FEASIBILITY OF A CULTURE-SPECIFIC MOROCCAN SMELL IDENTIFICATION TEST (MOROSIT): A PROPOSAL USING THE CASE OF PARKINSON DISEASE

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Abstract

Introduction: No culture-specific standardized olfactory tests exist in Morocco as yet. Olfactory problems are frequent in Parkinson disease.

Aim: To show the feasibility of investigating olfactory impairment using culture-relevant products (indigenous plant extracts) as a preliminary to the creation of a standardized olfactory test.

Method: Analytical cross-sectional study on a group of 69 patients with Parkinson disease, and a group of 66 healthy volunteers, in order to assess odor threshold, odor identification, and odor discrimination in both groups using *Mentha pulegium* and *Lavandula latifolia* extracts.

Results: We observed an increased mean of odor detection threshold in patients compared to healthy subjects (p<0.001). A significant difference was also found in the ability to discriminate odors; a higher number of patients were unable to distinguish between odors (p<0.001). Regarding the odor identification test, 70% of healthy subjects versus 36% of patients were able to correctly identify the test products. The difference was statistically significant (p<0.001).

Conclusions: Our study points to the potential of using indigenous products — with which patients are familiar — in the elaboration of a standardized smell identification screening battery.

Keywords: *Parkinson disease, olfaction, sniff test, indigenous plants, Mentha pulegium, Lavandula latifolia.*

Introduction

The interest in olfaction in neurodegenerative diseases has been on a steep rise in recent years.[1] Several studies have assessed the viability of olfaction tests as markers for Parkinson disease. The different approaches used include psychophysical tests, psychophysiological tests, electrophysiological measures and neuroimaging.[2–4] Of these, psychophysical tests are probably the most widely used.[5] The University of Pennsylvania Smell Identification Test (UPSIT, Sensonics, Inc., Haddon Heights, New Jersey), developed in the early 1980s, and known commercially as the Smell Identification Test, is the psychophysical test applied to a greater extent. It allows for evaluating odor identification using 40 microencapsulated odorants located next to forced-choice questions.[6]

Besides, olfactory tests are of clinical utility beyond the domain of neurodegenerative diseases. Brain trauma and Kallmann syndrome are other neurological conditions where olfaction could be impaired.[7,8] In fact, these tests are used in areas other than neurology, as oto-rhino-laryngologists may use them for patients presenting allergies or oral and nasal issues.[9] Unfortunately, no such test has been elaborated in Morocco.

The aim of our study is to investigate the feasibility of using indigenous plants extracts generated in our laboratory, en lieu of commercial exotic tests, to detect olfactory impairment in patients with Parkinson disease. Olfactory dysfunction is quite frequent in Parkinson disease; with an estimated prevalence of 50 – 90%. The ease of assessing olfactory dysfunction has made it a promising biomarker for the disease. However, studies have shown that assessment results are skewed by cultural factors thus creating the need for more culturally-specific tests. Since no such tests exists in our setting, we seek to use culture-relevant products to assess these impairments.

This should serve as a preliminary investigation toward a more sophisticated, population-validated Moroccan Smell Identification Test (MoroSIT).

Patients and Methods

Design
The present study is a cross-sectional analytical investigation conducted in the Movement Disorders Unit of the Neurology Department at the Mohammed VI University Medical Center of Marrakesh, in Morocco.

Participants
The participants comprised a group of 69 patients with Parkinson disease and another group of 66 healthy individuals. Patients were diagnosed with Parkinson disease based on the UK Parkinson disease brain bank criteria at least 6 months prior to the study, and were recruited during consultations in the Movement Disorders Unit. All patients were on L-dopa.

Non-Parkinsonian participants had to be aged over 30, nonsmokers, have no cognitive impairment or a history of brain trauma, stroke or encephalopathy, or any known neurological or non-neurological condition, and no known allergies.

Material and Methods

Three variables were studied: i) odor threshold, ii) odor identification, and iii) odor discrimination.

Test products
The products used were plant extracts produced in the biochemistry laboratory of the Faculty of Medicine and Pharmacy of Marrakesh. Two plants were used: *Mentha pulegium* and *Lavandula latifolia*. Essential oils from these plants are readily available and widely used in Moroccan households as disinfectants, perfumes and balms.

Aerial parts of *Mentha pulegium* and *Lavandula latifolia* were dried at room temperature and sheltered from light and humidity. The essential oils of plant samples were extracted during 2 hours by hydrodistillation using a Clevenger-type apparatus. Fifty percent NaCl was added, and then the supernatant was collected and dried over anhydrous sodium sulphate. The extracts were sealed in dark glass vials and stowed away from heat and light in a refrigerator at 4°C until use.

Various concentrations of essential oils were obtained for each plant. The ratios of extract to distilled water tested were 1:1, 1:10, 1:32, 1:100 and 1:320. Mixtures were then imbibed in Whatman filter paper strips for the tests.

Test sessions
Tests were conducted in a specially prepared consultation room in the Neurology Department. The room was calm and well aerated. Patients were supposed to abstain from food and drink at least half an hour before the session. The researcher washed his hands without soap, and used non scented gloves.

Each test strip was presented to participants, without visual information, 2 cm from their nostrils, for 3-4 seconds.[10,11] The subjects were then required to sniff no more than twice. Enough time was allowed between each test.

Statistical analyses
The analyzed variables were demographic (age, sex, level of education, residence) and test-specific (odor detection threshold, odor discrimination, odor identification).

For odor threshold, test strips were presented to participants, starting from the lowest to the highest concentration. The lowest concentration at which the subject detects the odor is the odor threshold. Patients were presented alternatively with test strips and blank strips as controls. Correct (+) and wrong (-) responses were recorded.

For odor discrimination, three sets of tests were presented to subjects. Each one comprised a triplet of strips presented in tandem: two mentholated strips and one lavender strip. A correct response (+) required correctly identifying all three odors, otherwise, response was considered wrong (-).

For odor identification, the highest concentrations of the two test products were presented to subjects. Correct (+) and wrong (-) responses were recorded.

Data were collected in Excel spreadsheet. Analysis was performed using SPSS® version 21 (SPSS Inc., Chicago, USA) for Windows®.

Results for threshold, discrimination and identification were compared between patients and healthy subjects. A p-value equal or less than 0.05 was admitted as statistically significant.

Ethics
The study was evaluated and validated by the Ethics Board of the Faculty of Medicine and Pharmacy of Marrakesh. Participants in the present study gave written consent before inclusion in the study.

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Results

Demographic data
Our cohort comprised a group of 69 Parkinson disease patients and a group of 66 healthy subjects (Table 1).

Table 1. Demographic characteristics of participants

	Parkinson disease patients	Healthy participants	p-value
Total	69	66	
Male/ female (%)	46/23 (66%/34%)	22/44 (33%/67%)	0.0001
Mean age (years)	59.6±12.4	46.0±11.2	<0.0001
Rural dwelling	39 (57%)	15 (23%)	<0.0001

Test data
We found an increased threshold for odor detection in patients compared to healthy participants (p<0.001). On average, patients required concentrations over 16 times higher than those detected by healthy participants (Figure 1).

A statistically significant difference was found in the ability to discriminate between the two odors; more patients were unable to distinguish between odors (p<0.001) (Figure 2).

For the odor identification test, 70% of healthy participants versus 36% of patients were able to correctly identify the test products. The difference was statistically significant (p<0.001), (Figure 3).
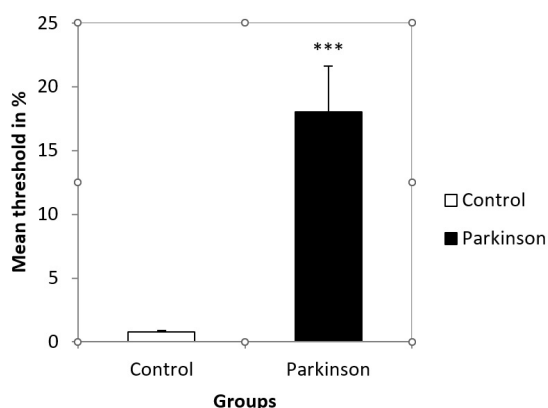

Figure 1. Comparison of detection threshold between healthy subjects and patients. Parkinsonian subjects had an increased mean detection threshold compared to healthy subjects, requiring solutions over 16 times more concentrated to detect odors (p<0.001).
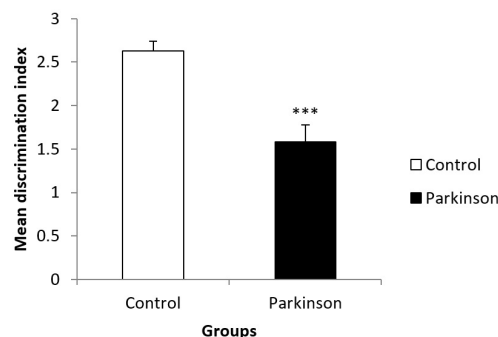

Figure 2. Comparison of discrimination index between healthy subjects and patients. Parkinsonian subjects exhibited decreased mean discrimination index compared to healthy subjects, with relatively more patients being unable to discriminate between odors (p<0.001).
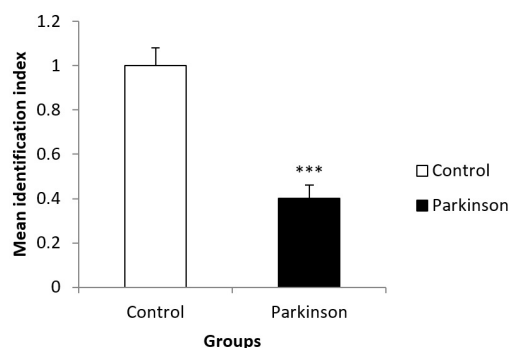

Figure 3. Comparison of identification index between healthy subjects and patients. Parkinsonian subjects exhibited decreased mean identification index compared to healthy subjects, with more patients being unable to discriminate between the two odors (p<0.001).

Discussion

The present study shows the possibility of using culture-relevant products (*Mentha pulegium* and *Lavandula latifolia*) to detect olfactory impairment in Parkinson disease compared to healthy subjects. The relevance of these plants to the Moroccan context stems from their ubiquity and pervasive use in households, beauty products and even food; it is expected that every Moroccan should know these fragrances, hence their utilization in the present study.

One of the challenges of the use of psychophysical smell tests is the variable complex interactions of several aspects of cognition in its execution. This makes comparability difficult between tests.[12,13] Furthermore, differences in culture and language could render cross-cultural usability difficult.[14]

Studies using the UPSIT in different cultural contexts have reported varying results. While some studies found no differences from standard normative values, others largely veer from these, rendering the utility of these measures questionable in some cultural contexts. Jiang et al found in a Taiwanese sample that a traditional Chinese version rendered relatively higher scores than the American UPSIT version.[15] In turn, Fornazieri et al reported slightly lower values than those of North American norms, but with a similar change pattern in age categories.[16] Concerns have been raised in several other cultural contexts.[17,18]

These discrepancies have led to the formulation of a cross-cultural smell Identification Test (CC-SIT) based on items from the University of Pennsylvania Smell Identification Test (UPSIT). Authors selected UPSIT items that were familiar to most persons from North American, European, South American, and Asian cultures.[19] Unfortunately, no specific Arab or African representation was included in the paper. This suggests an insufficiently "cross-cultural" Smell Identification Test and stresses the need for the development of testing based on culture-specific items. The study by Alrhman et, who used common items like tea, garlic, cinnamon, cacao, coffee, sage, and tobacco, allowed them to evaluate olfaction impairment in patients with a history of sinonasal disease.[20] A similar research was done by Hsu et al of the Taiwanese population.[21] Ogihara et al produced a modified Japanese version of UPSIT (UPSIT-J), and replaced some of the test items with more culturally familiar items.[22]

The foregoing notwithstanding, it is important to point out the extant variations in the reliability in olfactory tests. This requires caution in comparing findings from nominally different olfactory tests[12] Furthermore, it is primordial to highlight that a person's cognitive profile influences their test performance.[13]

Conclusion

In our context, no culture-specific standardized tests exist as yet. Our study points to the potential for the elaboration of a standardized screening battery using indigenous products with which patients are familiar. Further research is required to better characterize the diagnostic potential for the screening of olfactory impairment in Parkinson disease using indigenous products.

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Declarations of interest

The authors declare that they have no competing interests.

Author contributions

Mohamed Chraa: Conceptualization, methodology, validation, formal analysis, investigation, review and editing. **Hanane Imizgue**: Methodology, formal analysis, investigation, original draft, review and editing. **Raymond Klevor**: Conceptualization, methodology, formal analysis, investigation, original draft, review and editing. **Najib Kissani**: Conceptualization, methodology, validation, formal analysis, investigation, review and editing, supervision.

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