women: not associated with residual pulmonary function values .Interaction term for Pi MZ and parity (***parity x MZ***): associated with the residuals pulmonary function values: FEV_1/FVC, MMEF, $FEF_{50\%}$, $FEF_{25\%}$ values increase with the increasing parity in the Pi MZ group not in the Pi M group .Interaction term for parity and history of smoking (***smoking x parity***): associated with $FEF_{25\%}$: it increases rapidly with increasing parity in Pi MZ group with a history of smoking than in Pi MZ group with no history of smoking .Pi MZ women with parity = 0 or 1 have lower flow rates than expected or that observed in healthy women .Pi MZ women with parity ≥3: higher flow rates than expected	**G_1 vs. G_2** .Lower FEV_1, FVC .Greater FEV_1/FVC **C_1 vs. C_2** .Lower FVC, similar FEV_1 .Greater FEV_1/FVC **C_1 vs. C_2 (or C_3, C_4, C_5)** .Lower FEV_1, FVC .Greater FEV_1/FVC	**Overall analysis** .C_2 and C_3: association with a lower FEV_1 (%) .G_2: association with a lower FEV_1 (%) **Stratified analyses** .G_2, C_2 and C_3: association with a lower FEV_1 (%) for control and PRISm or mild obstruction but not across the more severe GOLD grades. **Interaction analyses** .Interaction of multiparity with age on FEV_1 (%) .No interaction of multiparity with smoking on FEV_1 (%)	.Multiparity: no association with FEV_1 (%) or FEV_1/FVC in never-S or LSE groups	

COPD Chronic obstructive pulmonary disease, *COPDGene* COPD Genetic Epidemiology, C_x Class number x, *ever-S* Ever-smokers, $FEF_{x\%}$ Forced-expiratory-flow when x% of FVC has been exhaled, FEV_1 Forced-expiratory-volume in one second, *FVC* Forced-vital-capacity. *GOLD* Global obstructive lung disease, G_x Group number x, *LSE* Low smoking exposure, *MMEF* Maximal-mid-expiratory-flow, *never-S* Never-smokers, *NHANES* National Health and Nutrition Examination Survey, *non-S* Non-smokers, *Pi* Protease-inhibitor, *PRISm* Impaired spirometry, *ERV* Expiratory-reserve-volume, G_x Group number x

Data were: [a]Percentage. [b]Mean

that Hsan et al. [1] "omitted" this crucial point (*ie*; the association between parity and FVC), especially since some of studies on this topic come from the same region (*ie*; Sousse, Tunisia) [3, 6–10]. The probable effects of parity on lung function data (LFD), including FVC, make parity a key predictor to be stressed and evaluated [3]. A 2021 Tunisian systematic review has reviewed the studies ($n=10$) assessing the effects of parity on LFD of healthy and unhealthy women [3]. The authors of the retained 10 studies [6–15] in the aforementioned systematic review [3] have expressed parity as numerical and/or dichotomous data. For the dichotomous expression mode, parity was presented in terms of two groups or different classes, and multiple parity thresholds were applied to classify women into groups or classes [3].

The five studies including healthy women [6–9, 11] reported contradictory results regarding the effects of multiparity on LFD (Table 1). First, some studies reported no effect of multiparity on some LFD (*eg*; similar LFD between the groups and/or classes of women divided according their parity) [6–9]. Second, certain studies recorded positive effects of multiparity on many LFD (*ie*; multiparous women have larger forced expiratory volume in 1 s (FEV_1), FVC, slow vital capacity, and inspiratory capacity) [9, 11]. Third, many studies noted that multiparity had negative effects on plenty LFD (*eg*; multiparous had higher static lung volumes; lower flows; tendencies to an obstructive impairment and/or lung-hyperinflation) [6, 7, 9]. Fourth, one study highlighted an acceleration of the lung aging process in multiparous women [10].

The four studies [12–15] examining the effects of parity on the LFD of unhealthy women [*ie*; chronic obstructive pulmonary disease (COPD), defect in protease-inhibitor (Pi), certains chronic conditions (COPD, asthma, endometriosis, ovarian diseases)] or a mixed population of healthy/unhealthy women also reported opposing outcomes (Table 2). On the one hand, certain studies stated that parity has no effect on FEV_1 decline or the natural history of COPD with comparable *i)* initial mean FEV_1, *ii)* rate of FEV_1 decline; and *iii)* COPD incidence between the different groups of parity [12], or that there is no association between parity and FEV_1 or FEV_1/FVC in never-smokers or in those with low smoking exposure [15]. On the other hand, three studies identified negative effects of parity on certain LFD (*eg*; multiparous women have a tendency to an obstructive impairment; lower flows; lower post-bronchodilator FEV_1, and increased Pi levels) [13–15].

To conclude, parity is a promising original direction for physiological and pathophysiological research, particularly for low- and lower-middle- income countries [3]. In the litterature, the trade-off between longevity and fertility described by scientists is termed the "longevity determination" or "biological warranty period" [16]. A negative phenotypic correlation is recognized between parity and lifespan, with multiparous women being more probably to have shorter lifespans [17]. Moreover, multiparity is linked with frequent poor outcomes, such as faster markers of aging (*eg*, telomere length), oxidative stress, coronary heart conditions, stroke, heart-failure, arterial-hypertension, type 2 mellitus-diabetes, renal cancer, and bad health related quality-of-life [18, 19]. In the study of Hsan et al. [1], multiparity could partly explicate the reported high frequency of women with a reduced FVC. Thus, upcoming epidemiological and clinical studies of LFD in women would need to include information about their parity status.

Abbreviations

COPD: Chronic obstructive pulmonary disease; FEV_1: Forced expiratory volume in one second; FVC: Forced vital capacity; LFD: Lung function data; Pi: Protease-inhibitor.

Acknowledgements

I dedicate this correspondence to my mother Khadija, my wife Henda and my three daughters Hana, Meriem and Molk.

Author's contributions

HBS wrote this correspondence. The author read and approved the final manuscript.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Availability of data and materials

Not applicable.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The author declares that his has no conflicts of interest concerning this correspondence.

Received: 19 July 2022 Accepted: 2 November 2022
Published online: 11 November 2022

References

1. Hsan S, Lakhdar N, Harrabi I, Zaouali M, Burney P, Denguezli M. Reduced forced vital capacity is independently associated with, aging, height and a poor socioeconomic status: a report from the Tunisian population-based BOLD study. BMC Pulm Med. 2022;22(1):267.
2. Lee HM, Le H, Lee BT, Lopez VA, Wong ND. Forced vital capacity paired with Framingham Risk Score for prediction of all-cause mortality. Eur Respir J. 2010;36(5):1002–6.
3. Triki L, Ben Saad H. The impacts of parity on spirometric parameters: a systematic review. Expert Rev Respir Med. 2021;15(9):1169–85.

4. Fertility Rate. Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/fertility-rate'. Last visit: July 19 2022.
5. Lockhart PA, Martin P, Johnson MA, Shirtcliff E, Poon LW. The Relationship of Fertility, Lifestyle, and Longevity Among Women. J Gerontol A Biol Sci Med Sci. 2017;72(6):754–9.
6. Ben Saad H, Rouatbi S, Raoudha S, Tabka Z, Laouani Kechrid C, Hassen G, Guenard H. Vital capacity and peak expiratory flow rates in a North-African population aged 60 years and over: influence of anthropometric data and parity. Rev Mal Respir. 2003;20(4):521–30.
7. Ben Saad H, Tfifha M, Harrabi I, Tabka Z, Guenard H, Hayot M, Zbidi A. Factors influencing pulmonary function in Tunisian women aged 45 years and more. Rev Mal Respir. 2006;23(4 Pt 1):324–38.
8. Ben Saad H, Prefaut C, Tabka Z, Mtir AH, Chemit M, Hassaoune R, Ben Abid T, Zara K, Mercier G, Zbidi A, et al. 6-minute walk distance in healthy North Africans older than 40 years: influence of parity. Respir Med. 2009;103(1):74–84.
9. Ketfi A, Triki L, Gharnaout M, Ben Saad H. The impacts of parity on lung function data (LFD) of healthy females aged 40 years and more issued from an upper middle income country (Algeria): A comparative study. PLoS One. 2019;14(11):e0225067.
10. Ben Saad H, Selmi H, Hadj Mabrouk K, Gargouri I, Nouira A, Said Latiri H, Maatoug C, Bouslah H, Chatti S, Rouatbi S. Spirometric "Lung Age" estimation for North African population. Egypt J Chest Dis Tuberc. 2014;63(2):491–503.
11. Harik-Khan R, Wise RA, Lou C, Morrell CH, Brant LJ, Fozard JL. The effect of gestational parity on FEV1 in a group of healthy volunteer women. Respir Med. 1999;93(6):382–8.
12. Krzyzanowski M, Jedrychowski W, Wysocki M. Factors associated with the change in ventilatory function and the development of chronic obstructive pulmonary disease in a 13-year follow-up of the Cracow Study. Risk of chronic obstructive pulmonary disease. Am Rev Respir Dis. 1986;134(5):1011–9.
13. Horne SL, Chen Y, Cockcroft DW, Dosman JA. Risk factors for reduced pulmonary function in women. A possible relationship between Pi phenotype, number of children, and pulmonary function. Chest. 1992;102(1):158–63.
14. Tang R, Fraser A, Magnus MC. Female reproductive history in relation to chronic obstructive pulmonary disease and lung function in UK biobank: a prospective population-based cohort study. BMJ Open. 2019;9(10):e030318.
15. Moll M, Regan EA, Hokanson JE, Lutz SM, Silverman EK, Crapo JD, Make BJ, DeMeo DL. The Association of Multiparity with Lung Function and Chronic Obstructive Pulmonary Disease-Related Phenotypes. Chronic Obstr Pulm Dis. 2020;7(2):86–98.
16. Carnes BA, Olshansky SJ, Grahn D. Biological evidence for limits to the duration of life. Biogerontology. 2003;4(1):31–45.
17. Wang X, Byars SG, Stearns SC. Genetic links between post-reproductive lifespan and family size in Framingham. Evol Med Public Health. 2013;2013(1):241–53.
18. Alsammani MA, Ahmed SR. Grand Multiparity: Risk Factors and Outcome in a Tertiary Hospital: a Comparative Study. Mater Sociomed. 2015;27(4):244–7.
19. Park S, Choi NK. The relationships between timing of first childbirth, parity, and health-related quality of life. Qual Life Res. 2018;27(4):937–43.

Publisher's Note