
Effect of Gender on Nasal Mucociliary Clearance

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Abstract

Background: The sexual dimorphism favours gender specific biological characteristics influenced by sex hormones. These sex hormones determined differences influence the health of an individual by influencing many physiological parameters. As the pulmonary functions are different between male and female and the susceptibility to different respiratory diseases varies between genders, this study has been designed to assess the relation between gender and the nasal mucociliary clearance, an inherent protective mechanism of the respiratory passages.

Aim & objectives: To assess the relation between gender and nasal mucociliary clearance (NMC).

Materials & methods: This cross sectional study was carried out on 60 randomly selected volunteers (30 male volunteers and 30 female volunteers) and NMC time was measured in them. The saccharin transit method was used to assess NMC. Saccharin transit time (STT) is the time taken by the participant to appreciate the taste of saccharin after placement of ¼ tablet of saccharin (1mm x 1mm) in the nostril.

Results: The mean NMC in males was 7.71 ± 2.35 min and in the females was 7.65 ± 2.22 min. There was no statistical significance as the p value is 0.9291.

Conclusion: NMC time did not vary between male and female population. Therefore it could be inferred that gender has no apparent influence on nasal mucociliary clearance.

Keywords: Gender, Nasal Mucociliary Clearance

1.Introduction

Gender determines the pulmonary characteristics specific for male and female. The sex-determined differences between genders involving structural and functional characteristics that include the differences in diameters of airways and the size of the lungs which in turn determine the various lung volumes, influences disease states in women at favourable circumstances[1][2]. This sex-specific pathological predisposition to various respiratory disease conditions could be appreciated from the examples of hyper responsive airway behaviour for cholinergic agents under the influence of sex hormones in post pubertal females rendering them vulnerable for asthma, and the early emphysematous changes in the alveoli as an inflammatory response to smoking in women than in men[3][4].

In recent times evidences have accumulated revealing the fact that women are more vulnerable for respiratory disorders than men[5]. In US COPD related mortality among women is on the rise since 2000 with rapid progression of the disease in them when compared to their male counterparts[6]. The evidence of influence of gender on respiratory diseases is strengthened from the implication of the role of female sex hormones in the pathophysiology of asthma as the condition is more prevalent among women after the third decade of life when compared to men of the same age[7]. The prevalence of lung cancer among women has increased with the disease trend on its decline among men[8][9]. All these evidences highlight the silent factor of gender as an

eminent variable in the pathophysiology of respiratory diseases.

From the scientific data available about the factors influencing the respiratory health, the gender has presented itself with dominance as one among the prime variables that influences respiratory physiology both in health as well as in disease, by the effect of sex hormones. As the influence of sex hormones on various lung parameters are well established with molecular evidences, antithesis exists about the influence of gender on mucociliary clearance mechanism, an innate protective measure to do away with the trapped particulates from the respiratory passage by the respiratory cilia that propels the overlying mucus, which traps the inhaled particulates, towards the oropharynx to be cleared to the exterior[10]. The impairment of this clearance mechanism predisposes to infections as a result of stasis of respiratory secretions[11]. Publications of inferences by Svartengren *et al*(1986) and Armengot *et al* (1993) made the inferences that nasal mucociliary clearance (NMC) was faster in females when compared to men[12][13]. But the observations of Kao *et al*(1994) and Plaza Valia *et al*(2008) were in contradiction to the previous observations with no significant difference in the clearance rates between genders[14][15]. As the observations are discrepant and contradicting, unresolving the role of gender's influence on NMC, this study has been designed to evaluate the influence of gender on nasal mucociliary clearance, as ciliary dysfunction can lead to pathological conditions like COPD which is more prevalent among women.

2. Materials and Methods

This study was designed as a cross sectional study involving 60 randomly selected volunteers with 30 male and 30 female participants. The study was carried out in the department of Physiology, Sri Venkateshwaraa Medical College Hospital and Research Centre, after obtaining the Institutional Ethical Clearance. The duration of the study was two months. The volunteers were between the age group of 18 and 40 years and the participants were staffs and students of the college. The volunteer recruitment involved evaluation of history of local and systemic pathologies that could alter nasal mucociliary clearance. Those with history of nasal surgery, smoking, nasal pathologies (sinusitis, allergic rhinitis, nasal polyps, deviated nasal septum), asthma, topical nasal medication or systemic anti-cholinergics use were excluded. Exclusion was done for those with history of diabetes, hypertension and those who were pregnant. The subjects were

explained about the procedure and an informed written consent was obtained from them.

The anthropometric measures were recorded first. The values of height and weight were recorded in centimetres and in kilograms for calculating the BMI and based on the BMI values the recruited volunteers were stratified into normal BMI group (BMI 18.5-22.9Kg/m²) and overweight & obese group (23 Kg/m² and above) as studies exist relating the influence of BMI on NMC. Each of these two groups had 30 volunteers with equal number of subjects from each gender.

2.1 Measurement of Nasal mucociliary clearance

NMC measurement was carried out by using the saccharin transit method. This method evaluates the nasal mucociliary clearance by assessing the saccharin transit time (STT), ie the time taken for the saccharin molecule placed in the nostril to reach the nasopharynx by ciliary beat function. It was done according to the saccharin method of Anderson *et al*[16]. A quarter tablet of sweetex (saccharin sodium) measuring 1 X 1 mm was placed on the floor of the nose, just behind the anterior end of the inferior turbinate and the test was carried out in sitting posture with neck slightly flexed and the time required by the subject for the perception of sweet taste was noted in minutes. (As saccharin crystals were unavailable quarter tablet of artificial sweetner (Sweetex) was used similar to the method of Valdez *et al*. who used "Equal" tablets.[17]) The saccharin transit time of each nostril was assessed with an interval of half an hour and the nasal mucociliary clearance time is calculated as an average of the mucosal clearance of both the nostrils. The subjects were advised to avoid nasal manipulation, sniff, cough, inhale or exhale forcefully during the test, and were told to report the perception of any taste by raising their hand. The subjects were not informed about the nature of taste and were informed that a harmless edible particle would be used for the test.) A single examiner performed the test in all subjects to avoid inter-observer variability.

2.2 Statistical analysis

The results were analysed using Statistical Package for Social Sciences (SPSS) version 17 and statistical evaluation was done using unpaired t-test for comparison of age between male and female groups, STT between males and females and STT between normal and overweight & obese BMI groups. $P \leq 0.05$ was considered statistically significant.

3. Results

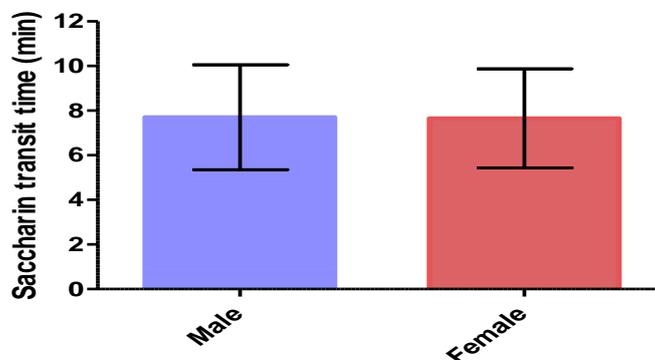
3.1. Age distribution

The mean age of the male volunteers was 28.53± 9.18 years and that of the female volunteers

was 27.83± 9.17 years. There is no significant difference in age between male and female population as the p value is 0.7705.

3.2. Comparison of BMI between genders

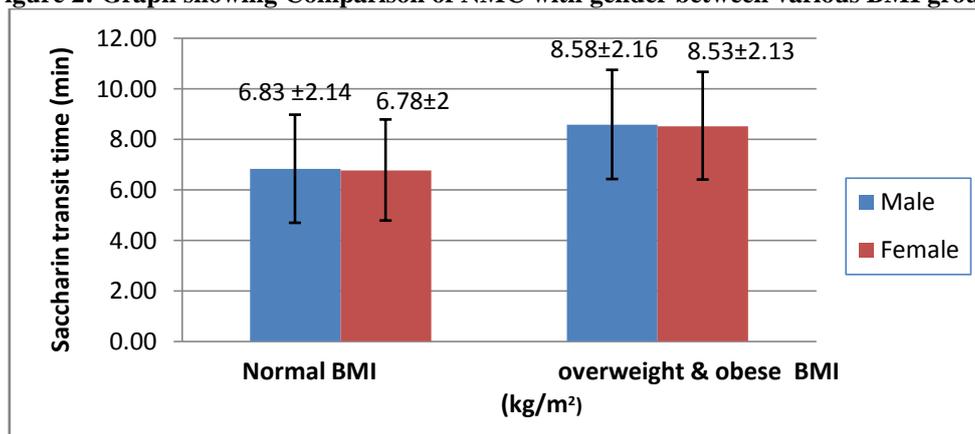
Figure 1: Graph showing Comparison of Nasal mucociliary clearance between genders



From figure 1 it could be inferred that the NMC did not differ between the genders as the mean NMC in male was 7.71 ± 2.35 min and in the female was 7.65 ± 2.22 min with a p value 0.9291 which is not significant.

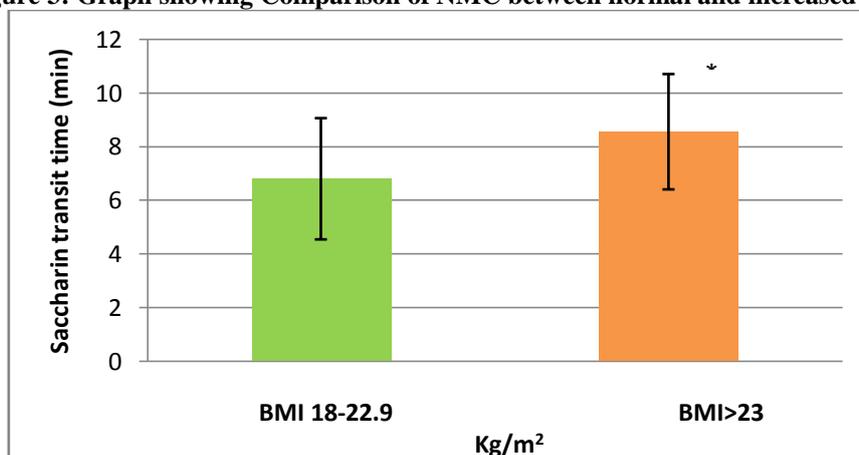
3.3. Comparison of NMC with gender between various BMI groups

Figure 2: Graph showing Comparison of NMC with gender between various BMI groups



From figure 2 it could be inferred that the Nasal Mucociliary Clearance (NMC) values measured by saccharin transit time (STT) did not differ between the genders in either groups (normal BMI and overweight and obesity categories) but differed between the various BMI populations.

Figure 3: Graph showing Comparison of NMC between normal and increased BMI



The mean NMC value in the group of normal BMI (n=30) was 6.8 ± 0.37 min while in group with overweight and obesity (n=30) was 8.6 ± 0.4 min. The difference is statistically significant with p value 0.002*.

4. Discussion

Nasal mucociliary clearance is an important protective mechanism that prevents the accumulation of respiratory secretions and it is influenced by many factors like age, sex, posture, sleep, exercise, environmental factors etc, in both health as well as in disease[11].The choice of wide range of age, between eighteen and forty years, has been made after the observation of non-correlation between NMC and the age of above mentioned range, as inferred from the studies of HellinMeseguer and Merino Galvez E and Armengot *et al.*, who reported that the nasal mucociliary transport did not vary until the age of sixty[13][19].

As the studies about the factors influencing various pulmonary parameters have brought to light the dimorphic differences between male and female respiratory system is determined by the sex hormones, its effect on nasal mucociliary clearance remains confounded with contradictory observations. Svartengren *et al.*(1986) and Armengot *et al.* (1993) observed that the NMC was faster in females when compared to men and Armengot *et al.* in 1990 reported that the mucus transit was faster during periovulatory phase in women when the serum estrogen is at the highest[12][13][20]. In contrast to the above findings observations of no correlation between NMC and gender was also reported. As the shift of respiratory morbidity due to COPD, a condition of compromised mucus clearance and progressive inflammation, is on the rise among women since the past decade, this study carried out to assess and compare the nasal mucociliary clearance time between male and female, made the observation that NMC time does not differ between genders. This observation is in accord with the observations of Kao *et al.*, Pedro Plaza Valiaa *et al.*, and HellinMeseguer and Merino Galvez E who had the similar observation of gender having no association with NMC and the latter also reported that NMC is uninfluenced by menstrual cycle[14][15][19]. The possible explanation for this non-significant relation could be the confluence of various other factors influencing the ciliary activity along with the influence of hormones. Autonomic activity is one among them that influences NMC by regulating the blood supply and thus the mucus secretion, along with its influence over other respiratory parameters[21]. Moreover, the environmental pollutants suspended in the inhaled air exert its effect on mucociliary function thus becoming an inevitable variable of influence[18]. Hence, from the observations made it could be inferred that as the factor of gender coexists with other variables that

modulate nasal ciliary function, the effect of gender on NMC is rendered less pronounced to the extent of less correlatable significance. At present, obesity prevails over health and BMI has become an inevitable parameter to be considered for associations with the physiological variables, as the transition from health to disease is driven with its values in higher range. Therefore the analysis based on the BMI between genders, after stratifying the study population into normal and over-weight & obese groups revealed that NMC did not differ between males and females of the same BMI range but differed with significance between the BMI groups and not between the genders of the same BMI range. The difference in the mean NMC time between the observations of our study and that of others could be due to the ethnic variations, as the studies on various population revealed the mucus transit time to be dissimilar.

5. Conclusion

Therefore it could be thus concluded from the observation of our study that gender has no apparent influence on nasal mucociliary clearance and research efforts are further needed to elaborate upon the regulation of ciliary function as the effect of sex hormones on ciliary activity remains obscured with controversies.

Limitations

Though the study population was sixty, the observation made would have been strengthened further had the study involved a larger population and the attempt being observational on experimental grounds and not diagnostic, the participant compliance was less.

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