

Assessment of the occurrence of menstrual disorders in female flight attendants – preliminary report and literature review

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Abstract

OBJECTIVE: The aim of the presented study was to determine the incidence of menstrual disorders and to evaluate the influence of the work period and the frequency of flying on the occurrence of these disorders in flight attendants flying within one time zone.

METHODS: The questionnaire-based survey covered 43 flight attendants which remained within one time zone. The statistical analysis was made by Statistica 10.0 (StatSoft Inc., USA).

RESULTS: The study population of flight attendants revealed the occurrence of irregular menstrual cycles in 21%. Irregular menstruations were found to occur more frequently in women with length of work period exceeding 5 years and in women covering more than 14 routes a week though the differences were not statistically significant ($p>0.05$). Statistically significant correlation was found between years of work and incidence of thyroid diseases and cervical erosions. Only flight attendants working longer than 5 were found to be treated for thyroid diseases. Also in these women cervical erosions developed more frequently than in women with a shorter period of work (55.00% and 21.74%, respectively). Sleep disturbances in the form of insomnia were reported in 19 cases (44%). The study revealed that women with sleep disturbances complain on dysmenorrhea significantly more frequently ($p=0.03$).

CONCLUSIONS: The specificity of the work of flight attendants contributes to a higher incidence of menstrual disorders, sleep disturbances and cervical erosions. These disorders seem to be largely related to the shift work.

Abbreviations:

BMI	- Body Mass Index
PRL	- Prolactin
FSH	- Follicle-stimulating hormone
LH	- Luteinizing hormone
TSH	- Thyroid-stimulating hormone

INTRODUCTION

The shift work system concerning night shifts covers, including, among others the work of flight attendants, is estimated to be performed in Europe and North America by approximately 15–20% of the professionally active population (Straif *et al.* 2007). Because of the character of the profession and the specificity of the working environment flight attendants are exposed to a number of diseases which over the past years were a subject of relatively few studies. Epidemiological studies indicate a significantly higher incidence in the population of flight attendants of diseases of the nervous, respiratory, cardiovascular, digestive, reproductive, endocrine, immune, locomotor and integumentary systems as well as neoplasms (Arjomandi *et al.* 2009; Barr *et al.* 2007; Brudnowska & Peplowska 2011; Griffiths & Powell 2012; Sharma 2007; Yang *et al.* 2013). This professional group reveals also a higher incidence of menstrual disorders, lower fertility rate, spontaneous abortions, preterm deliveries and lower infant body mass (Brudnowska & Peplowska 2011; Lauria *et al.* 2006). The occurrence of disturbances of the systems listed above is explained in terms of the influence of specific factors, i.e. higher exposure to cosmic radiation, electromagnetic field emitted by airplane equipment, changes of time zones, irregular way of life, disinfectants used to clean the board of the plane, exhaust fumes and, before the introduction of the ban on smoking on board, also exposure to passive smoking (Sigurdson & Ron 2004). In most cases there is no adequate evidence to support the etiology of diseases most common among flight attendants.

The aim of the study was to determine the frequency of occurrence of menstrual disorders and to evaluate the influence of the work period and frequency of flying on the development of these disorders in flight attendants flying within one time zone.

MATERIAL AND METHODS

The survey covered 43 flight attendants aged 21–37 who perform their work flying within one time zone. The survey used a self-developed questionnaire consisting of 34 questions. The survey was anonymous. The inclusion criterion was an absence of the use of hormonal contraceptives for at least two months prior to filling the questionnaire. The evaluation covered: work period, frequency of flying, obstetric history, gynaecological history, incidence of sleep disturbances and hormonal disorders. The frequency of flying was the number of so called 'routes' covered within one week (1 route means 1 take-off and 1 landing). Basic working time covered the performance of 14 routes a week. The statistical analysis was made with the Excel calculation and Statistica 10.0 (StatSoft Inc., USA). The analysis of relations between variables was made with chi-square independence tests while for an inter-group compari-

son for quantitative variables Mann-Whitney U test was used. A statistically significant p -value was $p < 0.05$.

RESULTS

The mean age of the studied women was 29.2 ± 3.62 years of age. Normal BMI (18.5 – 24.9 kg/m²) was found in 83.7% of the flight attendants. 39.5% of the women were smokers. The mean length of work in the study group was 6 ± 4.05 years while the mean frequency of flying, measured in routes was 14 ± 5.56 routes/week.

The studied flight attendants had their first menstruation on average at the age of 13.2 ± 1.23 yr. Regular menstrual cycles were reported by 79%, i.e. 34 women.

In the surveyed group eleven women reported pregnancy and three of them (7% of the study group) had a spontaneous abortion. The majority of deliveries (73%) were spontaneous, through natural passages. Post-delivery complications, i.e. infection of the groin wound and vagina as well as infection of the urinary system, developed in 4 women.

All the respondents breastfed, with 82% of flight attendants breastfeeding for at least six months after delivery. Among the eleven women who were pregnant, two had been treated for infertility (18.2% of the total study group). Among the respondents who had never been pregnant only one had been treated for infertility for 1.5 year and the treatment had been ineffective.

Insomnia in the form of difficulty in falling asleep, difficulty in maintaining the continuity of sleeping and too early morning wake-ups was reported by 19 (44%) respondents.

Hormonal disorders were revealed in 30.4% of the studied women and were primarily thyroid gland diseases (11.6%). 4.6% of the flight attendants were diagnosed with the polycystic ovaries syndrome. Other hormonal disorders reported by the respondents included abnormal concentration of PRL, cortisol, FSH and progesterone and occurred in 11.6% of the women studied.

In the study population every third respondent reported abnormal discharge from the genital tract (colporrhea). Cervical erosion was reported by 16 women (37.2%). 23.3% of the women studied reported dyspareunia and one bleeding or spotting after coitus.

In the evaluation of the influence of the work period on menstrual disorders in flight attendants we distinguished two groups: women with less than 5 years of work and women with over 5 years of work. The two groups differed in terms of age and BMI value in a statistically significant way. Women with over 5 years of work were older (31.7 ± 2.32 years of age vs. 26.8 ± 3.00 years of age) and had a higher BMI (21.8 ± 2.57 kg/m² vs. 20.1 ± 1.75 kg/m²). The characteristic of the menstrual cycle of the study population according to sub-groups of women with less than 5 and more than 5 years of work respectively is shown in Tables 1 and 2.

Assessment of the influence of the length of work on the occurrence of menstrual disorders revealed lack

Tab. 1. Characteristic of the menstrual cycle according to years of work.

Feature	Women with less than 5 years of work (n=23)		Women with more than 5 years of work (n=20)	
	Interval	Average ± SD	Interval	Average ± SD
Age of menarche (yr)	12–16	13.5±1.16	10–15	12.9±1.25
Length of menstrual cycle* (days)	21–32	28.0±2.17	24–32	28.8±1.83
Length menstruation (days)	3–7	4.7±1.23	2–7	5.1±1.44

* Only regular menstruating women (n=34); n- number of women; SD- standard deviation

of statistical significance ($p>0.05$) between the length of work and menstrual cycle regularity as well as incidence of intermenstrual bleeding. Menorrhagia was more common in women with over 5 years of service though the difference was not significant.

Statistically significant correlation was found between the years of work and the incidence of thyroid diseases and cervical erosions. Only flight attendants with over 5 years of work were treated for thyroid diseases. Cervical erosions were more common in women with length of work exceeding 5 years (55.00% vs. 21.74%).

For the assessment of the influence of the frequency of flying on the incidence of menstrual disorders we divided the study population into two groups: the first including women who flew with the frequency of 14 routes a week and the second – women who flew more than 14 routes a week (Tables 3 and 4).

No statistically significant correlation was found between the weekly number of routes covered and the regularity of the menstrual cycle, size of bleeding and occurrence of intermenstrual bleeding. A trend towards a higher incidence of irregular, dysmenorrhea and intermenstrual bleeding was observed in women covering more than 14 routes a week though this difference was not statistically significant.

Due to the occurrence of sleep disturbances in almost every second flight attendant, the study population was divided also according to these disturbances and the two groups were characterized. It was revealed that women who have sleep problems reported menorrhagia more frequently (47.37% vs. 16.67%), this difference being statistically significant.

DISCUSSION

Irregular menstrual cycles were found in 21% of the study population. This percentage is similar to data from other studies where the incidence of menstrual disorders in flight attendants ranged from 20.6% to 30.6% (Lauria *et al.* 2006; Yang *et al.* 2013). A study carried out in China assessed the influence of occupational risk factors on the functioning of the reproductive system. The survey covered a group of 1175 women of the airport personnel, including 536 flight attendants and 612 women of the ground service as a control

Tab. 2. Menstrual disorders according to years of work.

Feature	Women with less than 5 years of work (n=23)		Women with more than 5 years of work (n=20)	
	Number of women	Percent	Number of women	Percent
Irregular cycle	5	21.74	4	20.00
Hypomenorrhea	3	13.04	3	15.00
Normal bleeding	18	78.26	12	60.00
Hypermenorrhea	2	8.70	5	25.00
Dysmenorrhea	7	30.43	6	30.00
Intermenstrual bleeding	6	26.09	4	20.00

n- number of women

group. Yang *et al.* (2013) found a significantly higher incidence of menstrual disorders, including irregular menstrual cycles, severe dysmenorrhea, and hypomenorrhea or menorrhagia in the flight attendants as compared with the women of the ground service (30.55% vs. 13.40%) (Yang *et al.* 2013).

Lauria *et al.* (2006) conducted a survey covering 1943 flight attendants, 48% of whom no longer worked in the profession. Menstrual disorders in the year preceding the study for women under 40 yr were more frequent in current than former flight attendants (20.6% vs. 10.4%, $p=0.02$) (Lauria *et al.* 2006).

Another significant aspect is the evaluation of the incidence of menstrual disorders in women doing shift work referred to by Attarchi *et al.* (2013). The study covered 406 women of reproductive age, working physically in a pharmaceutical company. The studied workers were divided into two groups of shift workers and non-shift workers. Menstrual disorders were determined on the basis of a questionnaire and an investigation of the concentration of hormones in venous blood, i.e. FSH, LH, PRL, TSH, progesterone and estrogens, on the third day of menstruation. Attarchi *et al.* (2013) stated that menstrual disorders in shift workers were more common than in non-shift workers (28.3% vs. 9.2%). Hormonal investigations revealed an increased concentration of prolactin in women doing shift work,

Tab. 3. Characteristic of the menstrual cycle according to frequency of flying.

Feature	Women who covering less than 14 routes a week (n=18)		Women who covering more than 14 routes a week (n=25)	
	Interval	Average ± SD	Interval	Average ± SD
Age of menarche (yr)	10–16	13.4±1.53	11–15	13.1±0.97
Length of menstrual cycle* (days)	21–32	27.9±2.65	27–32	28.7±1.32
Length menstruation (days)	3–7	4.9±1.41	2–7	4.84±1.31

* Only regular menstruating women (n=34); n- number of women; SD- standard deviation

Tab. 4. Menstrual disorders according to frequency of flying.

Feature	Women who covering less than 14 routes a week (n=18)		Women who covering more than 14 routes a week (n=25)	
	Number of women	Percent	Number of women	Percent
Irregular cycle	3	16.67	6	24.00
Hypomenorrhea	3	16.67	3	12.00
Normal bleeding	12	66.67	18	72.00
Hypermenorrhea	3	16.67	4	16.00
Dysmenorrhea	5	27.78	8	32.00
Intermenstrual bleeding	3	16.67	7	28.00

n- number of women; SD- standard deviation

other differences in hormone concentration being statistically insignificant (Attarchi *et al.* 2013).

None of the studies referred to above took into account the number of time zones crossed. It should be assumed that the occurrence of menstrual disorders in every fifth flight attendant may result from the disturbance of the circadian rhythm due to shift work, stress and greater exposure to cosmic radiation than in the population as a whole (Bilski *et al.* 2002; Iglesias *et al.* 1980).

Population studies showed that insomnia affects approximately 15% of people (Wichniak 2012). The occurrence of sleep disturbances is an essential issue whenever menstrual disorders in shift-working women are discussed. Membranes of granule cells of the ovarian follicle were proved to contain melatonin receptors similar to those present in the brain (Woo *et al.* 2001). A positive correlation was also observed between the concentration of melatonin and progesterone (Adriaens *et al.* 2006; Alvarez *et al.* 2003) and a negative correlation between the concentration of melatonin and estradiol in the follicular liquid (Adriaens *et al.* 2006). Moreover, the concentration of melatonin was found to be significantly higher in pre-ovulation follicles than in immature ovarian follicles (Nakamura *et al.* 2003). The dissociation of the biological clock leads to numerous hormonal disorders, among others, to changes in the secretion of melatonin. Melatonin is thus likely to be

indispensable to proper ovulation and disturbances in its secretion seem to have an adverse influence on the maturation of ovarian follicles.

The confirmation in this study of an almost 3-fold more frequent occurrence of insomnia in flight attendants (44%) seems likely to be caused by the shift work system. In the study by Chung *et al.*, which covered flight attendants working on international flights, 59.9% of respondents reported sleep disturbances (Chung & Chung 2009). The most likely cause of this discrepancy may lie in the fact that our study population included women who crossed no more than one time zone.

Another important fact is that in the study group women actually complained more frequently of painful menstruation. It may be supposed that the occurrence in the same women of sleep disturbances and painful menstruation is a consequence of disturbances in melatonin secretion. Melatonin is also known to be an inhibitor of the synthesis of prostaglandins so it may be supposed that its decreased concentration leads to a rise in the level of prostaglandins which are responsible for pain (Urban *et al.* 2006). An additional factor underpinning the occurrence of dysmenorrhea in flight attendants may be decreased air humidity on board of airplanes which amounts to approximately 20% and which may also cause dehydration of the organism (Alvarez *et al.* 2003). Decrease of the capacity of the vascular bed provides an incentive stimulating the secretion of vasopressin an increased blood concentration of which was found in women with dysmenorrhea. Vasopressin was also confirmed to be responsible for increased contractility of the uterine muscle (Skalba 1998).

Statistically significant correlation was found between the years of work and the incidence of cervical erosions. Results of hitherto conducted studies indicate that the most common causes of the development of cervical erosions include hormonal disorders, viral infections and bacterial infections (Sánchez *et al.* 2012). What should be considered is whether changes in melatonin secretion may not also be the cause of a higher incidence of cervical erosions since melatonin is known to affect the immune system generating non-specific humoral and cellular reactions and also intensifying the production of immune response mediators (Carrillo-Vico *et al.* 2005). Flight attendants suffering from sleep disturbances may be presumed to have a low concen-

tration of melatonin, which weakens also the immune system causing poorer resistance of the epithelial cells of the cervix.

It is estimated that in Poland thyroid diseases afflict approximately 7.35% of the population (Budlewski & Franek 2009). In our study, 11.6% of flight attendants suffered from thyroid diseases. Moreover a significant correlation was found between the years of work and the incidence of thyroid diseases. Studies by Beatty *et al.* also point to an increased risk of thyroid diseases in flight attendants (Beatty *et al.* 2011). Figures found in literature seem to indicate that what may come to be disturbed in flight attendants is the function of the pituitary-thyroid axis due to changes to the synthesis and secretion of melatonin as well as a high level of stress (Lewinski & Karbownik 2002).

CONCLUSIONS

The results of the presented study seem to indicate that the specificity of flight attendants' work contributes to a higher incidence of menstrual disorders, sleep disturbances, thyroid diseases and cervical erosions in this population group. The disturbances seem to have their primary source in the shift work system. However, attention should be given to the limitations of this study. Due to the small size of the study group and lack of a control group the findings obtained cannot be applied to the whole population of flight attendants in Poland. In addition the study should be expanded to include gynaecological and endocrinological observation of the respondents in order to exclude subjective interpretation of menstrual disorders.

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