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Impact of prenatal physical preparation program on respiratory parameters of pregnant women

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Ethics Committee Approval
The study was approved by School of Public Health of the Faculty of Medicine of the University of Kinshasa (date and number: 17 September 2019). All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

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Abstract

Background/Aim: Pregnancy is a condition that alters a woman's respiratory parameters. We aimed to verify the impact of a prenatal physical preparation program on respiratory parameters of pregnant women.
Methods: A quasi-experimental study was conducted with 38 pregnant women over a period of 8 months. It consisted of measuring the respiratory parameters (using the New MIR Spirolab Spirometer) of pregnant women who participated in the prenatal physical preparation program. Each session lasted 45 minutes and took place once a week. The sessions involved low to moderate intensity and assessed the forced expiratory volume second, the vital capacity force, and the peak expiratory flow.
Results: After the intervention program in prenatal physical preparation, there was a significant change in the vital capacity force (74 (3.65) before vs 79 (0.54) after; P=0.003); forced expiratory volume (68 (0.63) vs 76 (0.45), P=0.002); and peak expiratory (69 (1.77) before vs 78 (1.12) after; P=0.001) The Tiffeneau index showed (72.8 (4.2) vs 76.19 (13.3), P=0.001). The number of pregnant women with normal spirometry doubled from 47.4% at the start of the program to 94.7% at the end of the program. Similarly, the proportion of pregnant women with mild restriction increased from 42.1% at the start of the program to 2.6% at the end, indicating a total improvement of the obstructive disorders.
Conclusion: The regular practice of physical activity allows for improvement of the respiratory parameters of pregnant women. This program must continue to enable these women to maintain their respiratory capacity after childbirth.

Keywords: physical preparation, prenatal, pregnant women, spirometry

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Introduction

Pregnancy is a critical period for pregnant women. Several adaptations are necessary to meet the increased metabolic needs of the mother and the fetus. Significant anatomical and functional changes in the cardiorespiratory system occur during pregnancy due to hormonal factors and the progressive increase in the size of the uterus [1].

It is not always easy to distinguish the physiological changes of pregnancy from the pathophysiological states associated with pre-existing cardiopulmonary disease or issues that may occur during pregnancy or in the postpartum period.

Physical exercise is defined as a structured modality of physical activity aimed at maintaining or increasing fitness [1]. The practice of moderate physical exercise during pregnancy is advised in order to increase or maintain a reasonable level of physical fitness. This is why several countries (France, Canada, United States, Norway, Denmark) have established recommendations for health professionals to better inform women about the benefits of physical activity. The Haute Autorité de Santé (HAS), the American College of Obstetricians and Gynecologists (ACOG) [2] and the Society of Obstetricians and Gynecologists of Canada (SOGC) recommend encouraging pregnant women with no contraindications (medical or obstetric) to initiate or continue the practice of moderate physical activity, regular and included in their lifestyle, up to 30 minutes a day, between three and five times a week (depending on the trimester of pregnancy) [3].

We found that despite the recommendations of learned institutions, Congolese pregnant women with no medical contraindication to the practice of physical exercises always remained sedentary. It is for this reason that we were motivated to design a physical preparation program to help these women stay active throughout the pregnancy period.

Materials and methods

This study was conducted among pregnant women recruited from the prenatal consultations of the Mont Amba Hospital Center in Kinshasa, Democratic Republic of Congo, from September 2020 to April 2021.

The pregnant women followed a prenatal physical preparation program. The selection criteria included:

- having a gestational age of at least 20 weeks gestation;
- having a chronological age between 20 and 39 years;
- agreeing to regularly attend prenatal consultation (PNC) at the Mont Amba Hospital Center in Kinshasa;
- not presenting pathologies or abnormalities that might limit the practice of exercise or physical activity that could influence the well-being of the mother and the fetus.

Through the use of convenience sampling, 38 pregnant women agreed to participate in the study at the Mont Amba Hospital Center.

The variables studied were:

- the forced expiratory volume second (FEV1);
- the vital capacity force (FVC);
- the peak expiratory flow (PEF);
- the Tiffeneau index (FEV1/FVC).

All these measurements were carried out using the New MIR Spirolab Spirometer. (Medical, Ref. JFB-246) (MIR Medical International Research).

Spirometry procedure for the 38 pregnant women

Prior to the measurement, a short questionnaire was administered to collect a profile of the pregnant woman. This included age, weight, sex, height, race, and physical activity.

Subsequently, the pregnant women carried out following steps in the examination:

- The pregnant woman was seated comfortably on a chair, with her head straight to optimize breathing. A nose clip was used so that all the air from the lungs passed in a single tube.
- Afterwards, the measurement took place in three stages: the first two stages involved a deep inspiration followed by the slow exhalation. The third stage consisted of a deep inspiration followed by a strong and fast exhalation in the mouthpiece with nose pliers.

Physical and respiratory exercises constituted the treatment to fight against respiratory disorders in some pregnant women and to maintain good physical condition and good breathing. The pregnant women walked on the spot with swinging arms, then walked with displacement in a room of six square meters.

In decubitus position:

- Diaphragmatic and thoracic inspiration-expiration, synchronized or alternated with the movements of the upper limbs (five series);
- Lifting the head from the mat while exhaling and returning to the initial position while inhaling (three times);
- Knees drawn while lifting the head and exhaling; returning to the initial position while inhaling (two times);
- Finally continue with normal breathing

Sitting or standing:

- Alternately make the lateral inclination of the trunk to the left and to the right, synchronizing with the exhalation during the movement and the inspiration during the return to the initial position (five times).
- Raising both arms forward, laterally or up while inhaling and lowering arms while exhaling (four times).

Quadripedal position:

- Hollowing the back while inhaling and rounding the back while exhaling (three times);
- Contracting while exhaling and relaxing while inhaling the abdominals (five times);
- Alternately raising one arm (four times);
- Deep inspiration followed by slow expiration (four times).
- Return to normal breathing.

The program lasted 16 weeks for each pregnant woman, from the 20th to the 36th week of amenorrhea.

Operational definitions (Spirometry)

Normal:

- FEV >80%
- FVC >80%
- FEV/FVC >75%

Mild Obstruction:

- FEV 60-79%
- FVC 60 -79%
- FEV1/FVC 60-79%

Moderate Obstruction:

- FEV1 41-59%
- FVC 51-59%
- FEV1/FVC 41-59%
- Mild restriction: PEF <70%.
- Moderate restriction: PEF >50%

Ethical considerations

The study was submitted and approved by the Ethics Committee of the E School of Public Health of the Faculty of Medicine of the University of Kinshasa under number ESP/CE/254/2019 on September 17, 2019. Written informed consent was obtained from each pregnant woman.

Statistical analysis

Quantitative data was presented as mean and standard deviation while qualitative data was presented as frequency and percentage. The student's t-parameter test was used to compare the means before and after the intervention program, against the non-parametric chi-square test that allowed us to compare the qualitative data. *P*-value <0.05 was considered the statistical significance level.

Results

The vital capacity force, the forced expiratory volume second, the FEV1/FVC: Tiffeneau index as well as the PEF: peak expiratory flow of pregnant women were significantly modified after the intervention program (Table 1).

Table 1: Evolution and comparison of spirometric parameters at the start and at the end of the program

Parameters	Before the program	After the program	
	Mean (SD)	Mean (SD)	*P*-value
FVC (%)	74 (3.65)	79 (0.54)	0.003
FEV1 (%)	68 (0.63)	76 (0.45)	0.002
FEV1/FCV (%)	72.8 (4.2)	76.19 (13,3)	0.001
PEF (%)	69 (1.77)	78 (1.12)	0.001

FVC: vital capacity force, FEV1: forced expiratory volume second, FEV1/FVC: Tiffeneau index, PEF: peak expiratory flow

The results shown in this table indicate that the number of pregnant women with normal spirometry doubled from 47.4% at the start of the program to 94.7% at the end of the program. Similarly, the proportion of pregnant women with a light restriction fell from 42.1% at the start to 2.6% at the end. The evolution was similar to mild and moderate obstruction.

Table 2: Respiratory disorders in pregnant women at the start and end of the program

Results	Before the program	After the program
	n=38 (%)	n=38
Normal spirometry	18 (47.4)	36 (94.7)
Slight restriction	16 (42.1)	1 (2.6)
Moderate restriction	1 (2.6)	1 (2.6)
Slight obstruction	2 (5.3)	-
Moderate obstruction	1 (2.6)	-

Table 3 shows the evolution of spirometry before and after the program according to an age greater than or equal to 30 years. In fact, in the under-30 age group, pregnant women with normal spirometry increased from 52.2% at the start of the program to 95.7% at the end of the program. The evolution was the same among those aged 30 and over (40% to 93.3%). The same trend was observed for mild and moderate restriction and for mild and moderate obstruction.

Table 3: Relationship between spirometry and the age of pregnant women.

Spirometry	Before the program			After the program		
	Age (years)			Age (years)		
	Under 30	30 and older		Under 30	30 and older	
	n=23 (%)	n=15 (%)	*P*-value	n=23 (%)	n=15 (%)	*P*-value
Normal spirometry	12 (52.2)	6 (40)	0.61	22 (95.7)	14 (93.3)	0.33
Slight restriction	9 (39.1)	7 (46.7)		1 (4.3)	-	
Moderate restriction	-	1 (6.7)		-	-	
Slight obstruction	1 (4.3)	1 (6.7)		-	-	
Moderate obstruction	1 (4.3)	-		-	1 (6.7)	

Discussion

The objective of the study was to evaluate the respiratory function of pregnant women who followed the prenatal physical preparation program, specifically by evaluating spirometric parameters with the New MIR Spirolab Spirometer.

Respiratory disorders were observed in 20 pregnant women, i.e. 52.63% of all participants in this study. These data, when compared to those reported in the literature by Goslin (6.5%) are much higher [4].

This is explained by the methodological approach used, which was to examine, using the New Spirolab, all the participating pregnant women at the start of the program. While at the end of the program, comparative data are unavailable in the literature, there is a lack of prospective and longitudinal scientific studies of prenatal physical preparation including spirometry [5].

In our study, the restriction was found in 17 (44.73%) of cases at the start of the program, and 2 (5.26%) pregnant women at the end of the program. A very significant improvement in restrictive disorders and a total improvement in obstructive disorders were observed. Nevertheless, this study highlighted the contribution of specific breathing exercises to remedy this situation.

In our series, we found the modification of the Tiffeneau index, peak expiratory flow, and forced expiratory volume of pregnant women after the intervention program. According to Reimann [9], the regular practice of adapted activities in pregnant women improves respiratory parameters. The Tiffeneau index results from our study were lower than those found by Kamanga et al. [6]. This is most likely justified by the small sample of the study composed exclusively of pregnant women. It is evident that a high secretion of progesterone causes an increase in respiratory rate, leading to hyperventilation.

The respiratory rate increases and can thus lead to a feeling of shortness of breath on exertion, or even at rest. It is estimated that one in two pregnant women is dyspneic [3].

The spirometric values obtained in healthy women in the 20-29 and 30-39 age groups in a study by Kamanga et al. [5], show agreement between the results of FEV1, FVC and DEP with those of the study. [3] In our series, at the end of the program, of all women under 30 and 30 and over, had 95.7% and 93.3% of normal spirometry, respectively. Artal and Mittelmark [6] reported the frequency of 50% of pregnant women who have difficulty breathing (dyspnea), a common complaint among pregnant women. In the present study, at the start of the program, the results were slightly higher than those in the literature reported by Artal and Mittelmark [6]. In a study titled "Reference Values and Predictive Equations of Spirometry in the Moroccan Population", Khalid Bouti [7] obtained spirometric values for a sample composed of men and women. Only the age groups of women aged between 20-29 and 30-39 were taken into account. The values of FEV1, FVC and PEF agree with the results of the study. There is a clear difference between the Tiffeneau Pinelli ratio in Khalid Bouti's study according to the two age groups, the values of which were 89 [7]. This difference is explained by the fact that the study sample is exclusively composed of pregnant women [8,9].

Limitation of the study

The absence of standard values for pregnant women is a major problem for the interpretation of the results of the examination.

Strength of the study

This study is the first in the Democratic Republic of Congo to show the beneficial effects of regular physical and respiratory exercise on the spirometric parameters (FEV1, FVC, PEF, FEV1/FVC) of pregnant women.

Conclusion

This study carried out at the Center Hospitalier du Mont Amba in Kinshasa showed the effectiveness of physical and respiratory exercise in the care of pregnant women with respiratory problems. There was a marked improvement in spirometric parameters (FEV1, FVC, PEF, FEV1/FVC) at the end of the prenatal physical preparation program. We suggest that this practice should continue in order to maintain the achievements of this program.

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