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SHORT COMMUNICATION

Is 3α–androstenol pheromone related to menstrual synchrony?

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Abstract

Background and methodology The ovarian cycles of females living and interacting together may synchronise due to pheromones released from axillary secretary glands, the highest concentration of which is produced in the mid-follicular phase, prior to ovulation. The objective of this study was to find evidence for menstrual synchrony in a group of female students living together and to obtain a correlation between the ability to smell the putative pheromone, 5α-androst-16-en-3α-ol (3α-androstenol), found in apocrine secretions and menstrual synchrony. This cross-sectional study involved 88 students who completed a standard questionnaire and whose sense of smell was measured using ten varying thresholds. The menstrual history, friendship scale and menstrual hygiene score was determined for the participants.

Results A total of 59.1% of the subjects studied were found to have menstrual synchrony. There was no significant association between menstrual synchrony and smelling threshold. However, a significant correlation was found between menstrual synchrony and personal hygiene score ($p<0.01$).

Conclusions The phenomenon of menstrual synchrony may be related to various factors. The results failed to demonstrate any significant difference between synchronised and non-synchronised subjects in detecting the steroid by sense of smell. However, the odours associated with menstrual blood or vaginal discharge might have an affect on menstrual synchrony.

Keywords 3α-androstenol, menstrual cycle, pheromones, synchrony

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Introduction

Menstrual synchrony was first demonstrated among 135 women students at Wellesley College, MA, USA who lived as roommates.[1] A follow-up experiment, involving exposing women to chemical compounds from the armpits of other women, altered menstruation.[2] Subsequently many other studies have supported synchronised menstrual cycles between friends, mothers and daughters and Bedouin families.[3] In most of these studies, women who spent more time together or who lived closely together were most likely to show menstrual synchrony. The source of this ovarian synchrony has been investigated by some researchers[4–6] and it has been postulated that environmental triggers such as pheromones can harmonise the ovarian rhythms. The synchronisation of ovulation time as a result of females living together shows how sensitive ovulation is to environmental factors such as body odours and pheromones. If the specific pheromones responsible for this phenomenon are known then the fertile time can be regulated using the synthesised material. This would herald a new era in the field of family planning and fertility treatment. Specifically those for whom religious or cultural reasons demand the use of natural family planning methods would be able to synchronise their ovulation time rather than preventing ovulation altogether.

The odours emanating from the axillary region may act as pheromones.[7] One of the pheromones found in female axillary secretions is a steroid, 5α-androst-16-en-3α-ol (3α-androstenol). This steroid with a musk-like smell or a floral odour[8] acts as a pheromone in other species such as pig, boar or other lower mammals and human.[9] If the hypothalamus is the centre for both receiving olfactory triggers and secreting luteinising hormone there is a possibility that smelling pheromones such as androstadienone may be closely involved with the regulation of reproductive functions.

This study aimed to investigate the ability to smell putative pheromones such as 3α-androstenol and their relationship to menstrual synchrony.

Key message points

- **Menstrual synchrony was found among the medical students investigated in this study.**
- **3α-Androstenadiol may not be the chemical causing the synchronisation.**
- **Other chemicals in menstrual bleeding or vaginal discharge may be responsible for menstrual synchrony.**

Methods

This cross-sectional study was conducted among 88 medical and nursing students at the Royal College of Medicine, Perak (RCMP) in Malaysia. The unique characteristic of this group of students is that they live in houses with five to eight rooms and only female students share rooms, often spending long periods (12–16 hours) participating in academic activities together. The study participants were medical or biomedical students who were aware of their menstrual dates and of whom many (46.9%) kept their own menstrual diary, marked their calendars or could recall their exact cycle dates. The majority of the subjects were Moslems (83.7%) and as such reported no premarital sexual activity since this is forbidden by their religion. (NB. The fact remains, however, that because of cultural taboos some of the participants may not have told the truth when questioned about this matter.) The students were living in the Malaysian climate with its greater humidity, which would expose them to more axillary pheromones generally.

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Exclusion criteria for the study were married students or those with a boyfriend; irregular menstruation; gynaecological, metabolic or medical problems; and usage of the oral contraceptive pill or any other hormones.

The total population of female students at RCMP was approached and everyone agreed to participate (n = 120). The total number of subjects analysed was 88 (as some failed to remember their menstrual dates or could not attend the smell test), which was divided into three groups: best friends (Group 1, n = 74), roommates (Group 2, n = 6) and both best friends and roommates (Group 3, n = 8).

The structured interview consisted of demographic data (age, ethnicity and religion), questions on menstrual history (age of menarche, characteristics of menstrual cycle) and personal hygiene (cleaning private parts, using clean underwear, having vaginal discharge). The menstrual synchrony scores were calculated as recommended by Weller and Weller.[3]

In order to detect the subjects' ability to smell odours the olfactory threshold detection test was done according to the methodology of Hummel *et al*.[10] using ten concentrations of 3α-androstenol (Steraloids Inc., Newport, RI, USA).

One sample t-test was used for each unit readings to determine the existence of menstrual synchrony. Each pair synchrony score was compared with its cut-off point cycle score. Student's t-test was used to compare quantitative data and the Chi-square test was used to compare qualitative data. A value of $p<0.05$ was considered to be significant. Non-parametric tests were used for threshold values since the distribution of data was not normal. The Mann-Whitney test of ranks was used to determine the threshold difference between synchronised and non-synchronised pairs.

Ethical approval

Ethical approval for the study was obtained from the RCMP Ethical Committee. This study formed part of an elective programme for medical students.

Results

The overall mean values for the absolute onset difference of menstruation between pairs and 'cut-off point of mid-cycle point' were 7.09 ± 4.89 and 7.48 ± 0.68, respectively. After subtracting each synchrony score from the expected onset difference, the mean difference was found to be 0.391 for the overall population. When divided by their expected cycle score, 59.1% of the couples were found to have synchrony. The corresponding figures for those who were only best friends (Group 1), those who were only roommates (Group 2) and those who were both best friends and roommates (Group 3) were 59.5%, 66.7% and 50.0%, respectively. Evidence for the possibility of menstrual synchrony was demonstrated for all three groups (Table 1).

Table 1 Frequency of synchronised subjects in each group and overall

Group	Total subjects [n (%)]	Synchronised subjects [n (%)]
Only best friends (Group 1)	74 (84.1)	44 (59.5)
Only room mates (Group 2)	6 (6.8)	4 (66.7)
Both best friend and roommates (Group 3)	8 (9.1)	4 (50.0)
Overall	88 (100.0)	52 (59.1)

The mean age of the subjects was 21.4 ± 1.7 years and was in the range 18–29 years. The time since menarche was 8.62 ± 2.16 years in synchronised subjects and 9.5 ± 1.99 years in non-synchronised subjects (p = 0.06). The length of menstrual flow was 6.96 ± 1.64 days in synchronised women as compared to 7.57 ± 2.28 days in non-synchronised women (p = 0.152). The majority (55.8%) of synchronised subjects had moderate bleeding, while heavy bleeding was found in the majority (57.1%) of non-synchronised subjects. When subjects were divided into two groups of heavy and non-heavy bleeders, a significant difference was found between synchronised and non-synchronised subjects ($p<0.001$). Some 57.1% of non-synchronised subjects reported bleeding heavily as compared to 23.2% of synchronised subjects.

No subject was found to be anosmic. There was no difference between synchronised and non-synchronised women in the detection threshold for 3α-androstenol (p = 0.365, Mann-Whitney test) when subjects were categorised into two groups (i.e. with or without any difference in the ability to smell). This indicates that olfactory ability to detect 3α-androstenol did not differ between the two groups.

The hygiene score was found to be higher among non-synchronised subjects (9.50 ± 1.93) as compared to synchronised ones (8.62 ± 2.16) ($p<0.05$). There was a statistically significant difference in the mean hygiene score between synchronised and non-synchronised subjects ($p<0.05$) (Table 2).

No significant correlation was found between the personal hygiene score and the score of the ability to smell 3α-androstenol threshold (p = 0.541). When subjects were classified according to their menstrual synchrony, no significant correlation was found between the two variables, neither for synchronised (p = 0.649) nor for non-synchronised subjects (p = 0.671).

The subjects' exposure to various smells as reported by them was compared for synchronised and non-synchronised subjects. No significant differences were found in terms of exposure to cigarette smoke (p = 0.514), male perfume (p = 0.08), female perfume (p = 0.134), soap scent (p = 0.134), male sweat odour (p = 0.210) or other smells (p = 0.192). However, synchronised subjects reported a greater exposure to female sweat odour (44.3%) compared to non-synchronised subjects (14.8%) (p = 0.015).

Discussion

This study demonstrated the possibility of the existence of menstrual synchrony among medical students at RCMP who were best friends, roommates or both best friends and roommates with a rate of 50–67%. This finding is in accordance with those of other researchers in either human or animal subjects[4] and is discordant with findings from lesbians living together.[11.] Menstrual synchrony among RCMP medical students may be due to intensive contact and increased exposure to body pheromones, which may be

Table 2 A comparison of the 3α-androstenol threshold and hygiene score in two groups of synchronised and non-synchronised subjects

Variable	Synchronised subjects [mean (SD)] (n = 52)	Non-synchronised subjects [mean (SD)] (n = 36)	
3α-Androstenol threshold	1.50 (0.90)	2.11 (1.92)	0.365
Hygiene score	8.62 (2.16)	9.50 (1.93)	0.05

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enhanced in the humid and warm Malaysian weather. Axillary 3α-androstenol levels in women is postulated to play a role as a synchronising pheromone[12] and it is found to show menstrual variation; the highest concentration of this compound being produced in the mid-follicular phase, prior to ovulation.[8] Recently research has shown that axillary compounds from women in this phase of the menstrual cycle shorten both the time to ovulation and the length of the menstrual cycle, whereas in the ovulatory phase they lengthen both these parameters.[13] Therefore 3α-androstenol is a possible pheromone included in axillary compounds secreted in the follicular phase. Morofushi *et al*. demonstrated that all the synchronised women in their study could detect 3α-androstenol,[6] however in the present study the ability to smell the putative pheromone, 3α-androstenol, was found to be similar in synchronised and non-synchronised subjects.

Other glands believed to secrete pheromones are located in the vagina. Genital scents are said to be the most potent in attracting the opposite sex.[13] The present study shows that the hygiene score was lower among synchronised subjects, suggesting that other chemicals present in the vaginal discharge or menstrual blood flow during menstruation may play a role in synchrony.

We studied the effect on menstrual synchrony of other smells such as cigarette smoke, soap scent and male or female perfume, none of which were found to be significantly different between the two groups of synchronised and non-synchronised partners.

Conclusions

Menstrual synchrony was found in 59% of our study population. However, the ability to smell 3α-androstenol was found to be similar between the two groups of synchronised and non-synchronised subjects. Other chemical compounds present in menstrual blood or vaginal discharge might be responsible for the synchronisation since the personal hygiene score was found to be lower in synchronised subjects.

Statements on funding and competing interests

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Competing interests None identified.

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BOOK REVIEWS

Menopause: Answers at Your Fingertips. H Currie. London, UK: Class Publishing, 2006. ISBN: 1-85959-155-8. Price: £17.99 (currently available from the publisher's website at the special offer price of £12.99). Pages: 220 (paperback)

When I began working for the Journal in 2004, my very first article covered the flurry of media panic over hormone replacement therapy (HRT) following the Million Women Study. I explored the unfortunate impact on women nationwide, and reported on several pieces of *ad hoc* research suggesting that women had become wary of medical solutions.

So when I read the back cover blurb of *Menopause: Answers at Your Fingertips* – and saw that its main aim was to meet such wariness head on, and 'debunk the scare stories' about medical solutions – I gave a silent cheer. At last a solid, experience-based book that could help pre- and postmenopausal women make sense of all that they've heard about HRT.

The book undoubtedly keeps faith. It explains the climacteric and its symptoms, and goes into depth about osteoporosis, contraception, diet, exercise, lifestyle and other assorted medical problems. And, as promised, it gives thorough and balanced coverage of the HRT issue, and avoids the 'shut up and take the tablets' approach by covering in just as much detail the non-HRT drug therapies and the non-medical alternatives to HRT. The style is clear, accessible, non-patronising, and the resources section full and well researched. I'd happily recommend the book to patients as background reading and support for menopausal symptoms.

But – and it's a fairly big but – I would also recommend that patients (and their partners) don't just stop there, and that they top up this excellent primer with additional reading. Because what the authors have missed out on – in their flurry to cover medical topics – is anything but surface coverage of the emotional issues surrounding the menopause. Even the chapter headed 'Sex, relationships and work' deals largely with how these are affected by physical problems.

I'm not moving into active criticism here; I suspect the authors' brief for this book was to major on the facts and steer clear of the 'fluffy'. All I ask is that if you do offer this book to one of your patients, you remember that menopause isn't just a hormonal event. It's a life changing and deeply challenging process – and so 'fluffy' coverage of the emotional backlash may also be needed. In which case, either recommend another of the more counselling-based books on the market – or ask the vital question "How are you feeling?", and meet your patients' emotional needs yourself.

Reviewed by **Susan Quilliam**, BA, Cert Ed, MNLP
Freelance Writer, Broadcaster and Agony Aunt, Cambridge, UK

The Menopause: What You Need to Know. M Rees, DW Purdie, S Hope (eds). London, UK: Royal Society of Medicine Press, 2006. ISBN: 1-85315-672-8. Price: £10.95. Pages: 104 (paperback)

The second edition of this handbook, published on behalf of the British Menopause Society, provides a valuable source of up-to-date information about health problems associated with the menopause for health professionals and also to women experiencing the menopause.

The text is designed to help women understand the changes they may experience during the menopause and the treatment options available to them.

The book provides unbiased information for health professionals on subjects such as contraception and sexual health in older women, osteoporosis, myocardial infarction, ischaemic stroke, dementia and urinary incontinence. The benefits, risks and controversies regarding hormone replacement therapy and also the alternative therapies are critically reviewed. Each chapter has a list of relevant references.

Reviewed by **R K Bhathena**, FRCOG, FFFP
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