AN ANALYSIS OF SUBJECTIVE ASSESSMENT OF SWALLOWING FUNCTION IN OLDER ADULTS USING THE EAT-10 QUESTIONNAIRE

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Abstract

Aim: In 2011, a study was carried out focusing on the prevalence and degree of subjective swallowing difficulties in older adults. The aim was to extend this scrutiny and using the already existing data, to conduct a comprehensive analysis of relationships between the individual items of the assessment tool. Methods: 160 older adults from 5 institutions of health and social care in the Liberec region participated in the study. They evaluated their swallowing function using the 10-item Eating Assessment Tool (EAT-10). For each item, a scale from 0 (no problem) to 4 points (severe problem) was used. The relationship between any two given items was expressed using the Kendall coefficient τb. Results: In all but one case, the relationships between the items were statistically highly significant (p-value < 0.01). All the obtained values of τb were positive. Very tight relationships existed between “emotional” items (τb > 0.7). Tight relationships also existed between selected physical items (τb > 0.6). The highest number of tight relationships was present for the item concerning stressful swallowing (τb > 0.6 for a relationship with 6 items). Tight relationships were lacking for the item assessing pill swallowing (τb < 0.5 for all relationships). Conclusion: Subjective swallowing difficulties were present in the emotional, functional and physical areas. A very tight relationship existed between several pairs of items and it is possible that in some cases, the tool items are duplicated, i.e. redundant. The question is whether the EAT-10 is a suitable tool for subjective assessment of swallowing.

Key words: dysphagia, EAT-10, swallowing function, older adults, subjective assessment.

Introduction

Swallowing disorders (dysphagia) are a common and potentially very serious problem which accompanies a wide range of diseases and, in many cases, is also a manifestation of ageing (Sura et al., 2012, p. 287). In professional literature we can find the results of studies on the existence of dysphagia both in hospitalized older adults and those living in the community. In a recently published survey which focused on the issues of dysphagia in older adults (aged 65 and above) who were undergoing surgical treatment for a hip fracture, oropharyngeal dysphagia was observed in 34% of cases (Love et al., 2013, p. 2). In those aged over 70 living in nursing homes, difficulties with food intake were observed in 87% of cases, while in 67% clear signs of dysphagia were present (Steele et al., 1997, p. 47). This view is valuable, involving as it does an older adult’s subjective evaluation of the swallowing function, including the assessment of quality of life related to swallowing. Chen et al. focused on older adults (aged over 65) in the community, and using the M.D. Anderson Dysphagia Inventory (MDADI), found that in 15% of cases, older adults perceived considerable limitations in everyday life due to impaired swallowing function; these limitations were related to one or more areas (physical, emotional or functional) (Chen et al., 2009, p. 2).

In the Czech Republic (CR) results have recently been published of research focusing on subjective assessment of swallowing function in older adults aged over 65 at 5 facilities of health and social care in the Liberec region, using the foreign questionnaire Eating Assessment Tool (EAT-10) (Petržílková et al., 2012). This questionnaire also focuses on a subjective assessment of swallowing function;
items relate to a physical area and 3 items refer to an emotional or functional area. It was first used in the Czech Republic in 2010, after a team of professionals, including 3 linguists, translated the English original, and then verified the comprehensibility of the Czech version in a pre-test (Vejrostová et al., 2012, p. 32). Other enquiries using the EAT-10 followed, aimed at investigating the prevalence and degree of severity of individual difficulties. Relationships between individual swallowing problems identified through this questionnaire have not yet been comprehensively analysed.

**Aim**
The aim was to build on the above-mentioned analysis of the prevalence and degree of subjective swallowing difficulty among older adults (Petřílková, 2012; Petřílková et al., 2012) and to carry out an analysis of the relationships between individual items of the EAT-10 based on the data obtained in this study. Part of the aim was to initiate discussion regarding the suitability of the EAT-10 for the identification of subjective swallowing difficulties.

**Methods**

**Sample**
Data were collected from April to October 2011. The study was conducted in 5 institutions of health and social care in the Liberec region. We approached 222 clients aged ≥ 65, of whom 22 refused to participate in the research, and another 40 clients did not meet the selection criterion – passing a test of cognitive function using the Mini-Cog tool (Borson et al., 2006, p. 349-355; Petřílková, 2012, p. 37). Success in the test of cognitive function was a prerequisite for inclusion in the study because adequate patient cooperation (i.e. providing meaningful answers to questions) was necessary for some data collection. The actual study involved 160 participants (77% women, 23% men). The age range was 65-99 and the mean age was 81 (Petřílková, 2012, p. 41-42).

**Data collection**
The core of the investigation was the use of the Czech version of the EAT-10 for subjective assessment of swallowing function (Table 1) (Vejrostová et al., 2012, p. 33; Belafsky et al., 2008, p. 922), a questionnaire containing 10 items describing subjective swallowing difficulty. For each item, the degree of difficulty is assessed using an ordinal scale from 0 (= no problem) to 4 points (= severe problem). The maximum possible score is, therefore, 40 points.

Data were collected by a researcher (a student in a master’s degree program in nursing), who read individual items to the participant and then recorded the score given by the participant, or the client’s verbal response (“It is a big problem”, “It bothers me a bit”) was converted into points with the client’s approval (Petřílková, 2012, p. 38).

**Data analysis**
For comparison of the relationships between individual pairs of items, Kendall’s rank correlation coefficient $\tau_b$ was used, which is based on the amount of agreement and disagreement of pairs of observations (Hendl, 2012, p. 272). Unlike the Spearman correlation coefficient, Kendall’s $\tau_b$ is suitable for situations where there are many values for variables of the same rank (so called “tied ranks”), a situation which occurs when a variable has

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>My swallowing problem has caused me to lose weight.</td>
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<tr>
<td>2</td>
<td>My swallowing problem interferes with my ability to go out for meals.</td>
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<tr>
<td>3</td>
<td>Swallowing liquids takes extra effort.</td>
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<td>4</td>
<td>Swallowing solids takes extra effort.</td>
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<td>5</td>
<td>Swallowing pills takes extra effort.</td>
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<td>6</td>
<td>Swallowing is painful.</td>
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<td>7</td>
<td>The pleasure of eating is affected by my swallowing.</td>
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<td>8</td>
<td>When I swallow, food sticks in my throat.</td>
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<td>9</td>
<td>I cough when I eat.</td>
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<td>10</td>
<td>Swallowing is stressful.</td>
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* (Belafsky et al., 2008, p. 922)
few categories and the research sample is large (Sim, Wright, 2000, p. 227). There are also relatively few categories (5) in the EAT-10 – the degree of difficulty in each item being expressed using the afore-mentioned ordinal scale from 0 to 4.

Kendall’s \( \tau_b \) can take values from -1 to +1 (Cope, 2006, p. 290). Zero represents a zero association between the values expressing the degree of difficulty in one item and a second item; a positive value represents a relationship between a greater degree of difficulty in one item and also in the second item (or a lower degree in one item and the second item) and a negative value represents a relationship between a greater degree of difficulty in one item and a lower degree of difficulty in the second item (Cope, 2006, p. 290). The closer the Kendall’s \( \tau_b \) value is to +1 or -1, the tighter the relationship (Cope, 2006, p. 290). For more specific interpretation of the tightness of a relationship between items, we can use a reference evaluation, which is also used in the case of calculations using the Pearson correlation coefficient (Table 2) (Morgan et al., 2011, p. 101, p. 118).

Calculations were performed using the IBM SPSS statistical program, version 20. For testing the zero hypothesis \( H_0: \tau_b = 0 \) (there is no relationship between two given items of the EAT-10) and bilateral alternative hypotheses \( H_a: \tau_b \neq 0 \) (there is a relationship between two given items of the EAT-10), we used an automatically pre-set 5% and 1% significance level \( \alpha \) in the SPSS program.

### Table 2 The interpretation of the strength of relationship between items*

<table>
<thead>
<tr>
<th>General interpretation of the strength of relationship</th>
<th>Kendall ( \tau_b ) value</th>
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<tbody>
<tr>
<td>Much larger than typical</td>
<td>( \geq 0.70 )</td>
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<tr>
<td>Large or larger than typical</td>
<td>[0.50–0.69]</td>
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<td>Medium or typical</td>
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<td>Small or smaller than typical</td>
<td>[0.10–0.29]</td>
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* (Morgan et al., 2011, p. 101 a 118)

Using a different number of asterisks in each cell of the obtained correlation matrix, the probability of a non-zero relationship was marked when performing the calculations: * = a 95% probability (the correlation is statistically significant) and ** = a 99% probability (the correlation is statistically highly significant) (Kozel et al., 2011, p. 125). The obtained Kendall’s \( \tau_b \) values (including the achieved significance levels, i.e. the p-value) were evaluated for individual pairs of items, and in the discussion, particular attention was paid to the relationships between subjective swallowing difficulties in the physical area on the one hand, and in the emotional or functional area on the other.

### Results

Table 3 shows the Kendall’s \( \tau_b \) value for each pair of the EAT-10 items, together with the p-value. All 160 participants gave scores for all 10 items (there were no missing data in the questionnaires). Therefore, for each pair of items, Kendall’s \( \tau_b \) was calculated.

### Table 3 The relationship between individual pairs of the EAT-10 items

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<thead>
<tr>
<th>Item 1</th>
<th>( \tau_b )</th>
<th>Item 2</th>
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\( \tau_b \) = Kendall’s \( \tau_b \); **correlation is statistically highly significant (p-value < 0.01) *correlation is statistically significant (p-value < 0.05).
based on 160 score comparisons (the order of degree of difficulty) obtained from participants. All the values obtained for Kendall’s $\tau_b$ showed a positive relationship between the items (Kendall’s $\tau_b$ was positive in all cases).

The relationships between the items were statistically highly significant (p-value < 0.01), except in one case, namely the case of the relationship between the items “My swallowing problem interferes with my ability to go out for meals” (no. 2) and “Swallowing pills takes extra effort” (no. 5); this relationship was statistically significant (p-value < 0.05). For this particular relationship, Kendall’s $\tau_b$ was the lowest (0.157) in comparison with all the possible relationships between two items.

For clearer representation in Table 3, those Kendall’s $\tau_b$ values representing a greater tightness of the relationship than typical are highlighted by shading in accordance with the interpretation illustrated in Table 2. Kendall’s $\tau_b$ values ranging from 0.50 to 0.69 are highlighted in light grey and Kendall’s $\tau_b$ values ≥ 0.70 are highlighted in dark grey.

From this perspective, the items “My swallowing problem interferes with my ability to go out for meals” (no. 2) and “Swallowing is stressful” (no. 10) have the most pairs of tight relationships. Both of them show a Kendall’s $\tau_b$ value > 0.50 in 7 of the 9 possible pairs of relationships with other items. It was this very pair of items (no. 2 and no. 10) which achieved the highest correlation overall ($\tau_b = 0.786$, p-value < 0.01). The second highest correlation was obtained for the pair of items no. 10 and no. 7 ($\tau_b = 0.781$, p-value < 0.01).

Another 5 items showed a Kendall’s $\tau_b$ value > 0.50 in most of the 9 possible pairs of relationships with other items: “Swallowing solids takes extra effort” (no. 4) and “When I swallow, food sticks in my throat” (no. 8) in 6 cases; “My swallowing problem has caused me to lose weight” (no. 1), “Swallowing is painful” (no. 6) and “The pleasure of eating is affected by my swallowing” (no. 7) in 5 cases. In contrast, “Swallowing liquids takes extra effort” (no. 3) had a Kendall’s $\tau_b$ value > 0.50 in only one pair of relationships with other items and the item “Swallowing pills takes extra effort” (no. 5) was the only item which did not achieve a Kendall’s $\tau_b$ value > 0.50 in any relationship with other items. With the exception of two cases (no. 8 and no. 9), the given item correlated the least closely with item no. 5.

**Discussion**

Out of the total of 10 items of the EAT-10, two items concern emotional areas (items no. 7 and no. 10) as they relate to the loss of the pleasure in eating and stress associated with subjectively perceived difficulties with swallowing. Another item (no. 2) relates to difficulties associated with going out for meals due to a swallowing problem – the definition of this item, however, is not quite clear and participants may perceive difficulties either from the emotional perspective (e.g. if the idea of going out for meals evokes specific emotions) or from the functional perspective (e.g. if they need various special aids to facilitate food intake and deal with the question of whether they will be available). At the same time, the tightest relationships existed particularly in these three areas: the Kendall’s $\tau_b$ value was > 0.7 for the relationship between items no. 10 and no. 2 and also between no. 10 and no. 7. This makes it a very tight relationship.

The remaining 7 items of the EAT-10 are connected to the physical area (items no. 1, 3-6, 8 and 9). They relate to the physical status and their presence can be verified by an objective examination of the patient. Regarding the relationships between individual pairs of items in the physical area, the tightest relationship was found for items no. 8 and no. 4 ($\tau_b = 0.687$, p-value < 0.01). This is a tighter relationship than typical (Table 2) and the connection between them would seem to be logical: it is the relationship between difficult swallowing of solid foods and food sticking in the throat. Equally logical (and only a little surprising) are the other results from the physical area, e.g. a small relationship between difficulties with swallowing pills and weight loss due to swallowing problems.

Interesting results were obtained in certain relationships where one item belonged to the physical area and the second item to the emotional area (or functional area in item no. 2). An example is weight loss due to problems with swallowing, which showed a slightly tighter relationship with the item “My swallowing problem interferes with my ability to go out for meals” ($\tau_b = 0.649$, p-value < 0.01) and also with the item “Swallowing is stressful” ($\tau_b = 0.638$, p-value < 0.01) rather than with the items that may have had an impact on the amount of the food taken, e.g. with the item related to difficult swallowing of solid food ($\tau_b = 0.531$, p-value < 0.01) or food sticking in the throat ($\tau_b = 0.467$, p-value < 0.01). This suggests that emotions play an important role in swallowing problems. The afore-mentioned survey by Chen et al. (2009, p. 2) clearly identified the presence of subjective difficulties with swallowing in physical, emotional and functional areas, but the EAT-10, unfortunately, contains few items dealing with emotions, alternatively with the functional area associated with swallowing, and focuses more on the
physical items. Yet we found difficulties in all these areas in our study (Petřížilková et al., 2012).

It is therefore desirable to consider the suitability of the EAT-10 for detecting subjective swallowing difficulty, which may be facilitated by analysing the relationships between individual items. It is interesting that the authors of the EAT-10 originally created the EAT-20 (which has not been translated into Czech), in which there were only three other items from the physical area and the remaining seven items were from the emotional or functional area (Belafsky et al., 2008, p. 921). These items concerned, for example, fear, avoiding people or the feeling that one is perceived as being sick or a burden on their family (Belafsky et al., 2008, p. 921).

However, based on the determination of the test-retest reliability and the identification of “useless” items (using Cronbach’s alpha), only the ten mentioned items were included in the final version of the EAT-10 (this “improved” Cronbach’s alpha from 0.947 to 0.960) (Belafsky et al., 2008, p. 921). When reducing the number of items from the original 20 to 10, Belafsky et al. (2008) were motivated by their desire to create a simple and concise tool for use in clinical practice. However, Cronbach’s alpha may have reached too high a value, which is sometimes criticized in the professional literature – Gliem and Gliem have recommended a Cronbach’s alpha value of approximately 0.8 (2003, p. 87). It is necessary to distinguish between two situations. Firstly, the questionnaire (tool) can measure a construct which is defined by different aspects, different ideas, activities, which can possibly be counted (Neuendorf, 2011, p. 1). An example is socio-economic status, which is defined by diverse items, such as education, income, or occupational prestige. In this case, we cannot automatically expect a high correlation (and a high Cronbach’s alpha) between individual items. Another situation arises when the tool consists of several indicators of one construct; indicators do not define the construct, but rather they are based on it. An example is self-esteem, whose indicators might be self-confidence, self-assessment, etc. In this case, a high correlation is more likely to be expected, however, it may even be that the items “measure the same thing” repeatedly (Neuendorf, 2011, p. 1-3).

In the case of the EAT-10, this situation could arise, for example, in the pair of items “Swallowing solids takes extra effort” and “When I swallow, food sticks in my throat” or “The pleasure of eating is affected by my swallowing” and “Swallowing is stressful”. Possibly it would be more beneficial if some other items from the original EAT-20 were included in the final EAT-10, for example, “I am afraid to eat because of my swallowing problem”, “I am afraid of choking in my sleep” or “I have altered my diet because of my swallowing problem” (Belafsky et al., 2008, p. 921).

Finally, it is important to take into account that out of a total of 160 participants, only 68 received at least one point, the remaining participants had normal results (Petřížilková, 2012, p. 39). The inclusion of many participants with normal results in the analysis may affect the relationships between items (overestimate the tightness of a relationship between items). Keeping this in mind, the items with a small relationship are probably not related to each other at all. However, Kendall’s τ is a non-parametric test which does not use specific values obtained (e.g. “0 = no problem” for a given item), but only determines their order (Doncha, Dempster, 2012, p. 202-206).

In our case it means that 92 participants with “normal” results evaluated each item in the first, “best” place, and the remaining participants evaluated at least 1 item in a different (2nd – 5th) place.

**Conclusion**

The study has addressed an analysis of the relationships between the individual items of the EAT-10 in older adults in health and social care facilities. The work builds on the existing and partially published analysis of the frequency and degree of subjectively perceived difficulties with swallowing in these participants, thus contributing to a deeper understanding of this issue.

The data which establish tight and very tight relationships between physical and emotional items, or alternatively, functional items, are valuable – one example is the relationship between the item related to weight loss on the one hand and stress associated with swallowing on the other. On the contrary, some pairs of items did not show a very tight relationship, for example, the items “cough while eating” and “weight loss”, which is an important finding as well.

The relationship analysis also found a very tight relationship between several pairs of “similar” items, for example, between “The pleasure of eating is affected by my swallowing” and “Swallowing is stressful”, or “Swallowing solids takes extra effort” and “When I swallow, food sticks in my throat”. It is possible that these are more or less duplicate, thus redundant items, which is also indicated by the high internal consistency of the questionnaire pointed out by its authors, Belafsky et al. (2008). Our aim has been to draw attention to this issue and consider the appropriateness of the questionnaire items. Clear and unambiguous conclusions cannot be made at this stage and further research in this area is obviously desirable.
Ethical aspects and conflict of interest

The study was conducted in accordance with ethical recommendations according to the Declaration of Helsinki (2002). All participants were informed of the purpose of the study and agreed to be included in the research; they expressed this agreement by signing an informed consent form. Participation was voluntary and all data were treated as confidential. The authors declare that the study has no conflict of interest.

Acknowledgement

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