

Changes in olfactory function with several pregnancies?

C. Wohlgemuth^{a,b}, E. Beinder^a, N. Ochsenbein-Kölble^a, T. Hummel^b

^a Obstetric Research Unit, Department of Obstetrics, University Hospital, Zurich, Switzerland

^b Smell & Taste Clinic, Department of Otorhinolaryngology, University of Dresden Medical School, Dresden, Germany.

Summary

Objective: To investigate whether olfactory performance decreases as a function of the number of pregnancies, previous research having indicated that olfactory function decreases in the course of pregnancy.

Methods: In a prospective study three groups of women were investigated (total n = 93), women who have given birth to no children (group 0), to one child (group 1), and to two or three children (group 2). Olfactory function was assessed using the "Sniffin' Sticks" kit.

Results: There was no significant difference in olfactory function between the three groups.

Conclusion: While pregnancy is typically accompanied by changes in olfactory performance, these alterations obviously do not translate into a long-lasting change in olfactory function dependent on the number of pregnancies.

Key words: olfaction; smell; "Sniffin' Sticks"; nose; odour

Introduction

Changes in the perception of odours during pregnancy are a well known phenomenon reported by the majority of pregnant women [1]. Explanations for this change in the perception of odours may relate to cognitive and hormonal factors. Other workers have indicated increased olfactory sensitivity as reported by women in early pregnancy [2], which was not confirmed, however, by studies measuring olfactory function [1, 3].

Concerning late pregnancy or the post partum period, a questionnaire-based study found olfactory dysfunction to be rare or absent, respectively [2]. In addition, previous research had indicated that olfactory function decreases in the

course of pregnancy [3]. Compared to controls pregnant women showed decreased olfactory sensitivity in the third trimester which was still present after birth. Odour thresholds but not odour discrimination or odour identification were significantly decreased during the third trimester of pregnancy and post partum. Since it is unclear whether this effect is reversible after birth, it may be hypothesised that repeated pregnancies would lead to a decrease in olfactory function. Thus the aim of the present investigation was to investigate whether olfactory performance decreases as a function of the number of pregnancies, and thereby exerts long-lasting effects.

Material and methods

Participants responded to a poster at the University Hospital. They were included in the study following written informed consent. The study was approved by the Ethics Committee of the University of Zurich Medical School.

Three groups of women were investigated, viz. women who had given birth to no children (group 0), to one child (group 1), and to two or three children (group 2) (for details see Table 1). Women in group 0 were younger than those in the two other groups (F [2, 92] = 11.9, p < 0.001).

All subjects were reported to be in good health. They were instructed to refrain from smoking, drinking anything but water, and eating at least 1 hour before testing. Exclusion criteria were drug and nicotine abuse (>10 cigarettes per day), and known gustatory/olfactory dysfunction. In addition, subjects completed a questionnaire related to their vocabulary skills [4]. To test the subjects' verbal skills, which may affect the results of odour identification tests, and to ascertain that subjects were able to understand the instructions given, only subjects with

scores higher than 10 were allowed to enter the study. All subjects also completed a mood questionnaire [5].

Butanol odour threshold, odour discrimination, and odour identification were assessed using the “Sniffin’ Sticks”, which are pen-like odour dispensers (Burghart Instruments, Wedel, Germany) [6]. Assessment of butanol odour thresholds was based on a geometric series of dilutions presented to blindfolded subjects, using a 3-alternative forced choice (3-AFC) task. The three pens were presented in random order, one containing butanol at a certain dilution, the other two solvent. The subjects’ task was to identify the odour-containing pen. The triplets were presented at 20 s intervals until the subject correctly discriminated the odorant in two successive trials, triggering staircase reversal. The mean of the last four of seven reversals was used as threshold. Discrimination was tested using 16 triplets of odorants with a 3-AFC procedure, where subjects had to find out which of the three odorants smelled differently. They were blindfolded to prevent them from identifying the odour pens. Triplets were presented at intervals of at least 30 s and in-

dividual pens at intervals of approximately 3 s. Identification was tested for 16 odorants presented at an interval of at least 30 s; subjects were asked to identify them from a list of four descriptors. Results are also expressed as the summated score of all three subtests (“TDI score”) [7].

Descriptive statistics are presented as means and standard deviations unless stated otherwise. The data gathered on olfactory function were regarded as continuous. Analyses of variance for repeated measures were employed with “group” [groups 0, 1, and 2] as between-subject factor, and “test” [tests for odour identification, discrimination, and odour threshold], whenever appropriate. The subjects’ age and the score in the vocabulary test were used as covariates, as both are known to affect results of olfactory testing. The alpha-level was 0.05. P values were based on two-sided tests. Coefficients of correlations are presented together with the number of data pairs involved, indicated as a subscript to the “r”. SPSS 12.0 for Windows™ (SPSS Inc., Chicago, Ill., USA) was used for the analyses.

Results

On average, women in group 0 scored highest for odour discrimination and odour identification, while women in group 2 had the lowest scores; for odour thresholds, however, the reverse was the case, with women in group 2 exhibiting, on average, the lowest thresholds. These observations were not statistically significant (factor “group”: $F = 1.14$, $p = 0.32$, $\eta^2 = 0.03$; interaction between factors “group” x “test”: $F = 1.49$, $p = 0.21$, $\eta^2 = 0.03$) (table 1).

When checking for both age and results obtained in the vocabulary test, there was no significant correlation between the results of olfactory tests and the number of children ($r_{89} < \text{abs}[0.17]$, $p > 0.12$). In addition, neither olfactory function ratings nor the results of the mood questionnaire differed significantly between the 3 groups.

Discussion

It was found that the olfactory sensitivity of women who had given birth to one child was comparable with that of women who had given birth to 2–3 children. Furthermore, olfactory sen-

sitivity was not significantly different between nulliparae and women who had given birth to at least one child, the last birth being an average of 3.6 years previously.

Table 1

Descriptive statistics (means, standard deviations; 95% confidence intervals) of dependent variables, separately for the 3 investigated groups.

	Group 0 (n = 26)				Group 1 (n = 26)				Group 2 (n = 41)			
	Means	SD	95% confidence interval		Means	SD	95% confidence interval		Means	SD	95% confidence interval	
			Lower	Upper			Lower	Upper			Lower	Upper
Age (years)	25.8	4.2	24.1	27.5	31.5	4.6	29.6	33.3	30.6	4.9	29.1	32.2
Odour threshold (dilution steps)	9.65	2.36	8.7	10.61	10.19	2.77	9.07	11.31	10.41	2.05	9.77	11.06
Odour discrimination (correct items)	13.54	1.53	12.92	14.16	13	1.77	12.29	13.71	12.88	2.08	12.22	13.53
Odour identification (correct items)	14.23	1.21	13.74	14.72	13.88	1.4	13.32	14.45	13.76	1.61	13.25	14.26
TDI score (composite score)	37.42	2.89	36.26	38.59	37.08	4.61	35.21	38.94	37.05	3.79	35.85	28.25
Vocabulary test (correct words)	30.5	4.7	28.61	32.39	28.9	6.8	26.13	31.64	27.6	7.6	25.22	30.00

Several studies have compared olfactory sensitivity during pregnancy with that in the post partum period, with contradictory results. A recent study including 38 pregnant women and 46 non-pregnant controls showed that pregnant women had a decreased odour threshold compared to non-pregnant women. Six weeks after birth this difference was still present [3]. Others [8] reported changes in olfactory performance during pregnancy and recovery after birth. (Hansen and Glass 1936). They tested olfactory sensitivities to rubber, "attar of roses", and nitrobenzene (smell of bitter almond) in 22 pregnant women at the end of pregnancy, on the 2nd or 3rd day after delivery and 6–8 weeks post partum. Their major finding was that all the women investigated initially showed hyposmia with improvement during the post partum period (Hansen and Glass 1936). Interestingly, a longitudinal descriptive study on self-reported smell perception has shown that as early as 9–12 weeks post partum smell abnormalities were almost absent (3%) compared to 16 gestational weeks (68%) or late-stage pregnancy (40%) [9]. Another survey investigated the changes in olfactory perception in women during each trimester of pregnancy, in non-pregnant women and in women between 2 and 3 month after delivery. Post partum the differences in odour evaluation which were greatest in the third trimester had vanished [1]. Considering the results from the present and previous studies it appears valid to hypothesise that olfactory function is reduced directly after birth and during the first 6–12 weeks post partum, but seems to recover completely thereafter.

The reason for the decrease in olfactory function during pregnancy is unclear. Based on the fact that odour thresholds were more affected than suprathreshold olfactory functions, it may be hypothesised that the olfactory deficit had its origin in the periphery (for discussion see [10]), similarly to patients with chronic nasal problems [11]. This is particularly interesting in view of the current debate surrounding the extent to which pregnant women suffer from nasal congestion. Subjectively, almost half of pregnant women suffer from nasal stuffiness [12, 13]. Bende and Gredemark [12] found that this was more pronounced in multiparae women. This subjective feeling of nasal obstruction has been found to regress several weeks after delivery [13]; it has not been possible to document it by rhinomanometric meth-

ods. This indicates that if nasal congestion occurs during pregnancy it seems to be inaccessible to currently available tools (rhinomanometry, endoscopy, etc).

It appears possible that slight nasal congestion occurs during pregnancy which is not relevant to nasal breathing, since the lower and middle meatus remain patent but sufficiently narrows the olfactory cleft to affect olfactory thresholds. In this context, one may also speculate to what extent the present findings may be an indirect measure of slight nasal congestion in the olfactory cleft. This situation is similar to the presence of nasal polyposis, e.g. during the follow-up of patients after surgery. In this case the recurrence of nasal polyps is not found by measurement of nasal patency, and sometimes not even by nasal endoscopy, but by olfactory function [14].

It may seem surprising that unchanged olfactory function across successive pregnancies is unrelated to the fact that the symptoms of nausea/vomiting (often mentioned by women as being triggered by odours) become less severe over consecutive pregnancies. However, as indicated by previous studies, there is no significant correlation between olfactory sensitivity and nausea/vomiting in the first trimester [15]. This is indirectly supported by the present results; in addition, it also points to the idea that nausea/vomiting during pregnancy in relation to smell is not an adaptive mechanism (see also [16]).

The present study is limited insofar as the number of subjects investigated per group was rather small to allow absolute certainty about the missing significant effects.

In conclusion, the present study emphasised that olfactory function does not decrease as a function of the number of pregnancies.

We would like to thank Dr. Elisabeth Pauli for her help with the psychological tests.

Correspondence:

Thomas Hummel, M.D.

Smell & Taste Clinic

Department of Otorhinolaryngology

University of Dresden Medical School

Fetscherstrasse 74

01307 Dresden

Germany

E-Mail: thummel@mail.zib.tu-dresden.de

References

- 1 Laska M, Koch B, Heid B, Hudson R. Failure to demonstrate systematic changes in olfactory perception during the course of pregnancy: a longitudinal study. *Chem Senses*. 1996;21:567-71.
- 2 Nordin S, Broman DA, Wulff M. Environmental odor intolerance in pregnant women. *Physiol Behav*. 2005;84:175-9.
- 3 Ochsenbein-Kolble N, von Mering R, Zimmermann R, Hummel T. Changes in olfactory function in pregnancy and postpartum. *Int J Gynaecol Obstet*. 2007;97:10-4.
- 4 Schmidt KH, Metzler P. Wortschatztest. Hogrefe Verlag: Göttingen, 2000.
- 5 von Zerssen D. Die Befindlichkeitsskala. Beltz Test: Göttingen, 1975.
- 6 Kobal G, Klimek L, Wolfensberger M, Gudziol H, Temmel A, Owen CM, et al. Multicenter investigation of 1,036 subjects using a standardized method for the assessment of olfactory function combining tests of odor identification, odor discrimination, and olfactory thresholds. *Eur Arch Otorhinolaryngol*. 2000;257:205-11.
- 7 Wolfensberger M, Schnieper I, Welge-Lüssen A. "Sniffin' Sticks": a new olfactory test battery. *Acta Otolaryngol*. 2000;120:303-6.
- 8 Hansen R, Glass L. Über den Geruchssinn in der Schwangerschaft. *Klin Wochenschr*. 1936;15:891-4.
- 9 Nordin S, Broman DA, Olofsson JK, Wulff M. A longitudinal descriptive study of self-reported abnormal smell and taste perception in pregnant women. *Chem Senses*. 2004;29:391-402.
- 10 Lötsch J, Reichmann H, Hummel T. Different odor tests contribute differently to the diagnostics of olfactory loss. *Chem Senses* 2008;33:17-21.
- 11 Klimek L, Hummel T, Moll B, Kobal G, Mann WJ. Lateralized and bilateral olfactory function in patients with chronic sinusitis compared with healthy control subjects. *Laryngoscope*. 1998;108:111-4.
- 12 Bende M, Gredmark T. Nasal stuffiness during pregnancy. *Laryngoscope*. 1999;109:1108-10.
- 13 Ellegard E, Karlsson G. Nasal congestion during pregnancy. *Clin Otolaryngol Allied Sci*. 1999;24:307-11.
- 14 Wolfensberger M, Hummel T. Anti-inflammatory and surgical therapy of olfactory disorders related to sino-nasal disease. *Chem Senses*. 2002;27:617-22.
- 15 Hummel T, von Mering R, Huch R, Kolble N. Olfactory modulation of nausea during early pregnancy? *BJOG*. 2002;109:1394-7.
- 16 Swallow BL, Lindow SW, Aye M, Masson EA, Alasalvar C, Quantick P, Hanna J. Smell perception during early pregnancy: no evidence of an adaptive mechanism. *BJOG*. 2005;112:57-62.

SMW

Established in 1871
Formerly: Schweizerische Medizinische Wochenschrift
Swiss Medical Weekly

The European Journal of Medical Sciences

The many reasons why you should choose SMW to publish your research

What Swiss Medical Weekly has to offer:

- SMW's impact factor has been steadily rising. The 2006 impact factor is 1.346.
- Open access to the publication via the Internet, therefore wide audience and impact
- Rapid listing in Medline
- LinkOut-button from PubMed with link to the full text website <http://www.smw.ch> (direct link from each SMW record in PubMed)
- No-nonsense submission – you submit a single copy of your manuscript by e-mail attachment
- Peer review based on a broad spectrum of international academic referees
- Assistance of professional statisticians for every article with statistical analyses
- Fast peer review, by e-mail exchange with the referees
- Prompt decisions based on weekly conferences of the Editorial Board
- Prompt notification on the status of your manuscript by e-mail
- Professional English copy editing

Editorial Board

Prof. Jean-Michel Dayer, Geneva
Prof Paul Erne, Lucerne
Prof. Peter Gehr, Berne
Prof. André P. Perruchoud, Basel
Prof. Andreas Schaffner, Zurich
(editor in chief)
Prof. Werner Straub, Berne (senior editor)
Prof. Ludwig von Segesser, Lausanne

International Advisory Committee

Prof. K. E. Juhani Airaksinen, Turku, Finland
Prof. Anthony Bayes de Luna, Barcelona, Spain
Prof. Hubert E. Blum, Freiburg, Germany
Prof. Walter E. Haefeli, Heidelberg, Germany
Prof. Nino Kuenzli, Los Angeles, USA
Prof. René Lutter, Amsterdam, The Netherlands
Prof. Claude Martin, Marseille, France
Prof. Josef Patsch, Innsbruck, Austria
Prof. Luigi Tavazzi, Pavia, Italy

We evaluate manuscripts of broad clinical interest from all specialities, including experimental medicine and clinical investigation.

We look forward to receiving your paper!

Guidelines for authors:

http://www.smw.ch/set_authors.html

All manuscripts should be sent in electronic form, to:

EMH Swiss Medical Publishers Ltd.
SMW Editorial Secretariat
Farnsburgerstrasse 8
CH-4132 Muttenz

Manuscripts: submission@smw.ch
Letters to the editor: letters@smw.ch
Editorial Board: red@smw.ch
Internet: <http://www.smw.ch>