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LARYNGOPHARYNGEAL REFLUX & VOCAL QUALITY IN SENIOR POPULATION: *"MR./MS. GLUTTONY"*

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ABSTRACT

Voice is a carrier of emotions and sentiments. It is, moreover, a distinctive element of one's personality. Voice is generated in the vocal tract from a sound produced in the larynx. When alterations occur in the normal process of voice emission, that dysfunction is called dysphonia. Dysphonia may be caused by Laryngopharyngeal Reflux (LPR). Correlations among the mentioned parameters are scarcely examined in the existing literature, making it pertinent to render information available and throw light on the issue. The current paper focuses on how to make the elderly population (and respective informal caregivers) aware of LPR's influence on vocal quality through a health education instrument originally designed to tackle this problem. That instrument – "Mr./Ms. Gluttony" – addresses behaviours, specifically dietary behaviours, known to precipitate, aggravate and/or perpetuate LPR.

INTRODUCTION

The larynx is an organ responsible for several functions, three of which can be highlighted as markedly important: respiration, phonation and deglutition (Behlau, 2001). Phonation is a physiological process that results in the production of sound, converting it in acoustic energy and generating voice – voice, in turn, assumes a relevant role in social and interpersonal communication and in a person's quality of life (Guimarães, 2007; Correia *et al*., 2012). There are three basic components that allow us to define euphony: (i) the intelligibility of the speech perceived by the listener; (ii) the acoustic properties studied and defined in the literature; and (iii) the social and occupational requisites of the cultural determinants where the individual carries out their life (Behlau, 2001; Guimarães, 2007). Therefore, when changes occurs in one (or more than one) of the basic components that make up euphony, we might be before a state of dysphonia, i.e., a difficulty in vocal emission that precludes a natural production of voice (Dias *et al*., 2013; Dias *et al*., 2015). Regarding the process of deglutition, the larynx acts as an organ that is part of the respiratory system, operating as a sphincter-like mechanism that prevents not only aspiration of food during deglutition, as also aspiration of gastric content(s) caused by reflux (Behlau, 2001; Guimarães, 2007). Reflux can be specified as gastric orlaryngopharyngeal. The former is defined by the flow of digestive fluids to the oesophagus, in ascending direction (Burati *et al*., 2003; Koufman, 2014). When the gastric acid ascends to the upper aero-digestive tract (larynx, pharynx, oral and nasal cavities), we speak of Laryngopharyngeal Reflux (LPR) (Kandogan *et al*., 2012; Yilmaz *et al*., 2016; Gupta *et al*., 2009). Due to insufficient functioning of the first defence barrier against LPR – the upper oesophageal sphincter, formed by the cricopharyngeal muscle – the gastroduodenal content is allowed to 'escape', moving up to the upper aero-digestive tract (Koufman, 2014; Gupta *et al*., 2009; Cielo *et al*., 2011). When that happens, clinical manifestations of LPR occur at a physiological level, as a result of vocal and laryngeal alterations, as well as from the exposure of those structures to gastric acid (Gupta *et al*., 2009; Cielo *et al*., 2011). Such alterations also include irritation in

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the mucous membrane of the vocal folds, causing an oedema in the vibratory edge of the vocal fold's lamina propria, thus interfering with phonation and with the speaker's voice quality (Yilmaz *et al*., 2016; Gupta *et al*., 2009; Cielo *et al*., 2011).
The following are described in the reviewed literature as signs and symptoms of LPR: hoarseness, excessive throat clearing, nasal obstruction, globus pharyngis, laryngitis and chronic cough (Gupta *et al*., 2009). Currently, however, dysphonia emerges as the symptom most often associated with LPR, followed by throat clearing, persistent cough, globus sensation, and dysphagia (Koufman, 2014; Gupta *et al*., 2009; Deus *et al*., 2015; Nunes *et al*., 2015). The literature reviewed showed us that, despite the paucity of empirical information (cor)relating LPR to voice quality, specifically as it pertains to foods that are likely to induce its emergence and development, some studies do exist where a (cor)relation between reflux and the sings and symptoms above mentioned was found (Burati *et al*., 2003; Xavier, 2013; Pontes, *et al*., 2007; Kauffman *et al*., 2008; Zucato *et al*., 2012). For instance, in an empirical study carried out in Brazil in 2003, involving a sample of 157 patients diagnosed with gastroesophageal reflux disease (GERD), researchers saw that the majority of those patients also suffered from moderate or severe LPR, as well as exhibiting symptoms of dysphonia (69,42%) and persistent throat clearing (52,86%)[6]. In that same year, a prospective study carried out at European level reported that 32,8% of patients manifested extra-oesophageal symptoms of reflux, and the current estimate as to the percentage of subjects ailed by this dysfunction worldwide falls somewhere within the 5-to-20% range observed in the European population (Xavier, 2013). d Figure 1).

Similar studies conducted in 2007 and 2008 in Brazil pointed towards the presence of LPR in 80-to-100% of the survey population, a sample where the presence of additional signs and symptoms was, once again, confined to dysphonia and throat clearing, with recorded rates of 63,8% and 60,3% (Pontes, *et al*., 2007; Kauffman *et al*., 2008). A more recent study, conducted in 2012 by the Centro de Estudos da Voz [Voice Studies Centre] of São Paulo, Brazil, points towards the presence of LPR in 50% of patients with voice disorders and, with signs and symptoms of dysphonia, in 68,6% of the surveyed patients (Zucato *et al*., 2012). Looking at the Portuguese reality, a study carried out in 2012, at Hospital Garcia de Orta, by a research team of speech therapists and an otorhinolaryngologist, points to the multifactorial etiology of dysphonia, and also draws the conclusion that clinical entities like Reinke's oedema and polyps are the only tissue alterations where LPR assumes itself as a relevant predictor – a conclusion that appears to be concurrent with results found in more recent international studies (Correia *et al*., 2012; Kandogan *et al*., 2012; Yilmaz *et al*., 2016).In light of these data, we would be justified in assuming that there appears to be a positive and significant correlation between dysphonic disorder and oropharynx inflammation in patients with LPR. In the course of a life cycle, individuals are given to experience marked biopsychosocial changes, and one of the stages of life where changes are clearly manifest is old age. We should therefore advise the senior population and make them aware of how important it is to keep healthy habits, and to avoid deleterious habits that may compromise good vocal health within this age group (Alves *et al*., 2015).In order to prevent unhealthy behaviours, seniors (who are clearly poised to be a prominent age-group in the near future) should be adequately informed as to which habits may negatively influence their vocal health. That leads us to the need to develop health education tools specifically targeted to elderly citizens. Some authors suggest that a set of guidelines concerning eating behaviours should be adopted, outlining a healthy and regular food regime tailored for seniors, where one recommendation put forward is that seniors should avoid spiced foods (Koufman, 2014; Soares *et al*., 2007). In fact, excessive ingestion of highly caloric and liberally seasoned foods is detrimental to the digestive process, slowing it down and hindering the free movement of the diaphragm – a muscle that is crucial in both breathing and phonation (Guimarães, 2007; Koufman, 2014). The ingestion of excessive amounts of soft drinks, i.e., carbonated drinks, and/or beverages served at extreme temperatures (too hot or too cold) also appears to cause alterations in the vocal tract and, consequently, alterations at the level of voice production (Behlau, 2001; Koufman, 2014; Cielo, 2011). Also, an excessive intake of alcoholic beverages seems to promote desensitisation of the laryngeal receptors, which may cause occasional oedemas and irritation, as a result of increasing the vocal folds' mass (Guimarães, 2007).Interestingly, seniors, for reasons that condition their masticatory function, seem to favour eating behaviours that are somewhat propitious to the development of LPR (examples of which include fried food, dairy products and fatty foods like cheese and butter, fatty meats, chocolate, coffee and some teas) instead of favouring a diet where fruit and vegetables feature prominently (Koufman, 2014; Gandenz *et al*., 2013; Heitor *et al*., 2015). Faced with this empirical concern, a need emerges to assess the impact that LPR has in seniors' voice quality and, in line it, the need to develop a health education learning tool aimed at (i) making the population aware of the impact that LPR has in the quality of senior citizens' voice, and (ii) inform and clarify which food items are recommended for daily consumption by elderly citizens.

MATERIALS AND METHODS

Participants

The current project is directed to the senior population – a demographic that, according to projections indicating a moderate increase in life expectancy, will constitute a significant proportion of the population in the near future (Soares *et al*., 2007; Pinto, 2006). The European Council and the Organisation for Economic Co-operation and Development (2012) define the concept of elderly population based on several demographic indicators. In Portugal, 'senior' is defined as any individual aged 65+ years old. The notion of including informal caregivers in the current project was prompted by data on seniors' autonomy – a concept based on the ability senior citizens have to carry out Everyday Activities (EA) (Moraes, 2012). Data gathered in the Portuguese 2011 Census show that 50% of the population aged 65 y.o. or older cannot perform, or experiences great difficulty in performing, at least one of the six everyday activities associated with vision, hearing, locomotion, memory and/or concentration, personal hygiene, and understanding and expressing oral verbal material (Censos, 2012). In 2003, the number of senior citizens living in Portugal was circa 700.000, a figure that had increased a further 16,8% by 2006, with future projections pointing towards a continuing growth of that number (Pinto, 2006). Such projections gain particular relevance when we look at the 2011 Census' data, which demographic indicators show that the percentage of youths decreased to 15%, and that

of seniors increased to 19% (Censos, 2012).Ageing brings to light changes that result from the intrinsic maturation of the human being. Such changes include modifications in the structure of vocal folds and in other structures associated with voice production (Zucato *et al*., 2012). With the onset of presbyphonia, the vocal apparatus' development and degree of deterioration seems to vary from person to person (Soares *et al*., 2007). The elderly population is an at-risk age- group for LPR, a vulnerability that can be further compounded by factors such as malnutrition and nutritional deficiencies, or declining physiological and cognitive functions – all of which detrimental to the ingestion and metabolism of nutrients (Kümpel *et al*., 2011; Fisberg, 2013). The dietary and nutritional aspect of the elderly population is therefore an important issue, so as to prevent the emergence of LPR as a function of chronological ageing (Xavier, 2013).

On the development of the instrument

In order to put together the current instrument, we have carried out several trials where we explored real, virtual and ludic images of the inner aspect of the human body. We began by drawing, cutting and sculpting the anatomical shape of the interior of the upper half of the "human being" on a board of Styrofoam (Figure 1). Next, we drew and coloured the organs (liver, gallbladder, pancreas, small intestine and large intestine). Given that we wanted to highlight the role played by the lungs and the stomach in breathing and food digestion, the pictorial representation of those organs was drawn by hand, cut, coloured and glued onto a sponge-like transparent material, providing a three dimensional perspective to the instrument (see the illustration captioned Figure 1).

Figure 1. *Mr./Ms. Gluttony* – Unisex doll, versatile, unique and innovative

In order to represent the oesophagus and the trachea, we decided to put together three transparent tubes with varying diameters and textures. The tube that stands for the trachea features a ring-like texture and it bifurcates when it reaches the lungs, so as to represent the bronchia. The pictorial model for the oesophagus (the organ into which the gastric acid flows in persons with LPR), we have joined two tubes with different diameters. In its lower part (beneath the stomach, descending to the pelvic girdle), the tube has a wider diameter, so as to make it possible to unite it to an air pump that, once squeezed, thrusts air into the tube, in ascending direction, thus mimicking the movement that occurs in a LPR patient. To visually depict the LPR, we elected to use a handful of chad, because they are small, light, and do not stick to the walls of the tube. Lastly, we produced the images representing the eyes and the mouth, so as to endow the simulacrum-doll with anthropomorphic features and thus attribute a realistic dimension to it (Mocho, 2014). Having fully created and assembled the instrument we called "Mr./Ms. Gluttony", we proceed to develop the pictograms associated with food items. Our choice fell, primarily, on those foods likely to precipitate, aggravate or perpetuate LPR. Those pictograms were hand-drawn and coloured by hand using crayons. They were then cut and thermal laminated, so that they could be glued to the Velcro, objectifying its future adherence to the doll's mouth (Directions for Use). This option facilitates the use of the doll by seniors, given that that fine motor skills trend to be the first ability to suffer progressive losses in the elderly (Costa, 2011).

A 'pictogram' is a highly simplified visual representation of an object, action, short narrative or even abstract concept that is designed to represent, in and by itself, without additional context or explanation, the object or concept it is meant to convey. In the present case, the goal was to represent food items that favour the emergence and/or development of LPR, so that such products could be easily identified and understood by the intended observer (Dias *et al*., 2015; Dranka, 2012). The size of both drawings and cards, as well as the appeal of the images' colours, were strategically thought up so as to take into account that most senior citizens are prone to visual perception deficits. Fifty-seven cards were created and pre-tested with a group of subjects. The pre-test resulted in the improvement of the pictorial quality of seven cards. The set of pictograms is based on Koufman's "Recommended Lifestyle and Dietary Modifications for Reflux" table, proposed in 2014. That table introduces three basic categories: (i) *Worst-for-reflux Foods* (see Figure 2) *and beverages to avoid*, that also includes acidic fruits and "idiosyncratic" foods (see Figure 3); (ii) the group named *The best-for-reflux Food* (see Figure 4); and(iii) *Beverage List* (see Figure 5) (Koufman, 2014).

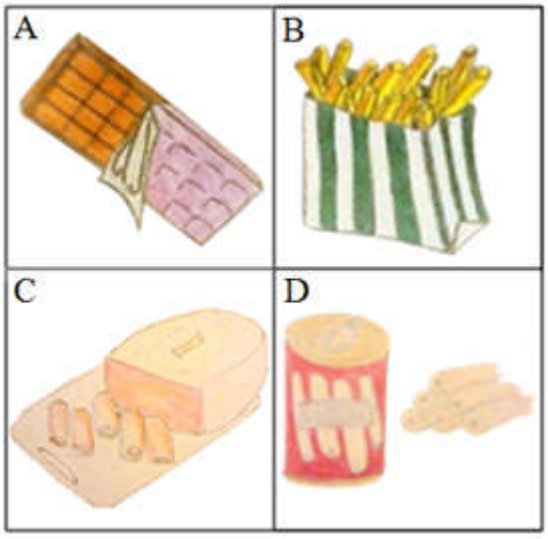

Figure 2. Pictograms representing *Chocolate* (A), *Frenchfries* (B), *Pork Ham* (C), and *Pork Sausages* (D)

In Figure 2, the chosen pictograms reflect food items found under the category *Worst-for-reflux Foods*, and are thus meant to represent fatty and fried foods. We have paradigmatically selected the following: chocolate (A), French fries (B), ham (C) and pork sausages (D). In fact, foods that appear under *Worst-for-reflux Foods* seem to be major contributors to the

development of LPR because of their intrinsic composition (fat), chocolate being listed as one of the most highly pathogenic foods related to LPR (Koufman, 2014). Data suggest that chocolate somehow alters the mucous membrane of the vocal folds, promoting vocal abuse behaviours such as excessive throat clearing.

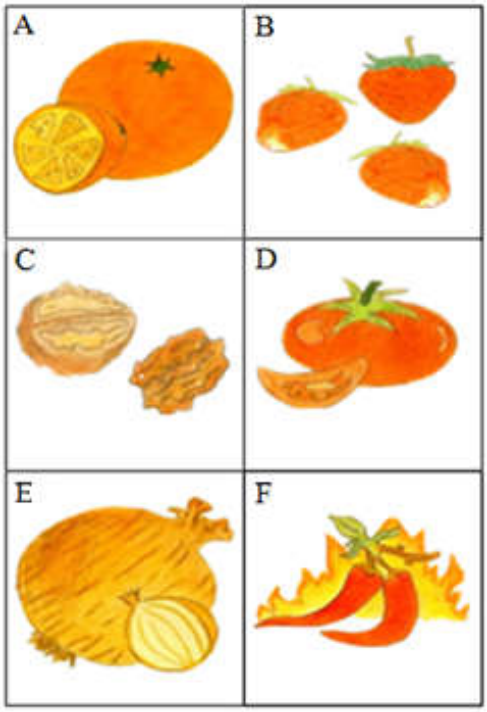

Figure 3. Pictograms representing *Orange* (A), *Strawberries* (B), *Walnut* (C), *Tomato* (D), *Onion* (E) and *Chili Pepper* (F)

In the group that lists fruits that are considered acidic and "idiosyncratic" foods (Figure 3 – cards A and B), we elected to depict orange (A) and strawberries (B) because their acidic quality is unquestionably recognised by any layperson (Koufman, 2014). Regarding idiosyncratic foods (Figure 3), identifiable by their distinctive characteristics, our choice fell upon the following food items: walnut (card C), which stands to represent nuts in general; tomato (card D); onion (card E); and chili pepper (card F), which stands for not only chili peppers, pepper spices and hot sauces, but also any liberally spiced foods that, due to their specificities, seem to substantially increase the development of LPR and, as a result, vocal abuse behaviours and the emergence of dysphonia (Guimarães, 2007; Koufman, 2014).Figure 4 is intended as a representation of *The Best-for-reflux Food*.

The first items shown are banana (A) and melon (B), considered to be healthy and advantageous foods that should be ingested by LPR patients. The subsequent cards show: broccoli (C); rice (D); and ginger root (E), which, despite its markedly pungent taste, is a beneficial food in tackling LPR (Koufman, 2014). As to those pictograms that represent animal proteins, we have elected to depict: chicken (F), standing here for white meat in general, a food item highly recommended due to its healthy component; boiled fish (G); and grilled salmon (H) – the "Recommended Lifestyle and Dietary Modifications for Reflux" classifies all kinds of fish as good choices, highlighting, however, that *fried* fish is to be avoided (Koufman, 2014).In the set of cards representing the category *Best beverages and Beverages to avoid* (Figure 5), only cards A and B (water and tea, respectively) are illustrative of healthy beverages – beverages which intake is, naturally, encouraged by health professionals (Correia *et al*., 2012). It should be noted that beverages shown in pictograms C (beer) and D (wine) are intended as illustrative of alcoholic beverages in general. Alcoholic beverages appear to be universally and scientifically associated with LPR development (Correia *et al*., 2012; Koufman, 2014). Furthermore, when taken in immoderate amounts, alcoholic beverages are likely to lead to desensitisation of the laryngeal receptors, which, in turn, not only generate vocal ill use and abuse, as also an increment in oedemas and irritation, with a corresponding increase in the vocal folds' mass (Guimarães, 2007).

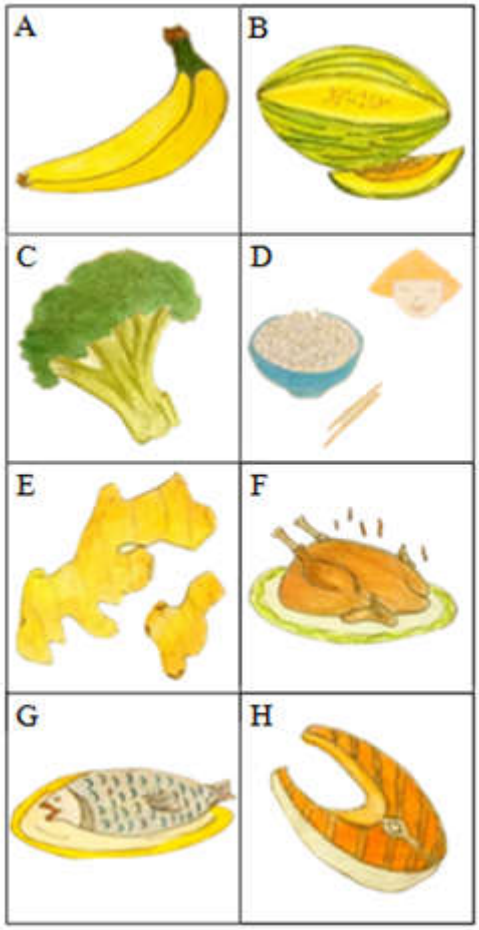

Figure 4. Pictograms representing *Banana* (A), *Melon* (B), *Broccoli* (C), Rice (D), *Ginger Root* (E), *Chicken* (F), *Boiled Fish* (G) and *Grilled Salmon* (H)

Pictogram E (Figure 5) intends to portray the consumption of soft drinks that, due to its carbonated component, favour flatulence, therefore promoting the development of LPR (Koufman, 2014). Lastly, pictogram F intends to portray the beverage coffee, mentioned as pathogenic beverage across the reviewed literature; data seems to suggest that coffee decreases pressure on the lower oesophageal sphincter and, consequently, increases production of acid secretion. Furthermore, it is also considered a diuretic beverage, thus promoting dehydration of the vocal folds' mucous membrane (Oliveira, 2014). Within the learning act that is provided to the patient, it should also be noted that our health education instrument underlines that, generally speaking, food items should be thoroughly masticated (circa 25 times), ingested in small amounts at a time, and that meals should be spread out throughout the day (five to six meals), recommending the last meal to be ingested four hours before bedtime (Koufman, 2014).

Conclusion

Health education instruments have, at core, a preventative basis, for they are, in essence, health promotion tools – strategic vehicles of promotion of health-inducing behaviours.
The instrument described – "Mr./Ms. Gluttony" – stems form the need to develop versatile and pedagogic health education tools that communicate through the universal language of pictures represented by pictograms. Our object here is that of leading the patient to learn coping strategies and to promote vocal health in senior citizens. As mentioned earlier, the available literature on this issue is scarce, almost inexistent.
In developing "Mr./Ms. Gluttony", we have attempted to show the importance of learning tools in the area of speech therapy, specifically of vocal health, bringing to the senior population and to their informal caregivers information on healthy vs deleterious eating habits regarding the development o LPR.
The "Mr./Ms. Gluttony" instrument was built around the character of a *human being*. Its anatomical design was set so as to emphasize the presence of an allegoric oesophageal tube, which pictorial content intends to suggest a symbolic representation of LPR. The instrument is particularly tailored to seniors (individuals aged 65 years old or older) with or without voice-related disorders associated with LPR. In the course of a speech therapy session, "Mr./Ms. Gluttony" can also be used in varied clinical contexts as assessment tool when the therapist wishes to gauge the patient's knowledge or awareness on LPR. The use of playful activities involves strong pedagogic abilities and is a valuable resource within clinical practice, for it motivates senior patients' engagement and instigates in them understanding and adherence to healthy habits. The use of pictograms is an added value to the construction of learning instruments developed with this specific population in mind – not only due to its didactic character, but also because it bridges linguist barriers, allowing senior patients to bypass any literacy shortcomings that would otherwise frustrate their knowledge acquisition."Mr./Ms. Gluttony" presents, however, as spatial limitation, its unlikely portability, due to its large dimension. Such limitation can nonetheless be said to be offset when considering that "Mr./Ms. Gluttony" shows an elementary pertinence as a therapeutic intervention tool: it is adaptable to the gender and age of the subject, allowing for a unencumbered and playful interaction, adjustable to each individual patient.

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