

RHINOLOGY

Development of a questionnaire to investigate socio-cultural differences in the perception of smell, taste and flavour

Sviluppo di un questionario per indagare le differenze socio-culturali nella percezione di olfatto, gusto e sapore

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SUMMARY

Objectives. Clinical experience and daily life indicate that the importance of smell, taste and flavour is variable among individuals. Therefore, the aim of this research was to develop a questionnaire to investigate the importance attributed to smell, taste and flavour and socio-cultural differences among individuals.

Methods. Cross-cultural adaptation of the questionnaire was executed by two professional translators and one bilingual investigator and pre-tested on a pilot group of 25 subjects with normal smell and taste abilities. The final version of the questionnaire was sent by e-mail to 850 healthy subjects. The Google form consisted of three parts: “*The importance of olfaction*” developed by Croy et al. in 2010, “*The importance of taste and flavour*” developed by our team and a section to collect demographic data. The questions were classified into “*association*”, “*application*”, “*consequence*” and “*aggravation*”. Statistical differences were assessed using *t*-test with $p \leq 0.05$. Correlations were calculated using Spearman’s test. Internal consistency was assessed using the Cronbach’s Alpha, while test-retest reliability was analysed by calculating the Intraclass Correlation Coefficients (ICC2k).

Results. The questionnaire received a non-response rate of 10.7%. Calculation of Cronbach’s alpha showed good internal reliability ($\alpha = 0.87$). Test-retest evaluation was satisfactory for all subscales, with an overall ICC2k = 0.84 (CI 0.79-0.89). Statistical analysis showed that smell, taste and flavour appeared to be more important for women when compared to men ($p < 0.001$). No statistical differences were seen between individuals with various educational background ($p > 0.05$), and the importance of smell ($r = 0.16$; $p < 0.01$), taste and flavour ($r = 0.08$; $p < 0.05$) did not decline with age.

Conclusions. The development of this original test provides an overview into the importance of smell, taste and flavour among individuals. Although further research is needed, it can help in the evaluation and investigation of aspects that influence people to seek medical attention in the presence of sensory alterations.

KEY WORDS: olfaction, taste, olfactory disorders, quality of life, statistics

RIASSUNTO

Obiettivo. L’esperienza clinica e la vita quotidiana mostrano come l’importanza attribuita al senso dell’olfatto, del gusto e del sapore siano variabili nella popolazione. L’obiettivo di questo studio è stato, pertanto, quello di sviluppare un questionario per indagare l’importanza attribuita a questi sensi e le differenze socioculturali esistenti tra gli individui.

Metodi. L’adattamento interculturale del questionario è stato eseguito da due traduttori professionisti e un ricercatore bilingue e pretestato su un gruppo pilota di 25 soggetti con normali capacità olfattive e gustative. La versione finale del questionario è stata inviata via e-mail a 850 soggetti sani. Il Google form era composto da tre parti: “L’importanza dell’olfatto” (Croy et al., 2010), “L’importanza di gusto e sapore” creato dal nostro gruppo, e un modulo per l’inserimento dei dati demografici. Le domande sono state suddivise in 4 classi: “associazione”, “applicazione”, “conseguenza” e “gravità”. Per l’analisi sta-

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Conflict of interest

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tistica è stato utilizzato il test *t* considerando come significative differenze con $p \leq 0,05$. Le correlazioni sono state calcolate con il test di Spearman. La coerenza interna è stata valutata utilizzando l'Alpha di Cronbach, mentre l'affidabilità del test-retest è stata analizzata calcolando i coefficienti di correlazione intra-classe (ICC2k).

Risultati. Il tasso di non risposta del questionario è stato pari al 10,7%. Il calcolo dell'Alpha di Cronbach ha evidenziato una buona affidabilità interna ($\alpha = 0,87$). Inoltre, la valutazione del test-retest è stata soddisfacente per tutte le scale, con un ICC2k complessivo pari a 0,84 (CI 0,79-0,89). L'analisi statistica ha evidenziato che: olfatto, gusto e sapore sono risultati più importanti per le donne rispetto agli uomini ($p < 0,001$); non sono state evidenziate differenze statisticamente significative tra individui con diversi titoli di studio ($p > 0,05$); l'importanza attribuita all'olfatto ($r = 0,16$; $p < 0,01$), così come quella al gusto e al sapore ($r = 0,08$; $p < 0,05$), non è diminuita con l'aumentare dell'età degli intervistati.

Conclusioni. Lo sviluppo di questo nuovo questionario fornisce una panoramica completa sull'importanza attribuita al senso dell'olfatto, gusto e sapore e sulle differenze socio-culturali esistenti tra gli individui. Sebbene ulteriori studi siano necessari, potrebbe essere di aiuto nel comprendere quali aspetti influenzano gli individui nel cercare o meno una consulenza medica in presenza di alterazioni sensoriali.

PAROLE CHIAVE: olfatto, gusto, disturbi olfattivi, qualità della vita, statistica

Introduction

The use of questionnaires and clinical E-Surveys has become increasingly popular in medicine in the last few years, not only for research purposes, but also as diagnostic instruments. In the field of smell and taste disorders, subjective patient-reported olfactory assessment should be undertaken as a first level evaluation before proceeding with psychophysical olfactory tests¹. Validated questionnaires and recognised forms of assessment exist in rhinology; they predominantly focus on sinonasal symptoms², olfactory dysfunction and quality of life³, while giving more limited attention to taste complaints. Another type of questionnaire was developed by Croy et al.⁴ to provide a gauge of the individual importance of olfaction. Clinical experience and daily life show that the consideration of smell, taste and flavour varies among individuals. Interestingly, the importance of olfactory and gustatory function seems to vary not only within the general population, but also among patients with sensory impairment, who may or may not choose to pursue medical counselling⁵.

Therefore, the aim of this research was to develop a questionnaire to investigate the importance attributed not only to the sense of smell, but also to taste and flavour, and the socio-cultural differences among individuals.

Materials and methods

The study was conducted from June 2017 to March 2018 and was compliant with the Checklist for Reporting Results of Internet E-Surveys (CHERRIES)⁶. The Institutional Review Board of the University of Foggia Department of Otolaryngology approved this study. The questionnaire was translated into Italian and English and uploaded to Google Drive.

Inclusion and exclusion criteria

Recruitment was directed to male and female subjects aged ≥ 18 , with intact reading comprehension abilities and

normal cognitive function [mini mental state examination (MMSE) score ≥ 26 for subjects aged between 18 and 64 years and ≥ 24 for subjects older than 65⁷]. Subjects assessed the severity of their nasal symptoms by answering the Sino-Nasal Outcome Test (SNOT-22) questionnaire in order to limit the possibility of any pre-existing sino-nasal disorder that might influence the chemical senses of the population; subjects with a baseline score ≤ 10 ⁸ were consequently included.

There were no exclusion criteria related to sex, race, gender or ethnicity, while subjects meeting any of the following criteria were excluded:

- history of Ear, Nose and Throat (ENT) diseases or pre-existing smell/taste disorders;
- previous airway surgery (i.e., septoplasty, turbinoplasty, sinus surgery etc.);
- presence of upper respiratory tract infection (URTI);
- history of neuropsychiatric disorders (i.e., Parkinson's disease, Alzheimer's disease, multiple sclerosis, depression, eating disorders etc.);
- previous major head trauma;
- history of significant comorbidities, such as severe hypertension, poorly controlled diabetes mellitus, rheumatic or autoimmune disease;
- concurrent treatment or medication that may interfere with olfactory/gustatory function;
- history of drug or alcohol abuse;
- history of smoking 20 or more cigarettes/day⁹.

Development of the questionnaire

Cross-cultural adaptation of the questionnaire was executed by two professional translators and one bilingual investigator speaking Italian and English. Three Otolaryngologists, well acquainted with the topic involved, further improved the preliminary version obtained. A new version including all the suggestions was forwarded to the translators to execute the back-translation into Italian. Finally, the expert group developed a consensus version of the instrument¹⁰.

As a last step, the tool was pre-tested on a pilot group of 25 subjects with normal smell and taste abilities confirmed by Sniffin' sticks and taste strips tests (Burghart®) who fulfilled the inclusion criteria mentioned in the previous section to check for comprehensibility, redundancy and consistency of its items, including technical usability and functionality of the electronic platform.

The Google form consisted of three screens presenting the following questionnaires:

1. "Importance of olfaction" (IO-Q), developed by Croy et al. ⁴ to evaluate the subjective importance attributed to the sense of smell (Tabs. I, II). For this questionnaire an Italian version validated by the Italian Academy of Rhinology (IAR) already existed and was adopted.
2. "Importance of taste and flavour" (ITF-Q), created by our group to evaluate the subjective importance attributed to taste and retronasal smell (Tabs. I, II).
3. "About you", a section for collecting demographic data (age, sex, nationality, education).

Based on the questionnaire by Croy et al. ⁴, the items in the questionnaire "The importance of taste and flavour" (ITF-Q), were classified into four groups: "association" with sensations, "application" of the sense, ability to draw "consequences" from the olfactory and gustatory perception, and tendency to "aggravate" the importance of sensory loss. The first and second page consisted of 18 personal statements referring to one of the four mentioned subscales. The subjects attributed a score of 1 to 4 to indicate how much they agreed with the statement ("I totally agree" to "I totally disagree"). They were unaware of which scale the items belonged to. The third page consisted of a simple module in which the subject manually entered his or her age, country of origin, sex and education level.

After a preliminary meeting, during which eligibility of individuals to participate was established, informed consent was obtained and instructions and purpose of the research explained, the link was sent by e-mail to a sample of 850 people. The cohort comprised health workers, university and college students including international/exchange students, visitors to our University Hospital or patients' relatives who consented to be enrolled in this study. The "jellybean flavour experiment" was used to explain the not intuitive difference between taste and flavour to participants during the preliminary meeting [e.g.: close your eyes, pinch your nose with your hand and put a jellybean in your mouth. You should be able to perceive the taste (i.e., sweet), but only if you release your hand, will you be able to distinguish the correct flavour (i.e., strawberry)]. Before submitting the questionnaire, a mandatory completeness check highlighted the missing response items. Answers were automatically captured and stored in an electronic spread-

sheet (Excel, Microsoft, 2011). In order to prevent multiple entries from the same individual, users were required to register first. The username was stored together with the survey results and later eliminated. The spreadsheet was stored and protected by unique passwords and kept on a secure, restricted network drive. Only the principal investigator and authorised study personnel had access to the files. No incentives were offered to complete the survey.

Reproducibility of the questionnaire

The reproducibility of the questionnaire was evaluated using internal consistency and test-retest reliability. Internal consistency was considered acceptable in case of Cronbach's alpha values between 0.7 and 0.9. Additionally, 50 patients in the study group were randomly selected for assessment of test-retest reliability. In this cohort, the questionnaire was administered twice, after an interval of one month, without any possibility for participants to look at the answers given the first time. Test-retest reliability was assessed through Intraclass Correlation Coefficients (ICC2k) and considered acceptable with a minimum test-retest correlation coefficient of 0.7.

Statistical analysis

Descriptive statistics were performed to characterize responses to the survey. Qualitative data were summarised as percentages. The assessment of significant differences across the means of continuous variables relied on t-tests for independent samples, with those values with $p \leq 0.05$ were considered significant. To assess the distribution of the variables, Bartlett's test was used. The correlations were calculated using the Spearman test and Spearman's rho was also calculated. Internal consistency was assessed using Cronbach's alpha, while test-retest reliability was analysed by calculating the ICC2k. All analyses were performed using STATA-MP software, version 15 for Mac OS X.

Results

Overall, 759 of 850 subjects answered the questionnaire with a non-response rate of 10.7%. Calculation of Cronbach's alpha showed good internal reliability ($\alpha = 0.87$). Test-retest evaluation was also satisfactory for all the subscales, with an overall ICC2k = 0.84 (CI 0.79-0.89). Of the responders, 460 (60.6%) were female, 299 (30.4%) were male, 508 (66.9%) were college graduates, 231 (30.4%) were high-school graduates and 20 (2.7%) were secondary school graduates. By country of origin, 653 (86%) were Italian and 106 (14%) were non-Italians; among this group, 64 (8.4%) were from other European countries, 12 (1.6%) were from Africa, 21 (2.7%) from

Table I. (A) "Importance of olfaction" questionnaire (IO-Q, Croy et al., 2010⁴); (B) "Importance of taste and flavour" questionnaire (ITF-Q) by our group in the English language with reference to the subscales.

(A) Importance of olfaction					
<i>This questionnaire refers to the role your sense of smell plays in your daily life. Please answer all of the questions spontaneously, there are no right or wrong answers.</i>					
Scale		4	3	2	1
		I totally agree	I mostly agree	I mostly disagree	I totally disagree
Ass	The smell of a person plays a role in the decision whether I like him/her.				
App	I smell foods to find out whether it is spoiled or not.				
App	I sniff food before eating.				
Con	Please imagine you visit a museum. There is an offer to get additionally smell-presentations to underline the overall impression for the price of 2. Would you take this offer?				
Con	When I don't like the smell of a shampoo, I don't buy it.				
Ass	When I smell delicious food, I'm getting hungry.				
Agg	Without my sense of smell, life would be worthless.				
Con	I try to locate the odour, when I smell something.				
Ass	I feel rather quickly disturbed by odours in my environment.				
Ass	Certain smells immediately activate numerous memories.				
App	Before drinking coffee/tee, I intentionally smell it.				
App	When I buy tomatoes, I pay attention to their odour.				
Con	If my partner has a nasty smell, I avoid kissing him.				
Ass	Certain smells immediately activate strong feelings.				
App	I smell my clothes to judge whether I have to wash them or not.				
Con	When there is a nasty smell in the office/apartment of a colleague, I leave the room as soon as possible.				
Ass	Certain odours can stimulate my fantasy.				
Agg	To me it is more important to be able to smell than to be able to see or hear.				
App	Sometimes I smell a person (e.g., my partner or my child) to judge, if he/she has drunken alcohol or smoked.				
Con	I cannot pass good smelling candles in a store without buying one.				
(B) Importance of taste and flavour					
<i>The questionnaire refers to the role your sense of taste plays in your daily life. Please answer all of the questions spontaneously. There are no right or wrong answers.</i>					
Scale		4	3	2	1
		I totally agree	I mostly agree	I mostly agree	I mostly disagree
App	I taste a food to find out whether it is spoiled or not.				
Ass	Kissing a partner with a bad breath does not please me.				
Con	Please imagine you go to a restaurant. There is the chance to participate in a tasting session at an additional cast of 10€. Would you take this offer?				
Agg	To me it is more important to be able to taste than to be able to see or hear.				
App	I taste a food before buying.				
Ass	After taking a first bite of a delicious food, my appetite to eat gets stronger.				
Con	When I don't like the taste of a toothpaste, I don't buy it.				
Agg	Without my sense of taste, life would be worthless.				
App	When I kiss my partner, I am able to understand whether he/she drank or smoked.				
Ass	I feel rather quickly disturbed by a food that I don't like.				

continues ►

Table I. (B) follows.

B) Importance of taste and flavour		<i>The questionnaire refers to the role your sense of taste plays in your daily life. Please answer all of the questions spontaneously. There are no right or wrong answers.</i>			
Scale		4	3	2	1
		I totally agree	I mostly agree	I mostly agree	I mostly disagree
Con	If my partner has a bad breath, I don't kiss him/her.				
App	After cooking/before serving pasta, I taste it to find out whether it is salty or not.				
Ass	Certain tastes/flavours evoke a lot of memories.				
Con	If I don't like the food I tasted in a restaurant, I do not go back a second time.				
App	I taste food with my eyes closed and I am able to understand what it is.				
Ass	Certain tastes/flavours immediately activate strong feelings.				
Con	I absolutely have to buy a food I enjoy after tasting it.				
App	I often taste first only a little piece of a food to judge whether I want to eat more of it or not.				
Ass	Certain tastes/flavours can stimulate my imagination.				
Con	If I taste a food I don't like, I feel the need to spit it as soon as possible.				

Table II. (A) "Importance of olfaction" questionnaire (IO-Q, Croy et al., 2010⁴); **(B)** "Importance of taste and flavour" questionnaire (ITF-Q) by our group in the Italian language with reference to the subscales.

A) Importanza dell'olfatto		<i>Questo questionario si pone l'obiettivo di comprendere il ruolo che il senso dell'olfatto gioca nelle nostre vite quotidiane. Si prega di rispondere a tutte le domande con la massima sincerità tenendo presente che non esistono risposte giuste o sbagliate.</i>			
Scala		4	3	2	1
		Sono completamente d'accordo	Sono tendenzialmente d'accordo	Sono tendenzialmente in disaccordo	Sono completamente in disaccordo
Ass	L'odore di una persona gioca un ruolo fondamentale nel decidere se mi piaccia o meno.				
App	Annuso il cibo per capire se sia avariato o meno.				
App	Annuso il cibo prima di mangiarlo.				
Con	Immagini di visitare un museo. Con una spesa aggiuntiva di 2 € c'è la possibilità di partecipare a un'esperienza sensoriale di tipo olfattivo. Accetterebbe l'offerta?				
Con	Quando non mi piace l'odore di uno shampoo non lo compro.				
Ass	Quando percepisco l'odore di buon cibo mi viene fame.				
Grav	La mia vita perderebbe di valore senza il senso dell'olfatto.				
Con	Quando percepisco un odore, cerco di capire da dove provenga.				
Ass	Mi sento disturbato molto rapidamente da odori nel mio ambiente.				
Ass	Alcuni odori mi evocano nella mente numerosi ricordi.				
App	Annuso the o caffè prima di berli.				

continues ►

Table II. (A) follows.

A) Importanza dell'olfatto	
<i>Questo questionario si pone l'obiettivo di comprendere il ruolo che il senso dell'olfatto gioca nelle nostre vite quotidiane. Si prega di rispondere a tutte le domande con la massima sincerità tenendo presente che non esistono risposte giuste o sbagliate.</i>	
Scala	
	4
	3
	2
	1
	Sono completamente d'accordo
	Sono tendenzialmente d'accordo
	Sono tendenzialmente in disaccordo
	Sono completamente in disaccordo
App	Quando acquisto dei pomodori presto attenzione al loro odore.
Con	Se il mio/la mia partner ha un cattivo odore evito di baciarlo/a.
Ass	Alcuni odori mi scatenano immediatamente forti emozioni.
App	Annuso i miei vestiti per decider se lavarli o meno.
Con	Quando c'è un cattivo odore nell'appartamento/ufficio di un collega, lascio la stanza il più velocemente possibile.
Ass	Alcuni odori possono stimolare la mia fantasia.
Grav	Per me è più importante avere il senso dell'olfatto che quello della vista o dell'udito.
App	A volte annuso una persona (es. il mio partner o mio figlio) per capire se abbia fumato o bevuto alcolici.
Con	Ogni volta che in un supermercato sento la fragranza di una candela profumata devo acquistarla.

B) Importanza del gusto/sapore	
<i>Questo questionario si pone l'obiettivo di comprendere il ruolo che il senso del gusto gioca nelle nostre vite quotidiane. Si prega di rispondere a tutte le domande con la massima sincerità tenendo presente che non esistono risposte giuste o sbagliate.</i>	
Scala	
	4
	3
	2
	1
	Sono completamente d'accordo
	Sono tendenzialmente d'accordo
	Sono tendenzialmente in disaccordo
	Sono completamente in disaccordo
App	Assaggio un cibo per capire se è avariato o meno.
Ass	Non trovo piacevole baciare un partner con un cattivo alito.
Con	Parteciperei ad una degustazione in un ristorante con una spesa aggiuntiva di 10 €.
Grav	Ritengo più importante il senso del gusto che la vista o l'udito.
App	Assaggio un cibo prima di comprarlo.
Ass	Dopo aver assaggiato un pezzetto di un cibo delizioso il mio appetito cresce.
Con	Se il gusto/sapore di un dentifricio non mi piace, non lo compro.
Grav	Senza il senso del gusto la mia vita sarebbe priva di senso.

continues ►

Table II. (B) follows.

B) Importanza del gusto/sapore		4	3	2	1
Questo questionario si pone l'obiettivo di comprendere il ruolo che il senso del gusto gioca nelle nostre vite quotidiane. Si prega di rispondere a tutte le domande con la massima sincerità tenendo presente che non esistono risposte giuste o sbagliate.		Sono completamente d'accordo	Sono tendenzialmente d'accordo	Sono tendenzialmente in disaccordo	Sono completamente in disaccordo
App	Nel baciare il mio/la mia partner, sono in grado di capire se ha bevuto o fumato.				
Ass	Mi sento disturbato molto rapidamente da un cibo che non mi piace.				
Con	Se il mio/la mio/a partner ha un cattivo alito, non mi viene voglia di baciarlo/a.				
App	Prima di servire la pasta, la assaggio per capire se è salata o meno.				
Ass	Alcuni gusti/sapori rievocano in me numerosi ricordi.				
Con	Se il cibo mangiato in un ristorante non mi piace, non ci torno.				
App	Assaggio il cibo ad occhi chiusi e capisco di cosa si tratta.				
Ass	Alcuni gusti/sapori suscitano in me forti emozioni.				
Con	Devo assolutamente comprare un cibo che mi piace dopo averlo assaggiato.				
App	Mi capita spesso di assaggiare prima un pezzetto di un cibo per capire se voglio mangiarne di più o no.				
Ass	Alcuni gusti/sapori possono stimolare la mia fantasia.				
Con	Se assaggio un cibo che non mi piace, sento l'esigenza di sputarlo il prima possibile.				

Asia, 7 (0.9%) from North America and 2 (0.3%) from South America. The average age was 35.4 years, while the median was 29 (range: 18-80 years).

Figure 1 shows the results on the comparison between average scores. The results revealed that women reported significantly higher scores ($p < 0.05$) than men in all subscales (*association, application, consequence, aggravation*) of both questionnaires (IO-Q, ITF-Q). College graduates showed higher scores than high school graduates in every subscale, but the difference between the variables reached significance ($p < 0.05$) only in two subscales (*association* in the IO-Q and *consequence* in the ITF-Q). Lastly, there was a positive and significant correlation (Fig. 2) between age and importance of smell ($r = 0.16$; $p < 0.01$) and between age and importance of taste ($r = 0.08$; $p < 0.05$).

Discussion

This study constitutes a preliminary investigation into socio-cultural differences in the importance attributed to sensory perception in the general population, not only regarding olfaction as in previous literature^{4,11}, but also with respect to gustatory function.

There appears to be wide variability in the importance that olfactory sensations play in individuals' lives. This variability must be viewed and understood by otolaryngologists and others both in the context of the everyday lives of individuals and in society as a whole. Odours can activate memories, affect social relationships and arouse sexual drive, purchasing decisions and dietary behaviours, and influence our mood and attitude towards being and objects^{12,14}. While these findings have scientific support, they are not universally true; nor do they affect all individuals with equal intensity. Clinically, the condition of anosmia

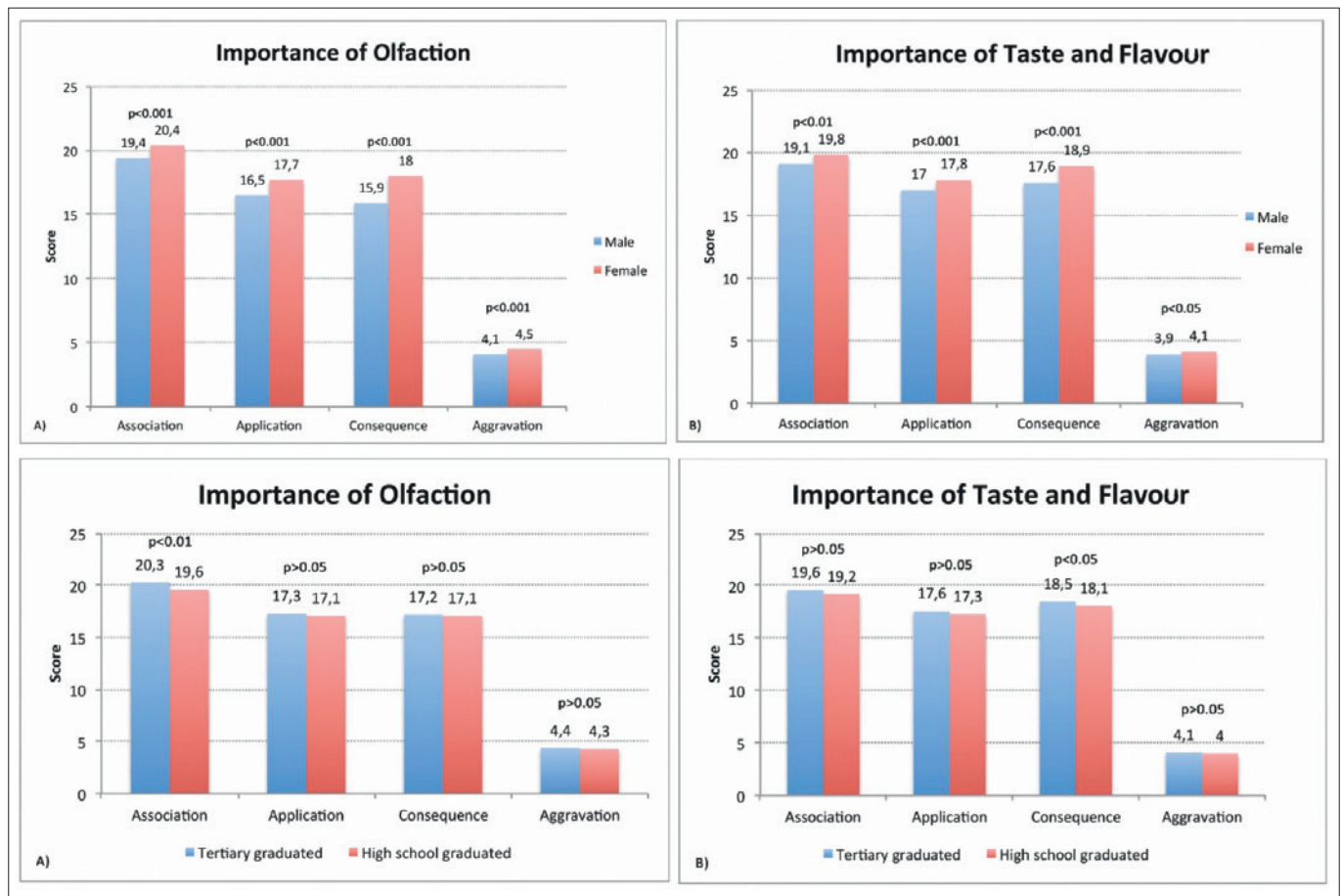


Figure 1. Importance of olfaction (A), taste and flavour (B) in male vs female subjects (upper figure), and in tertiary educated vs high school educated (lower figure).

can be kept private⁴ in contrast with other sensory disorders such as hearing impairment¹⁵. According to Merkonidis et al.¹⁶ who published the results from a survey about the characteristics of chemosensory disorders, the greatest number of complaints related to a decrease in eating enjoyment followed by a decrease in overall quality of life. According to Murr et al.¹¹, the assessment of the subjective importance of olfaction is useful to examine the adaptation to olfactory disorders. Questionnaires enable systematic and time efficient collection of medical history. Subjective olfactory assessment should not be undertaken in isolation, but can be completed prior to psychophysical assessment of olfactory function (e.g. “Sniffin’ Sticks”, “University of Pennsylvania Smell Identification Test, UPSIT”) or during the waiting time between clinical examinations^{1,5}.

However, according to the literature, tests about subjective olfactory importance and coping are still rare and are often performed using visual analogue scales, Likert questionnaires, or as part of other outcome assessments¹. The only

validated, internationally used questionnaire focusing on management of smell impairments is the “Questionnaire of Olfactory Disorders” (QOD)³, while the only questionnaires analysing the individual significance of olfaction are the “Odor Awareness Scale” (OAS)¹⁷ and the “Importance of Olfaction Questionnaire” (IO-Q)⁴. In our opinion, the IO-Q has the advantage of taking only limited clinical time both for patients, who have to answer only 20 items compared to 34 on the OAS, and for consultants who can easily draw conclusions by calculating the scores of the different subscales. Moreover, the changing answer format within the OAS may generate confusion in some participants. The greater comprehensibility and lower redundancy of the IO-Q ensure that respondents answer the entire questionnaire appropriately.

For the reasons noted above, our group preferred to make use of this currently available validated questionnaire. The “ITF-Q”, a novel extension of the “IO-Q”, is intended to provide a wide gauge of the importance of taste and fla-

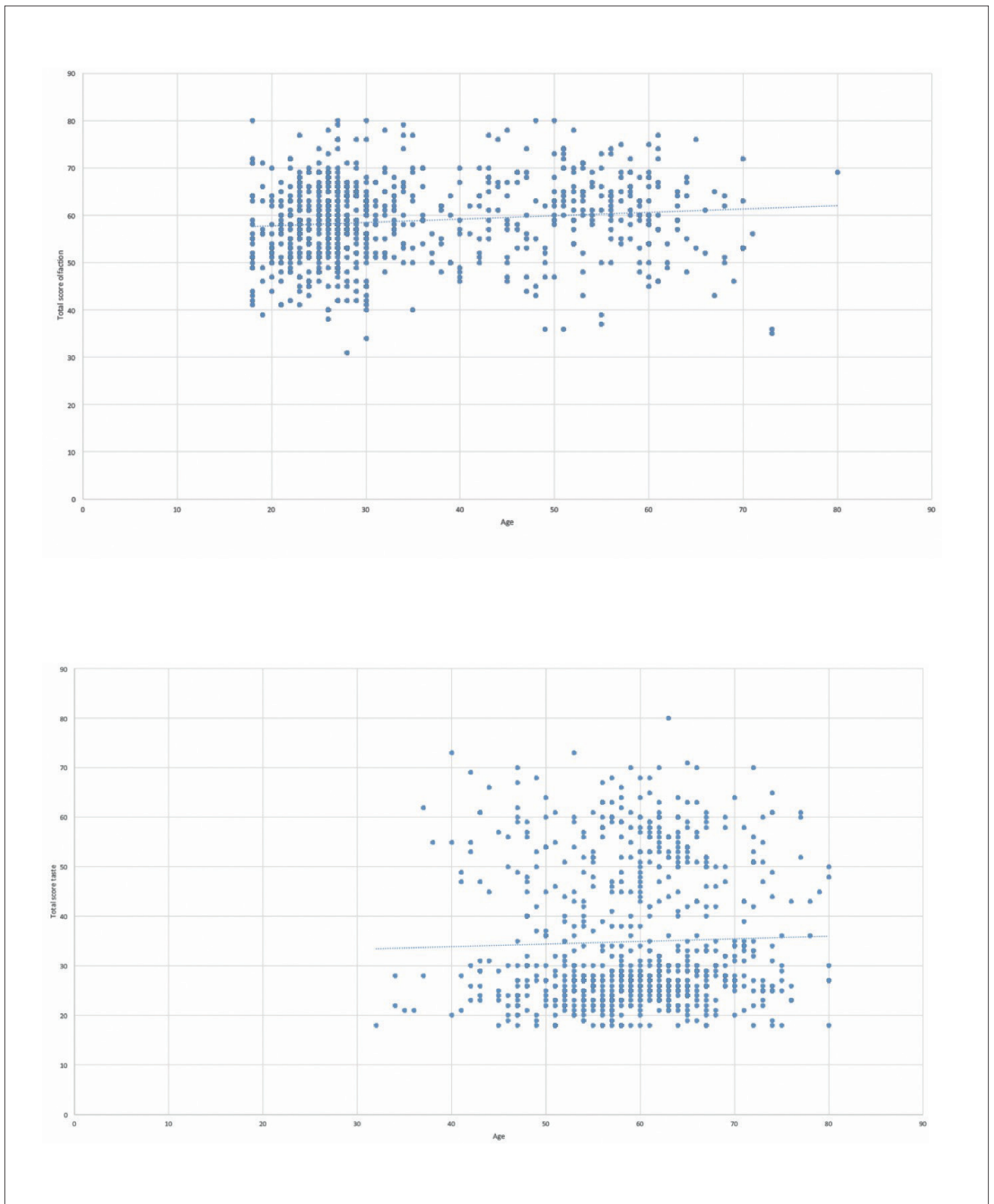


Figure 2. Correlation between total score of the IO-Q and age (upper figure) and between total score of the ITF-Q and age (lower figure).

avour. To the best of our knowledge, questionnaires on the individual importance of olfaction are rare, but even fewer questionnaires on taste have been published. Thus, following a comprehensive review, we decided to propose the first questionnaire on the importance of taste and flavour. Since specific exams evaluating taste and retronasal smell have been validated (e.g., taste strips, retronasal assessment), tests on the subjective importance of gustatory function should also be performed in combination with psychophysical testing.

Designing and pre-testing a questionnaire on taste and flavour immediately revealed a controversial issue. For non-specialists, the words “taste” and “flavour” are essentially equivalent, while the term retronasal smell may be unfamiliar. According to the French physical chemist Hervé This, an expert in molecular gastronomy¹⁸, taste should be considered as a global, synthetic perception, made up of all sensations that a food transmits to us, and which we use to make a judgment. His theory stated that food should stimulate the various sensory receptors involved in vision, odour, taste, trigeminal system and temperature and showed the multisensory experience deriving from our perception of food and drink. Zampini et al.¹⁹ studied the multisensory perception of flavour, specifically analysing its interaction with visual and auditory stimuli. The authors noted that the average individual believes that the flavour of food primarily comes through the taste buds, ignoring the important “nasal” component in the perception of flavour. For the reasons noted above, we preferred to refer to “taste” and the entire eating experience in our questionnaire, rather than speaking of taste, flavour or retronasal smell in scientific terms²⁰.

Analysis of our results indicated that smells, tastes and flavours are more important for women compared to men. This is consistent with a greater sensitivity of women in these areas^{4,11}. Secondly, there were no statistically significant differences in importance in these areas between people with different levels of education. Third, the perception of smells, tastes and flavours tends to deteriorate with age; however, their importance does not seem to decrease⁴.

The individual significance of olfaction was investigated by using the IO-Q by Croy et al. who first presented the survey to 123 individuals attending a scientific conference at the University of Dresden⁴ and then compared the importance of olfaction between patients with smell impairment and healthy normosmic subjects. Murr et al.¹¹ also used the IO-Q to capture the differences between normosmic and dysosmic individuals. Analysis of our results and those of previous studies reveals that women place higher importance on olfaction than men. Croy et al. in 2010⁴ detected this sex-related difference only in the consequence

subscale ($p = 0.013$), while in 2011²¹ normosmic control female individuals presented higher scores on the *application* ($p = 0.003$) and *consequence* ($p < 0.001$) subscales than males. Murr et al.¹¹ demonstrated that the importance of olfaction was highest in the group of young normosmic women aged < 26 years, while there were no sex related significant differences in the other age groups. In our study, we showed an enhanced importance of olfaction in female individuals in each subscale ($p < 0.001$). These results are in accordance with the current literature. The assessment of male physical desirability is highly correlated with the assessment of male body odour attractiveness in women²². While olfactory detection thresholds of pregnant women do not seem to be different from those of controls, many women report heightened smell sensitivity during pregnancy²³. As demonstrated by Minovi et al.²⁴, on a clinical level, sex was a predictor of the outcome of nasal surgery in terms of olfactory function with women reporting a significantly higher benefit from surgery ($p < 0.03$).

Investigating the effects of age, we detected a positive and significant correlation (Fig. 2) between age and the individual importance of olfaction ($r = 0.16$; $p < 0.01$). Croy et al.⁴ noticed the absence of significant correlation between age and the importance of olfaction in the main score and in any of the subscales ($r = 0.0-0.1$). The same group²¹ showed no effect of age on IO-Q scores in normosmic control individuals or patients. As previously noted, Murr et al.¹¹ found enhanced importance of olfaction in the group of young women, but detected no differences in the other age groups. On the other hand, men did not present any variability in importance of olfaction across the different age groups. These findings appear to fit well with Croy's theory⁴ according to which the importance of olfactory function is independent of age. Decreased olfactory function is very common in the elderly, with the $> 50\%$ of individuals aged 65 and 80 years suffering from it. However, the individual importance of olfaction does not appear to decrease throughout life, probably because of the notable effects of age-related olfactory sensory loss on physical well-being, quality of life, nutritional status and everyday safety²⁵.

Education-related variability in the individual importance of olfaction was not investigated in the previous study by Croy et al.⁴ in which the IO-Q was used. The conclusions drawn should be interpreted within the limitations of the sample, presenting a high percentage of college graduates (66.9%) compared to individuals with lower levels of education. In fact, the participating group presented the usual attributes of such voluntary samples, including higher education level⁴ and better awareness of the topic being investigated. However, our results demonstrate that the importance of smell, taste and flavour is the same regardless of

the cultural background. It is worth noting that our sample scored significantly highest the *association* scale, which is related to memories, feelings and judgments guided by the sensory perception⁴. These findings are consistent with the finding that the olfactory pathway is a portion of the palaeocortex, the oldest part of the brain, which generates emotions and accounts for memory. Perception of olfactory sensations is emotionally influenced²⁶; it is ancestral and deeper than the educational and cultural levels of individuals. Moreover, other parameters (i.e., work conditions, hobbies, environments) may modify individual olfactory sensitivity, especially in an era in which great attention is given by media to odour and food culture. For example, perfumers tend to respond more sensitive to odours²⁷ and working in perfume retail shops is associated with increased odour discrimination²⁸. The present study is limited by not having investigated the odour expertise of the subjects included, while behavioural studies on this topic are warranted. Even though Croy et al.⁴ encouraged the use of the IO-Q to study cross-cultural variability in the perception in greater depth, the current and previous literature has not analysed country-related differences in the importance of chemosensation. Our sample had more Italians than individuals from other countries (Italians: 653; non-Italians 106). As a result, it should be noted that a response bias might be present, and this limitation prevented us from studying country-related variability. However, this remains a very interesting topic and further studies by Otolaryngology societies worldwide should be undertaken in order to better understand the factors behind socio-cultural variability in perception. The individual significance attributed to taste and flavour has not been widely discussed in the existing literature; consequently, we encourage the use of the ITF-Q, in order to confirm or invalidate our results.

Regarding the strengths and limitations of our study, we introduced a new tool to investigate the subjective importance of sensory importance and used it on a rather large sample of 759 subjects with heterogeneous characteristics. However, our research may be limited by issues of validity associated with email surveys, which can be subject to considerable bias⁶. Although such criticism may be appropriate, Internet and Web-based research may be useful to get pilot data. Another limitation of the present study is the lack of correlation of subjective results with objective measurements. The next step in this research would be to perform an investigation using questionnaires in patients with olfactory or gustatory disorders, while describing their causes of sensory impairment and comparing the results with those of a control group. Moreover, in a further experiment, we plan to establish the relationships that exist between the subjective results of the questionnaire with

those of psychophysical testing of olfactory and gustatory function and to improve the accuracy of our data. Lastly, an interesting point for future research would be to evaluate the types of diets and feeding behaviours of the population and investigate if they have any relationships with the importance attributed to smell and taste.

Conclusions

We propose a novel test that provides insight into the importance of smell, taste and flavour among individuals as well as socio-cultural differences. Although further research is needed, this new tool revealed preliminary useful information about the importance of smell, taste and flavour. In a wider context, it could help in the evaluation and investigation of the aspects that influence patients to seek medical attention in the presence of sensory alterations²⁹.

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