

# Human Axillary Secretions Affect the Length of Menstrual Cycle in Reproductive Age Women and Pre-Menopausal Women

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**Abstract:** - Human male underarm secretions, when applied to women recipients, alter the length and timing of the menstrual cycle. These effects are thought to arise from exposure to primer pheromones that are produced in the underarm. Specific aim of our study was to investigate the influence of male axillary extracts on the length of menstrual cycle of premenopausal women in comparison with women of reproductive age. Total of 43 women, age of 21–51, with known medical history participated in our study. We monitored the length of the menstrual cycle for each test subject for six months before the experiment and followed monitoring for two months after the experiment. We applied axillary extracts/or diluent on the upper lip three times a week for six hours in the morning for duration of nine weeks. Women of 21–44 years old were subdivided into three groups: with menstrual cycle length of 26–32 days (1); menstrual cycles shorter than 26 days (2) and with cycles longer than 32 days (3). Experimental data from women over 45 years old were analyzed separately. Male axillary extracts did not affect significantly length and regularity of menstrual cycle in women with normal and regular cycles ( $n=12$ ,  $p> 0.1$ ). At the same time, we observed significantly shorter menstrual cycles ( $n=12$ ,  $p< 0.01$ ) under male axillary extracts applications in women with cycles longer than 32 days. For women with menstrual cycle length less than 26 days, we also did not observe statistically significant changes under male axillary extracts treatment ( $n=9$ ). In premenopausal women male axillary extracts applications caused significant shortening of the menstrual cycle ( $n=10$ ,  $p< 0.01$ ) as well as we observed a tendency for more regular cycles for this group of test subjects. Repeated exposures did not cause habituation, and the effect was stable for at least two next cycles after completion of the exposure.

**Key-Words:** - chemical communication, reproduction, humans, menstrual cycle, chemical signals, luteinizing hormone

## 1 Introduction

The human body odors are natural components of the environment in our everyday life, especially in overcrowded conditions in metropolitan areas. The natural human body odor includes about 120 individual chemicals [1], and some of them have pheromone properties [2–4]. Chemical signals and pheromone-like substances are potentially involved in human intraspecific chemical communication. In general, body odors may carry information of great importance for individuals across a wide range of species [4]. Synchronization of the menstrual cycles reported for dormitory roommates and close friends and this effect seems to be mediated by the secreted substances of the female axillary apocrine glands [5,6]. The extract of the secret collected in the ovulation phase of the cycle caused a 28% increase in the luteinizing hormone (LH) frequency of pulses in the signal recipients, whereas the secret collected from a donor in the follicular phase of the menstrual cycle caused a 16% decrease in frequency of LH

pulses [7]. It appears to be a mechanism underlying the synchronization of menstrual cycles. Similarly, in reproductive age women exposed to male underarm axillary extracts, the frequency of LH pulses increased, accelerating the onset of ovulation [3]. Also, odors of some volatile steroids from human body secretions may affect emotional state, level of stress, and an ability to focus attention [8–10]. However, the effects of male body odors on regulation of menstrual cycles were studied only in younger women (under 45 years old) with normal and regular menstrual cycles [3,11,12]. The experiments were performed mainly under clinical conditions, and a single exposure during different intervals [3,11,13,14] did not allow to evaluate the duration of the effect and potential habituation to repeated exposures.

## 2 Problem Formulation

Specific aim of our study was to investigate the influence of male underarm axillary extracts on the length of menstrual cycle of premenopausal age women in comparison with women of reproductive age; to assess potential habituation to repeated exposures to male underarm axillary extracts and evaluate whether effect of exposure may last longer than next cycle just after application of the extract.

### 3 Problem Solution

#### 3.1 Test Subjects and Methods

Test subjects were 43 healthy heterosexual women with known medical history, who did not use hormonal contraceptives. Age of test subjects ranged from 21 to 51 years old. Information on the menstrual cycle length and its regularity for the period of six months preceding the experiment was available for each woman participated in the study. This information was used for assignment of test subjects to certain experimental groups. Women of reproductive age were subdivided into three basic groups: those with regular menstrual cycles of normal length, 26–32 days (first group); those with abnormally long (>32 days) menstrual cycles (second group) and women with short (<26 days) menstrual cycles (third group). The women of the fourth experimental group were 45–51 years old and with irregular menstrual cycles. The average age of test subjects in group one was  $29.83 \pm 8.95$  years old, in group two -  $29.50 \pm 8.45$  years old, in group three -  $30.11 \pm 9.39$  years old. In group four average age of test subjects was  $48.40 \pm 1.90$  years old. The male underarm axillary extracts were collected for six hours onto sterile cotton pads of  $0.2 \times 10 \times 10$  cm using the standard technique [11, 14, 15]. The donors were six healthy heterosexual men of 22 - 45-years old. Women test subjects were not personally acquainted with the donors. The samples were extracted with 70% ethanol [14]. A mixture of extracts was used in our experiments, phenylethyl alcohol (0.005%) was added to mask the odor. In the control, 70% ethanol with phenylethyl alcohol (0.005%) was used. The control subjects did not distinguish experimental and control solutions by smell. Male axillary extract or control solution (0.5 mL on a sterile cotton disc) were applied above the upper lip of a woman three times a week at 10:00 a.m. during nine weeks on average (two complete menstrual cycles). We did not wash out the extract or control solution at least during six hours after application. The remaining amount of extract on a

cotton disk was placed in a close proximity to test subjects until the odor completely vanished away (30 min). The menstrual cycle length was monitored additionally for two cycles before the start of exposures. Afterwards, the test women were exposed to the control solution during another two cycles and after that, they were again exposed to the male axillary extract during two complete cycles. The length of the menstrual cycle was monitored for two complete cycles after the end of all exposures. Thus, the experiment with each test subject lasted for 8-10 months depending on the length of the menstrual cycle. We performed statistical analysis using the Statistica 8.0 software. Intergroup differences were determined with Wilcoxon Signed-Ranks test.

The study was conducted according to the principles of the Declaration of Helsinki. Participants provided informed written consent. All procedures were approved by the research ethics committee of A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences.

#### 3.2 Results and Discussion

We did not observe statistically significant changes in the length of menstrual cycle of the reproductive age (21–45 years old) women with regular cycles who were exposed to the male underarm axillary extracts ( $n=12$ ,  $p=0,40082$ , Wilcoxon Signed-Ranks test). In the control group, the menstrual cycle length was  $28.60 \pm 1.74$  days, in the experiment -  $28.67 \pm 1.55$  days. These findings are in good agreement with the data of Preti et al. [3]. Similarly, we did not observe statistically significant changes in the menstrual cycle length under exposures to male underarm axillary extracts in the group of the reproductive age women with abnormally short menstrual cycles (<26 days). In the control, length of the menstrual cycle was  $23.11 \pm 1.28$  days, in experiment -  $23.08 \pm 1.14$  days ( $n=9$ ,  $p= 0,75315$ , Wilcoxon Signed-Ranks test). At the same time, extracts of the male underarm axillary secretions caused significant shift (vs. control) to shorter cycles in women with long irregular cycles (>32 days). In control, menstrual cycle length was  $35,68 \pm 2,48$  days, in experiment -  $33,91 \pm 1,92$  days ( $n=12$ ,  $p= 0,00222$ , Wilcoxon Signed-Ranks test). On average, the menstrual cycles of the experimental group women were 2–3 days shorter than in women of the control group. In the group of premenopausal age women (46-51 years old) extracts of male axillary secretions also caused a significant shift toward the normal menstrual cycle length ( $n=10$ ,  $0,01252$ , Wilcoxon Signed-Ranks

test). In control, menstrual cycle length was  $33,93 \pm 4,14$  days, in experiment -  $30,85 \pm 1,82$  days. For this group of test subjects (group four) we also observed a tendency for more regular cycles. The menstrual cycle length seems to be reduced under the influence of male axillary extract due to the decrease of time interval to the next LH peak and an increase of its amplitude which accelerates the onset of the next ovulation. As reported in [3], the time interval between LH peaks was 20% reduced and the amplitude of the next LH peak increased significantly when the reproductive age women were exposed to the male underarm axillary extract. In women with normal and abnormally short cycles, no shortening of the cycle length was observed because the follicular phase was initially short. Thus, we have demonstrated for the first time that the male underarm axillary extracts induce a significant shortening of the abnormally long menstrual cycles not only in the reproductive-age women, but also in women of premenopausal age. Repeated exposure caused no habituation, and the effect lasted for at least two next menstrual cycles after completion of the exposure. Our data are important for understanding of the fundamental principles of human chemical communication, as well as for development of the medical reproductive technologies.

#### 4 Conclusion

We have demonstrated first that the male underarm axillary extracts cause significant shortening of menstrual cycles in women with a history of irregular menstrual cycle lengths regardless of the age: reproductive (< 45 years old) or premenopausal. The effect lasted for at least two next menstrual cycles after completion of the exposure. Repeated exposures did not cause habituation indicating the innate nature of the response. The data obtained are very important for basic research in the field of human chemical communication as well as for development of medical reproductive technologies; ecology of working place for certain categories of professionals.

#### 5 Acknowledgments

Research was supported by the Russian Science Foundation, project no. 16-15-10312 to VVV.

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