

ORIGINAL ARTICLE

Reference Values of Olfactory Function for Mexico City Inhabitants

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Background and Aims. Olfactory testing is useful in the differential diagnosis of age-related pathologies. To provide baseline reference values for clinical use in Mexico City we investigated the relation between olfactory capabilities and the principal population parameters of age, sex, and smoking habits in a large sample of healthy inhabitants.

Methods. We applied the internationally recognized and commercially available Sniffin' Sticks test battery to 916 men and women from across the adult life span. The Sniffin' Sticks test evaluates three key aspects of olfactory function: 1) ability to detect an odor, 2) to discriminate between odors, and 3) to identify odors.

Results. We found a significant decline in olfactory function from the 5th decade of age, and that detection threshold was the most sensitive measure of this. We did not find a significant difference between men and women or between smokers and non-smokers. In confirmation of our previous studies of the negative effect of air pollution on olfactory function, Mexico City inhabitants had poorer overall performance than corresponding subjects previously tested in the neighboring but less polluted Mexican state of Tlaxcala.

Conclusions. Although we basically confirm findings on general demographic patterns of olfactory performance from other countries, we also demonstrate the need to take into account local cultural, environmental and demographic factors in the clinical evaluation of olfactory performance of Mexico City inhabitants. The Sniffin' Sticks test battery, with some adjustment of stimuli to correspond to Mexican culture, provides an easily administered means of assessing olfactory health. © 2015 IMSS. Published by Elsevier Inc.

Key Words: Olfactory function, Sniffin' Sticks test, Sex, Age, Smoking, Mexico City.

Introduction

The utility of olfactory assessment in the diagnosis of a wide range of pathologies is increasingly recognized, particularly in neuroendocrine, neurological, and age-related conditions (1–7). Indeed the loss of the sense of smell is a distinctive feature of different disorders that commonly afflict the elderly. There has been an increase of interest in olfactory dysfunction since it was realized that anosmia is a common feature of idiopathic Parkinson's disease (PD) (8–11) that appears earlier than the movement or

cognitive symptoms (12). Olfactory testing has proven useful in clinical practice; for instance, normal smell identification ability in PD patients is rare and should prompt a revision of diagnosis (13). Likewise, the finding of anosmia in a patient diagnosed with progressive supranuclear palsy should also prompt diagnostic review (14,15). Thus, olfactory testing may play a useful complementary role in the differential diagnosis of neurodegenerative diseases such as PD in distinguishing them from other movement disorders (16–18).

Previously, the clinical use of olfactory testing in the diagnosis of disease was hampered by the lack of comprehensive, easily administered, standardized and commercially available tests. However, These difficulties have now been largely overcome by the availability of several validated and easily administered test kits. One of the most widely used is the Sniffin' Sticks test battery in which

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odorants contained in felt-tipped marker pens are presented to subjects according to a standard protocol (19–21). The standard Sniffin' Sticks procedure evaluates subjects' ability to detect an odorant (threshold), to distinguish between odorants, and to identify (name) them using a verbal checklist. One advantage of combining these different measures is to help identify where in the chemosensory and associated pathways functional impairment occurs. Another is that using more than one measure of olfactory performance increases the likelihood of detecting olfactory and other associated functional loss (22–27).

However, performance on this test, as for all olfactory testing, depends to some degree on subjects' culture and on local environmental conditions. Odorants that are familiar and thus readily detected, discriminated and identified by subjects from one culture may be unfamiliar and so more difficult to detect, to discriminate and to identify by subjects from elsewhere (28–31). Environmental factors such as altitude (air pressure), temperature and humidity (32,33), and air pollution (22–25) can also affect the olfactory performance of otherwise healthy populations. Such factors make it necessary to determine regional reference values with which to compare the results of clinical testing. Accordingly, research groups across the world employing the Sniffin' Sticks battery have found it useful to establish local norms of responding that take such factors into account (3,34–41).

Given the increasing use of the Sniffin' Sticks test battery in research and clinical contexts, it was our aim in the present study to test a large sample of adult Mexico City inhabitants of all ages and both sexes to obtain reference data with which to compare the results of clinical testing for this population and test method. This involved obtaining a general database and analyzing the data according to the broad demographic categories of age, sex and smoking habits.

Materials and Methods

Study Population and Setting

The study was conducted at the science museum "Universum", Universidad Nacional Autónoma de México, Mexico City, where we recruited visitors opportunistically according to their availability and willingness to participate. We obtained data from 916 subjects from 16–83 years of age (615 women, 301 men, mean age 31.84 years, SD 14.31; Table 1) coming from a wide area of Mexico City. All subjects were Mexico City residents, had indoor occupations, and all reported to be in good general health and to their knowledge not to be ill or suffering from any longer-term pathology. None had previous experience with tests of olfactory function.

The procedure conformed to the Declaration of Helsinki for medical research involving human subjects and to the

Table 1. General characteristics of the study sample

	Group A 16–35 years	Group B 36–55 years	Group C > 55 years
Sample size	649	211	56
Women	431	143	41
Men	218	68	15
Smokers (> 1 cigarette/day)	134	29	6
Nonsmokers	448	170	49
^a Age (mean, SD)	22.4 (5.0)	44.8 (5.6)	63.7 (7.2)
^a Schooling (mean, SD)	14.2 (2.2)	14.8 (2.7)	14.4 (5.4)

^aYears.

guidelines for the treatment of human subjects of the Instituto de Fisiología Celular and the Instituto de Investigaciones Biomédicas, UNAM, Mexico. The study was approved by the Subcomité del Campo de Conocimiento en Biología Experimental y Biomedicina, Posgrado en Ciencias Biológicas, UNAM. Because this is considered a minimal risk study according to articles 17 and 23 of the Mexican regulations for clinical studies (42), the ethics committee approved using the verbal consent of participants. Furthermore, testing took place in a science museum where the interactive participation of visitors of all ages in such tests or demonstrations is encouraged. Testing did not involve physical intervention or have treatment consequences. Subjects were fully informed about the purpose and methods of the study and anonymity was assured.

Test Procedure

Subjects were tested in a 4 m² ventilated cabin designed for human olfactory testing. After obtaining subjects' informed consent, their age, sex, smoking history, years of schooling, occupation and city area of residence were recorded (Table 1). We only included recruits who reported not to have smoked, eaten or consumed any beverage other than water for at least 30 min before the test. Their olfactory performance was then evaluated using a slightly modified version of the standard Sniffin' Sticks test battery (see below); three odorants (licorice, green apple, and turpentine) were dropped from the identification test because we have previously found these to be unfamiliar to Mexicans and therefore largely unidentifiable (23,25). Each subject was tested in a single session lasting a maximum of 30 min.

Olfactory Performance

Odorants were presented to blindfolded subjects (except for the identification test, see below) and performance scored following an established procedure (19–21,23–25). Odorants were presented in felt-tipped marker pens (Sniffin' Sticks; Figure 1) filled with 4 mL of liquid odorant or odorant dissolved in odorless propylene glycol. At the time of testing, the cap was removed by the experimenter who

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