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Original research article

# Association between trait anxiety and quality of life in an adult population with food allergy

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**Abstract**
*Introduction:* Food allergy is a chronic disease that requires a great deal of effort. It can result not only in a reduced quality of life, but also increased feelings of anxiety and stress. This study examines the association between health-related quality of life (HRQL) and trait anxiety levels in adults with food allergy.
*Methods:* The research sample consisted of 167 adults with food allergy aged 19–69 years, arithmetic average (M) age 37. The STAI X2 questionnaire was used to measure trait anxiety. The food allergy quality of life questionnaire for adult population (FAQLQ-AF) was used to measure the health-related quality of life – and this achieved high reliability values.
*Results:* A moderate, positive relationship was demonstrated between anxiety and the FAQLQ-AF. Simple linear regression analysis demonstrated that trait anxiety level is a predictor of HRQL level, and an increase in anxiety level decreases HRQL. Factors such as tetanus syndrome, comorbidities, prescribed medications and recommended over-the-counter medications are associated with trait anxiety levels. Related illnesses and symptom clusters are related to HRQL levels.
*Conclusions:* Adults with food allergy who are more anxious are more likely to experience a poorer quality of life. Early intervention, prevention and optimization of treatment management should be a necessary part of the psychological care of patients with food allergy.

**Keywords:** Food allergy; HRQL; Quality of life; State anxiety; Trait anxiety

## Introduction

Food allergy is a clinical manifestation of hypersensitivity to food allergens, which must have an immunological basis. Its treatment is based on a strict diet. In adulthood, this is a definitive and lifelong diet (Fuchs, 2008). It is caused by allergens that may be of plant or animal origin. The allergen is responsible for the antibody response in which specific antibodies called IgE are formed. These cause sensitisation (Ferenčík et al., 2006). Food allergy is divided into IgE mediated, mixed IgE with non-IgE, and non-IgE mediated. Celiac disease has a specific place within food allergies (Fuchs, 2019). Food allergy affects 2–4% of the adult population (Fuchs, 2008). Currently, 25% of the European population is affected by allergic disease (Greenhawt, 2016). The trend of food allergy prevalence continues to grow, with documented prevalence up to around 10%. Genetic, epigenetic, and environmental risk factors are increasingly becoming more prominent in the context of food allergy (Sicherer and Sampson, 2018). For a diagnosis to be made, a direct link must be found between the patient's symptoms after consuming a specific food and laboratory findings. In Central Europe, the most common reported allergens are eggs, nuts, milk, certain fruits, poppy seeds, and root vegetables (Fuchs, 2008). The central management in food allergy therapy is in the avoidance of foods that cause an allergic reaction. The range of reactions can be mild to life-threatening. The likelihood of a fatal reaction is small. The goal of food allergy management is achieved through diet modification, education, behavioral approaches aimed at allergen avoidance, and pharmacological and non-pharmacological strategies (Muraro et al., 2014). Several studies have demonstrated the potential benefits of interventions that included a self-regulation module and focused on anaphylaxis education (Greenhawt, 2016). A key pillar of an effective long-term elimination diet is education. Education and training are an essential part of managing food allergies. Dietary restrictions should exclude food allergens and be tailored to the specific allergic and nutritional needs of the individual. Extensive and prolonged avoidance of allergens should be carefully monitored, as it can lead to nutritional impairment and poorer quality of life (Muraro et al., 2014). The same result was reached by Knibb and Semper (2013) who argue that food exclusion due to food allergy leads to nutritional impairment. On the other hand, a positive aspect is the unique experience that individuals with food allergy receive. As Dyer et al. (2020) stated: The unique experience of living with food allergy helped the young individuals (research population) to recognize and respond to others who are also facing some special needs. (In this case Special need means a person's need resulting from an emotional, behavioral, cogni-

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tive, physical or personal condition). Improved interpersonal relationships and enhanced advocacy skills have been also found (Dyer et al., 2020).

Friedman and Morris (2006) provide two cognitive-behavioural theories to explain the relationship between food allergy and anxiety. The first is the psychological theory of classical conditioning. If a person has an allergic reaction due to a food allergy, he or she becomes fearful of a recurrence of symptoms and experiences feelings of anxiety and fear (the conditioned response) that is related to the symptoms associated with the allergic reaction. The second cognitive-behavioural theory is based on learning and modelling parental behaviour. Food allergy elicits high levels of emotional distress and anxiety in patients, which is also related to the threat of a life-threatening allergic reaction. Short-term anxiety is to be expected and may even be helpful if it maintains behaviors such as allergen avoidance and emergency preparedness. Research has shown that high levels of anxiety are counterproductive and related to maladaptive coping. The total absence of anxiety can lead to risky behaviors and lack of vigilance (Polloni and Muraro, 2020). To better manage anxiety, patients and their families need to find appropriate providers focused on mental health care, educational programs, and behavioral intervention (Protudjer et al., 2021). In studies researching depression in relation to food allergy, it has been demonstrated that depression can be attributed to the stress of the chronic illness itself, and the recognition that food allergy can be a persistent condition which leads to social exclusion (Feng and Kim, 2019). Most individuals with food allergy reported mild anxiety, and a small but substantial proportion of individuals experienced relevant anxiety that interfered with optimal functioning. In some studies, this dysfunctional anxiety was related to previous anaphylaxis, which as a life-threatening event can lead to post-traumatic reactions in patients. It is therefore very important to help and support patients after experiencing severe allergic reactions and to implement effective preventive measures. These can include the early identification of patients with food allergy who are at risk of mental health issues, as well as the development of appropriate intervention and prevention programs (Polloni and Muraro, 2020). Cognitive-behavioral therapy can be very effective for this purpose. CBT involves the assessment of emotions, behaviors, and negative thoughts to determine how they cause and perpetuate the patient's anxiety and depression. During therapy, patients learn techniques to modify their thoughts and behaviors (Feng and Kim, 2019). In a further study by Wirtz et al. (2014), it was revealed that acceptance and willingness to face emotions were among the strongest predictors of lower anxiety symptomatology. This suggests that less emotional avoidance or escape from emotional reactions, along with acceptance of one's own emotions, leads to a reduction in perceived anxiety.

Quality of life is a multidimensional construct, with underlying dimensions related to a physical component (e.g., pain), an emotional component (mood), a mental component (concentration), a social component (contacts), and a functional component (work functioning). Health-related quality of life is referred to as HRQL and is influenced not only by the disease and its treatment, but also by psychosocial factors – particularly the coping mechanisms and resilience of the individual (Bullinger, 2014). Food allergy exacerbates HRQL, and several studies have found significant differences in HRQL between countries. This may be influenced, for example, by the way of coping with life events, which may differ from country to country and can also influence attitudes towards food allergy. Dietary habits and traditions also differ between European countries (Saleh-Langenberg et al., 2015). Factors that impair HRQL include stress, anxiety associated with increased food monitoring and constant avoidance of allergens, lack of broadly available prevention and treatment strategies, as well as social isolation (Dyer et al., 2020). Monitoring HRQL is very important in people with chronic illness. It is a crucial factor that is observed when making and taking strategic decisions regarding treatment, as well as the overall approach towards the patient (Kalová et al., 2005). Within the social component of quality of life a study by Lieberman et al. (2010) indicated that 24% of all adolescents and adults with food allergy had been bullied at some time because of their food allergy (Feng and Kim, 2019). Also, the presence of comorbid allergic diseases has a major impact on the quality of life of a person suffering from food allergy. Patients who were diagnosed with another allergic disease in addition to food allergy such as asthma, allergic rhinitis, eczema, or other dermatological condition recorded a lower quality of life score compared to individuals who were affected by three or fewer allergic diseases. In addition, asthma has been shown to have a significant effect on the quality of life of individuals with asthma compared to individuals who have no asthma (Jansson et al., 2013). Peniamina et al. (2016) reported that the most common problems with food allergy included negative physical symptoms, higher food prices, food safety concerns, difficulty maintaining a healthy diet, and anxiety or stress at social occasions. Therefore, targeting the identified problems could reduce stress in patients with food allergies and improve their overall quality of life. In the present study, we examine the association between trait anxiety and health-related quality of life (HRQL) in an adult population with food allergy. We also investigate several possible factors that are related to food allergy and may thus contribute to a decreased quality of life and an increased level of trait anxiety.

## Materials and methods

The study sample consisted of adults from Slovakia aged 19 to 69 years with food allergy. The total number of valid respondents was $N = 167$, of which 158 were female and 9 were male. The research sample was collected using occasional sampling, convenience sampling, and snowball technique. Several social networking groups of people with food allergies were approached: Milk Allergy and Lactose Intolerance, Coeliac Disease (Gluten Free Diet), Lactose Free Diet and Probably HIT, How to LIVE with HIT? (Histamine Intolerance). Data collection was carried out online from June 2021 to November 2021. Respondents were informed at the outset about the legal framework regarding privacy and the aim of the research. There was no time limit for completing the questionnaire. The FAQLQ-AF questionnaire is the first disease-specific questionnaire measuring HRQL in adult population with food allergy and reflects the most important problems that food allergy can bring with it. Research has demonstrated good internal consistency and construct validity (Flokstra-de Blok et al., 2009). It contains 29 items on a seven-point scale, where 1 is the best possible score (highest HRQL) and 7 the worst possible score (lowest HRQL) (Jansson et al., 2013). The tool was developed as part of the EU EuroPrevall project which aims to improve quality of life in individuals with food allergy. The FAQLQ-AF consists of four domains: allergen avoidance and dietary restriction (AADR), emotional impact (EI), risk of unintentional allergen exposure (RAE), and food allergy associated with health (FAH) (Jansson et al., 2013). The questionnaire also includes a Food

Allergy Independent Measure (FAIM) section, which was developed to validate the questionnaire (Salvilla et al., 2014). The STAI (State-Trait Anxiety Inventory) research instrument differentiates anxiety as a current psychological state, and anxiousness as an enduring personality trait. The authors of the scale were Spielberg, Gorush, and Lushene – and it was originally published in 1970. The Slovak version was published in 1980 thanks to Müllner, Ruisel and Farkas (Svoboda et al., 2013). It is a 40-item self-assessment questionnaire, aimed at measuring STAI X1 state anxiety and STAI X2 trait anxiety. Each subscale has 20 items. Items are rated on a scale of 1 to 4, where 1 represents almost never and 4 almost always. The STAI X1 subscale contains statements on the question: "how the respondent feels now". In our research we focus mainly on STAI X2, which contains statements on the question "how the respondent usually feels" (Müllner et al., 1980). IBM SPSS Statistic 27 and Microsoft Excel were used for statistical data processing. Some variables had to be recoded and categorized before data processing. To verify the significance, a threshold of $p < 0.05$ has been set.

## Results

The measured values of both research instruments indicate appropriate and very high reliability. The FAQLQ-AF tool was translated according to the instructions of the questionnaire author Flokstra-de Blok (personal communication, March 1, 2021) and used for the first time in an adult population within Slovakia. Cronbach's alpha was measured at 0.959 for the Slovak version of the FAQLQ-AF together with the FAIM section. The FAQLQ-AF alone had a value of 0.957 and the FAIM had a value of 0.771. Cronbach's alpha of its four dimensions (AADR, EI, FAH and RAE) was measured at 0.913. The Cronbach's alpha of the STAI instrument had a measured value of 0.906. Specifically, the STAI X 2 had a measured value of 0.942.

The results reveal that the number of food allergies is not linearly correlated with the overall HRQL rate. Allergy duration is not linearly related to anxiety, and disease duration is not linearly related to HRQL or to the individual domains of the FAQLQ-AF. There was no significant difference in HRQL variable values between participants prescribed an epinephrine injection (EpiPen). There was also no significant difference in HRQL variable values between genders. However, there was a statistically significant difference in the mean rankings for the HRQL (Table 1) and anxiety variables between people with and without related disease (Table 2).

**Table 1. Results of testing: Mann–Whitney *U* test**

| | Related disease | *N* | Mean ranking | Mann–Whitney test | |
|---|---|---|---|---|---|
| HRQL | yes | 64 | 96.58 | *U* | 2491.000 |
| | no | 103 | 76.18 | *Z* | –2.650 |
| | total | 167 | | Sig. | 0.008 |

**Table 2. Additional findings: Mann–Whitney *U* test**

| | Related disease | *N* | Mean ranking | Mann–Whitney test | |
|---|---|---|---|---|---|
| Trait anxiety | yes | 64 | 93.52 | *U* | 2686.500 |
| | no | 103 | 78.08 | *Z* | –2.007 |
| | total | 167 | | Sig. | 0.045 |

Next, we looked at the difference in mean rankings between people who have and do not have prescribed medication (Table 3). Based on the analysis, a statistically insignificant result was found for the HRQL variable, but a statistically significant result for the trait anxiety variable.

**Table 3. Results between medication and trait anxiety: Mann–Whitney *U* test**

| | Medication | *N* | Mean ranking | Mann–Whitney test | |
|---|---|---|---|---|---|
| Trait anxiety | yes | 50 | 73.22 | *U* | 1514.000 |
| | no | 78 | 58.91 | *Z* | –2.131 |
| | total | 128 | | Sig. | 0.033 |

The Kruskal–Wallis test was used to detect the difference in the groups according to the prevalence of food allergy symptoms in the HRQL rate, with a result of $\chi^2 = 42.368$ at df = 25; Sig. < 0.05. Differences in mean ranks between groups are statistically significant. There is a significant difference in HRQL rates between persons of different types of food allergy symptoms. Participants ($N = 1$) with a combination of skin, mucosal, respiratory, and gastrointestinal symptoms have the highest value of the FAQLQ-AF measure, which is the worst HRQL value (MR = 158.00). Participants ($N = 2$) with skin, respiratory, and gastrointestinal symptoms have the lowest FAQLQ-AF, which is the highest HRQL value (MR = 11.00). There was a significant difference in the level of anxiety between people with and without tetanic syndrome.

In the next step, we addressed the possible predictors of trait anxiety rates on HRQL of people with food allergy. We used linear regression analysis to find the prediction. We consider the correlation between the trait anxiety and HRQL variables to be significant, with a Sig. value < 0.001 (Table 4). HRQL linearly related to trait anxiety. The relationship is significant, positive, and moderate. A statistically significant model [$F$ (1,165) = 29.86, ρ < 0.001] was used for prediction (Table 5). The Durbin–Watson test indicates no independent measurement error. The adjusted $R^2$ value explains that 14.8% of the variance in anxiety scores can be explained by the variance in HRQL (Table 6). Trait anxiety is a statistically significant predictor of HRQL level ($t = 5.465$, ρ < 0.001). The regression model in Table 7 showed that an increase in the level of trait anxiety decreased the HRQL level by 0.806 points. The regression equation for this model is: reduced HRQL rate = 2.768 – (0.806 × trait anxiety). The Charts 1 and 2 graphically display the results.

**Table 4. Results of Spearman's rank coefficient on the correlation (*p*) between HRQL and trait anxiety**

| | | |
|---|---|---|
| Trait anxiety | Spearman ρ | 0.382 |
| | Sig. | 0.000 |
| | *N* | 167 |

**Table 5. Results of linear regression analysis – ANOVA**

| ANOVA Model | | Sum of squares | df | Mean square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 35.52 | 1 | 35.52 | 29.86 | 0.000 |
| | Residual | 196.26 | 165 | 1.19 | | |
| | Total | 231.78 | 166 | | | |

**Table 6. Results of linear regression analysis – model summary**

| Model | R | R-Square | Modified R square | Standard deviation | Sig. *F* | Durbin–Watson |
|---|---|---|---|---|---|---|
| 1 | 0.391 | 0.153 | 0.148 | 1.09062 | 0.000 | 2.055 |

**Table 7. Results of linear regression analysis – coefficients**

| Model | | Unstandardized coefficients | | Standardized coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. error | Beta | *t* | Sig. |
| 1 | Constant | 2.768 | 0.361 | | 7.675 | 0.000 |
| | Trait anxiety | 0.806 | 0.147 | 0.391 | 5.465 | 0.000 |

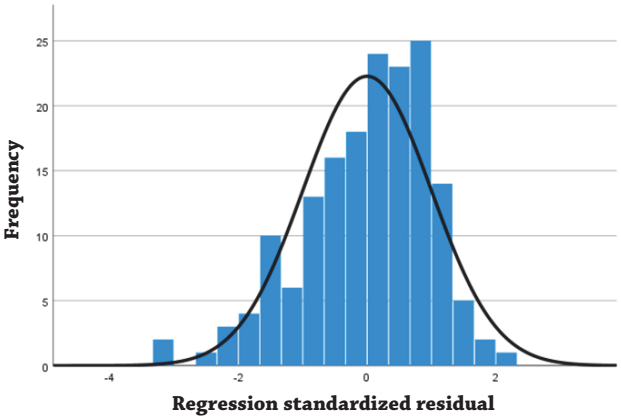


**Chart 1.** Histogram of the distribution of residuals of the linear regression analysis of the dependent variable HRQL

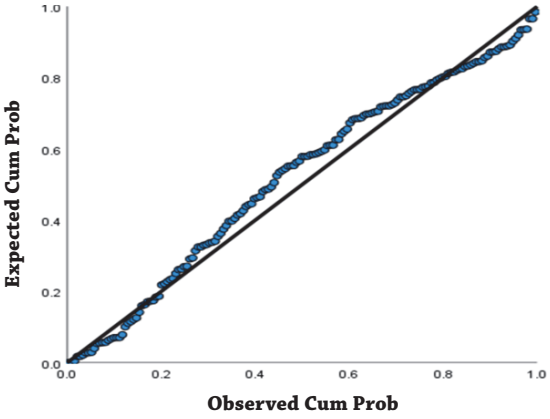


**Chart 2.** P-Plot showing observed and predicted standardized residuals from LA analysis of HRQL

## Discussion

Why is it legitimate to link the consequences of food allergy to an individual's trait anxiety and quality of life? Constant dietary restrictions, unreadable labels, restricted social consumption, mobbing and bullying related to food allergy are just a few factors that directly affect quality of life. On the other hand, the threat of accidental ingestion, constant vigilantism and possible loss of control are long term and unchanging realities that can easily contribute to increased anxiety. The largest number of respondents (49%) had suffered food allergies from a range of one to five years. The question remains as to whether people to whom this condition is new are seeking out groups in the online space with similar issues, or whether this is an upward trend in the rise of food allergy diagnoses (as highlighted in research by Sicherer and Sampson, 2018). More than half of the respondents (53%) are satisfied with their doctor, giving their doctor the highest rating between 8–10. Gastroenterologists were at 36%, followed by allergists at 30%. Noticeably, in Slovakia it is mainly gastroenterologists and allergists who are key to the detection and diagnosis of food allergy. Meanwhile, around 10% of diagnoses were made by immunologists and immuno-allergists. It is therefore important that these specialists have the appropriate communication skills, as doctor-patient communication plays an important role in the patient's quality of life and in their experience of anxiety in relation to the diagnosis of food allergy. It would also be interesting to see how research would have developed in the paediatric population.

According to several studies, a higher number of food allergies leads to a decrease in the overall HRQL rate (Flokstra-de Blok et al., 2009; Goossens et al., 2011). In the present study, this claim was verified using Spearman's rank correlation coefficient, which did not support a relationship between HRQL and the number of allergic foods. In the research, food allergens were divided into groups, where each group was assigned one point within the coding. If a respondent reported a histamine allergy, it received 4 points as this includes a wide range of foods from different categories. The research results are in line with the study by Jansson et al. (2013), where it was confirmed that the number of food allergies was not related to change in quality of life (HRQL), and those with more than four types of food allergens did not have significantly different HRQL rates compared to respondents who were allergic to three or fewer foods. Within foods, it is mainly cow's milk protein, gluten, and fruit that most often cause digestive problems. The most common symptoms were digestive problems such as flatulence, cramps, and diarrhoea. In addition, respondents were given the opportunity to write down other symptoms. The most frequently mentioned were fatigue, sweating, irritability, mood changes, anxiety, insomnia, and tremors.

Participants suffering from concomitant allergic problems achieved lower HRQL rates compared to those without concomitant allergic problems (Jansson et al., 2013). Our research confirmed the above statement. It was possible to demonstrate a significant difference between individuals who suffer from concomitant allergic problems and those who do not have other allergic diseases. Based on the results obtained,

we looked at another possible association between related diseases and trait anxiety. Here too, a statistically significant difference between those with related illnesses and those who do not suffer from them was confirmed. It seems that related illnesses in people with food allergy are a possible additional burden, causing a significant difference in HRQL and trait anxiety levels. According to studies (Greenhawt, 2016; Jansson et al. 2013), the prescription of an epinephrine injection leads to a worsening of the HRQL level. Based on the findings, there was no evidence of a difference in HRQL levels between people who were prescribed an adrenaline injection and those who were not. The results are consistent with the claims of the study by Saleh-Langenberg et al. (2015), where the EpiPen did not contribute to worsening HRQL. However, in our research only 16 individuals were prescribed this medication.

Several studies (DunnGalvin and Hourihane, 2016; Greenhawt, 2016; Saleh-Langenberg et al., 2015) have found that the male gender demonstrated less impaired HRQL level than the female gender. However, according to our findings, there is no significant difference in HRQL scores between genders. It is important to point out the unevenness of the sample in relation to male and female gender representation. Of the total 167 respondents, only 9 persons represented the male gender group, which could have led to a bias in the results. Another limitation is the nature of the measurement instruments (i.e., the self-assessment scales). These may negatively affect the objectivity of the measured results and the research instrument itself. Since the FAQLQ-AF research instrument was used for the first time on the Slovak population, it would be advisable to conduct further findings and research to further validate the Slovak version of the research instrument.

## Conclusions

Research on the links between food allergy, anxiety and quality of life is still in its beginnings in central Europe. The present study provides one of the first insights into this issue in Slovakia. The research offers useful insights that could be beneficial in the management and therapy of food allergy, providing inspiration for effective and early intervention and leaving only prevention. Furthermore, we believe this study can be a stimulus for further research that covers anxiety and health-related quality of life in people with food allergy.

### *Ethical aspects and conflict of interests*

The authors have no conflict of interests to declare.


### Súvislosť úzkostlivosti a kvality života u dospelej populácie s potravinovou alergiou

**Súhrn**

*Úvod:* Potravinová alergia je chronické ochorenie, ktoré si vyžaduje veľké úsilie a môže mať za následok nielen zníženú kvalitu života, ale aj zvýšený pocit úzkosti a stresu. Štúdia skúma súvislosť medzi potravinovou alergiou, kvalitou života (HRQL) a úrovňou úzkostlivosti u dospelých jedincov s potravinovou alergiou. Sekundárnym cieľom bolo overiť spoľahlivosť slovenskej verzie dotazníka FAQLQ-AF, ktorý bol použitý pre slovenskú populáciu po prvýkrát.

*Metódy:* Výskumnú vzorku tvorilo 167 dospelých osôb s potravinovou alergiou vo veku 19–69 rokov (M vek = 37). Na meranie úzkostlivosti bol použitý dotazník STAI X2 a na meranie kvality života súvisiacej so zdravím bol použitý dotazník FAQLQ-AF, ktorý dosiahol vysoké hodnoty reliability.

*Výsledky:* Vo výsledkoch sa preukázal mierny, pozitívny vzťah medzi úzkostlivosťou a HRQL meraný dotazníkom FAQLQ-AF. Jednoduchá lineárna regresná analýza preukázala, že úroveň črty úzkosti je prediktorom úrovne HRQL a nárast úrovne úzkostlivosti znižuje úroveň HRQL. Faktory ako tetanický syndróm, komorbidity, predpísané lieky a odporúčané voľnopredajné lieky sú spojené s úrovňou úzkostlivosti. Súvisiace ochorenia a zoskupenia symptómov súvisia s úrovňou HRQL.

*Závery:* Dospelí jedinci s potravinovou alergiou, ktorí sú viac úzkostliví, majú vyššiu pravdepodobnosť horšej kvality života. Včasná intervencia a prevencia, optimalizácia manažmentu liečby by mali byť nutnou súčasťou psychologickej starostlivosti o pacientov s potravinovou alergiou.


**Kľúčové slová:** HRQL; kvalita života; potravinová alergia; úzkosť; úzkostlivosť

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