

The Influence of Food Allergies on Health-Related Quality of Life

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Received February 15, 2023; Revised August 6, 2023; Accepted, September 13, 2023

Abstract

Since the 1990s, the prevalence of food allergies has grown. Individuals with food allergies must prepare for potentially life-threatening allergic reactions. Previous research has shown that food allergies contribute to increased anxiety because of avoidance of allergens, ultimately contributing to the health-related quality of life of both the patient with the allergy and the parents of a child with a food allergy. It is necessary to investigate the impact of health-related quality of life with an inclusive demographic of participants, a component past studies lack, to better create food allergy management strategies. The influence of food allergies on health-related quality of life was closely examined through the distribution of three surveys: a general health-related quality of life questionnaire based on a number of reported unhealthy days, and a food allergy-specific health-related quality of life adolescent and parental burden questionnaire. 113 adolescents and 274 parents completed these surveys after providing informed consent. Adolescents with a food allergy had fewer overall unhealthy days than non-allergic adolescents, but reported a greater number of unhealthy mental and physical health days. Adolescents with long-term health impairments reported a greater number of overall unhealthy days than adolescents with food allergies. Parents of a child with a food allergy reported experiencing a larger quantity of overall and physically unhealthy days than parents of a child without a food allergy, though no significant conclusion could be drawn regarding the connection between the parental burden associated with food allergies to health-related quality of life.

Keywords: Allergies, Adolescent, Health-Related Quality of Life, Parent, Stress

1. Introduction

Food allergy (FA) prevalence has risen significantly throughout the past three decades, an epidemic and “food safety and public health concern” that impacts 31.6 million people in the United States (Centers for Disease Control and Prevention (CDC), 2020, para. 1; Platts-Mills, 2015; Food Allergy Research & Education, n.d.-a). The variety of food allergens has increased along with these rising cases (Jones, 2020), but the most common, or the “Big 9”, are “milk, eggs, fish, shellfish, tree nuts, peanuts, wheat, soybean, and sesame” (U.S. Food and Drug Administration (FDA), 2022, para. 4).

FA and food intolerance are often unclearly distinguished in research (Teufel *et al.*, 2007). It is therefore necessary to first differentiate the two. As a result of a FA, consuming a particular food protein, or allergen, causes the immune system to overreact (Food Allergy Research & Education, n.d.-b), whereas food intolerance is a digestive issue. Secondly, the term “health-related quality of life” (HRQOL) will be used in this study, referring to the effect quality of life has on one’s “perceived physical or mental health over time” (CDC, 2018a, para. 7).

2. Literature Review

The combination of increasing prevalence of FA and the lack of treatment options to completely resolve it leaves patients with FA to cope with a constant fear of allergic reaction, even to the point of experiencing anaphylaxis, a potentially deadly reaction. They must stay perpetually vigilant. In addition, food allergens are difficult to clearly identify on food labels, for trace amounts of allergens may be found in packaged foods. This contributes to the stress and confusion of patients with a FA (Athas, 2019). Furthermore, Congress does not yet require all “Big 9” allergens to be listed on ingredient labels. For example, identifying the presence of sesame will not be mandatory until 2023. This contributes to already high distrust of food labels and the need for consumers to engage in “risk assessments” (FDA, 2022; Athas, 2019). Moreover, children with FA often display increased anxiety, particularly when engaging in social activities such as eating at restaurants and attending birthday parties. Their parents often experience guilt for their child’s anxiety (Cimons, 2021). Dietary restrictions, a common method of avoiding accidental consumption of food allergens, have also been found to contribute to poor HRQOL in adolescents with FA (Nowak-Wegrzyn *et al.*, 2021). Moreover, caring for a child with FA costs families billions of dollars annually (FARE, n.d.-a), creating potential financial strain that may induce increased stress levels in another way. This can also undermine mental health. Ultimately, these factors influence the HRQOL of both the patient with a FA and their caregivers.

Numerous factors, such as FA development and novel treatments, have been investigated. However, HRQOL remains insufficiently researched. The CDC highlights the importance of investigating HRQOL, as this would promote better improvement of public health and provide a means to determine the burden of certain medical conditions (CDC, 2018b). Additionally, limited studies have investigated HRQOL, using a FA-specific scale rather than a general HRQOL questionnaire (Cummings, 2010). Unfortunately, although FA-specific HRQOL questionnaires have been developed, until recently, few had been statistically validated with a broad sample. The EuroPrevall project, which sought to create management strategies for patients with a FA, resolved this issue and successfully validated several FA-specific questionnaires for children, teenagers, and parents (Fernandez-Rivas *et al.*, 2015). Two of these instruments were used in this study. These questionnaires have been effectively employed since Nowak-Wegrzyn *et al.* (2021) utilized the FA Quality of Life Questionnaire-Teenager Form to measure the HRQOL of adolescents with FA, and Franxman *et al.* (2015) utilized the FA Quality of Life Questionnaire-Parental Burden Form to conclude that caregivers of patients with a confirmed FA reported poor HRQOL.

An additional issue with current FA research is the narrow demographic band of participants. For instance, Cohen *et al.* (2004) sought to validate a disease-specific HRQOL questionnaire to determine the parental burden related to caring for a child with a FA, yet 96% of participants were mothers, 90.8% were White, and nearly half earned over \$100,000, demonstrating a severe lack of gender, racial, and economic diversity within its participants. A study by Nowak-Wegrzyn *et al.* (2021) demonstrated similar problems in terms of its racial demographic, with a parent sample that was 69.4% White. However, these researchers *did* contribute to the limited research available regarding the connection between feelings of parental burden and caring for a food- allergic child, concluding that patients with peanut allergies and their caregivers self-reported poor HRQOL. Moreover, equal gender representation is lacking throughout the current research. In King *et al.* (2009), only 35% of food-allergic participants were female. In Penner Protudjer *et al.* (2016), only 31% of participants were female. It is vital to rectify these percentages, as females with FA are more likely to exhibit poorer HRQOL than males (Penner Protudjer *et al.*, 2016).

However, some suggest that other facets of FA research should be more thoroughly investigated before devoting significant time to HRQOL, given recent progress in treatment options. For instance, oral immunotherapy (OIT), which gradually exposes patients to a food allergen to increase their threshold for allergen consumption without a reaction, has shown promising results. Additionally, Palforzia, now a FDA-approved drug, can be used in the OIT process (Zarif, 2020). Some scholars propose strictly focusing on creating treatment options to completely resolve FA, such as immunotherapy vaccinations, approaches still undergoing clinical trials (Zarif, 2020). Despite these significant developments, HRQOL research remains equally important, for it promotes improved understanding of both the physical and mental burden associated with having a FA.

Thus, this study aims to determine how the presence of a FA influences the HRQOL of food-allergic adolescents and parents of a child with a FA compared to a non-food-allergic population, with a specific focus on increasing the

gender diversity of participants. Within the non-food-allergic adolescent population, the HRQOL of participants with health impairments lasting over 8 months will be compared to the HRQOL of the food-allergic adolescent participants to determine whether a FA is comparable to other long-term health impairments, such as anxiety. Identifying variations between the HRQOL of these populations could aid in the development of effective management strategies for food-allergic patients and their families, with a specific focus on mental well-being. We are especially interested in whether chronic stress, a factor of HRQOL, may exacerbate existing and future health complications (Wright, 2005).

2.1 Hypotheses

It is hypothesized that:

1. Adolescents with a FA will report poorer HRQOL than adolescents without a FA and adolescents with long-term health impairments.
2. Adolescents with a FA will report feeling troubled, frightened, and disappointed by their FA, according to the FA-specific adolescent HRQOL questionnaire.
3. Parents of a child with a FA will report poorer HRQOL than parents of a child without a FA.
4. Parents of children with a FA will report feelings of limitation and fright as a result of their child's allergy, according to the FA-specific parental burden questionnaire.

3. Method

3.1 Participants

113 adolescents, 14-18 years of age, participated. Subjects all hailed from New York's Nassau, Suffolk or Queens counties, with the majority drawn from an all-girls Catholic high school located in Hempstead, NY (mean age = 16.39, standard deviation = 1.02). Participants were recruited via email and through snowball sampling, in which they were asked to share the surveys with other potential study participants. Of the adolescent participants, 5.3% identified as male, 92.9% identified as female, and 1.8% chose not to disclose their gender. The sample mostly aligned with the ethnic makeup of the school, though the percentage of Hispanic/Latina participants was greater (see Table 1).

Table 1. High School Ethnicity Statistics

Ethnicity	High School Population**	Nassau County	United States	Sample %
White	74%	72.2%	75.8%	66.7%
Black	10%	13.1%	13.6%	9.8%
Hispanic / Latino	4%	17.6%	18.9%	13%
Asian / Pacific Islander	11%	11.9%	6.1%	10.6%
Other	-	2.1%	2.9%	-

*Totals may not equal 100 due to those who reported themselves as multiracial.

**2018-19 data provided by Sacred Heart Academy Annual 2019 Report to NYSED + 2021 U.S. Census Estimate (United States Census Bureau, 2021)

274 parents, 22-83 years of age, participated. All participants also resided in Nassau, Suffolk, or Queens (mean age = 37.46, standard deviation = 11.76). 62% of parents/guardians identified as male and 38% as female. The sample reflected a greater percentage of Asian/Pacific Islander participants and a smaller percentage of Black and Hispanic/Latino participants in relation to the demographics of Nassau County or the United States (see Table 2). Additionally, although some parents were related to adolescent participants because their child shared the parent survey with them, the majority of parents had no relation to adolescent participants. The responses of any adolescents with parents who also happened to complete the survey were not linked to their parents' responses in any way.

Table 2. Adult Ethnicity Statistics

Ethnicity	Nassau County	United States	Sample %
White	72.2%	75.8%	72.5%
Black	13.1%	13.6%	3.4%
Hispanic / Latino	17.6%	18.9%	4.1%
Asian / Pacific Islander	11.9%	6.1%	14.8%
American Indian / Alaska Native	.6%	1.3%	3.4%
Other	2.1%	2.9%	1.4%

*Totals may not equal 100 due to those who reported themselves as multiracial.

**2021 data provided by 2021 U.S. Census Estimate (United States Census Bureau, 2021)

Among the 113 total adolescent participants, 18 reported having a FA. This is approximately twice the 8% FA rate for children in the United States (CDC, 2020). Of these adolescents, whose ages ranged from 15-18 (mean = 16.5, standard deviation = 1.1), 5.6% identified as male and 94.4% identified as female. 68.4% identified as White, 10.5% identified as Black/African American, 5.3% identified as Hispanic/Latino, and 15.8% identified as Asian/Pacific Islander. Within the 274 total parent participants, 150 reported

having a school-aged child with a FA. Their ages ranged from 22-67 (mean = 33.68, standard deviation = 10.), and 69.3% identified as male and 30.7% identified as female.

FA support groups, including Food Allergy Support and Education (FASE), were contacted to share the surveys within the food-allergic population of adolescents on Long Island and in Queens, as well as within the population of parents of children with FA. Amazon Mechanical Turk, a virtual survey-distribution platform, was also utilized, which provided monetary compensation for completion of the parent survey. Compensation was supported by a grant from the New York Institute of Technology to support student public health research. The survey participants accessed was titled “Health-Related Quality of Life-Student Form” or “Health-Related Quality of Life-Parent Form,” and all participation was on a volunteer basis.

3.2 Design

This study utilizes a between-subject experimental design. The independent variable is the presence of FA in an adolescent participant, and the dependent variable is the HRQOL of participants, as well as the subscales of the FA-specific questionnaires (troublesome, frightened, disappointed, and limited). Adolescent participants completed their appropriate survey online via Google Forms after parent/guardian consent, and their assent was provided at the beginning of the form. Parents/Guardians provided their consent before completing their own appropriate form.

3.3 Measures

FA-Specific HROOL

The Food Allergy Quality of Life Questionnaire-Teenager Form (FAQLQ-TF) (Flokstra-de Blok *et al.*, 2008) is a 23-item questionnaire designed to determine the HRQOL of adolescents with a FA. The survey utilizes a 7-point scale, from 0 (not) to 6 (extremely), and includes 4 domains: how troublesome the FA, with a

Table 3. FAQLQ-TF Sample Questions - Flokstra-de Blok et al. (2008)

Subscale	Sample Question
Troublesome 1	How troublesome do you find it, because of your food allergy, that you must always be alert as to what you are eating?
Troublesome 2	How troublesome is it, because of your food allergy that you have to explain to people around you that you have a food allergy?
Frightened	How frightened are you because of your food allergy of an allergic reaction?
Disappointed	How disappointed are you when people do not take your food allergy into account?

focus on social situations (questions 1-12), how troublesome the FA is in regard to the packaging of foods (questions 13-18), how frightening the FA is (questions 19- 21), and 2 questions concerning discouragement and disappointment resulting from the FA (questions 22- 23). Table 3 displays a sample question from each domain.

Parental Burden.

The Food Allergy Quality of Life-Parental Burden Questionnaire (FAQLQ-PB) (Cohen, B. L. et al., 2004) is a 17-item questionnaire that details the HRQOL of parents of children with a FA. This survey utilizes a 7-point Likert scale, with 0 indicating “not limited/troubled” and 6 indicating “extremely limited/troubled,” and consists of two subscales. The first 3 questions, part of the first subscale, detail limitations parents/guardians face with a food-allergic child, and the following 14 questions of the second subscale detail how troubled they are for their child. Table 4 displays a sample question from each subscale.

Table 4. FAQLQ-PB Sample Questions – Cohen, B. L. et al. (2004)

Subscale	Sample Question
Limitation	If you and your family were planning a holiday/vacation, how much would your choice of vacation be limited by your child’s food allergy?
Troublesome	In the past week, how troubled have you been by your concerns for your child’s health because of their food allergy?

General HRQOL

The Healthy Days Measure (CDC, 2018b) is a 14-item survey detailing a participant’s general HRQOL by evaluating the number of unhealthy days a participant had within the past 30 days before completing the survey¹. It contains the

Healthy Days Core Module (overall health), the Activity Limitations Module (mental health), and the Healthy Days Symptoms Module (physical health). The Healthy Days Module contains questions 1-4, the Activity Limitations Module contains questions 5-9, and the Healthy Days Symptoms Module contains questions 10-14. Question 1 is based on a 5-point scale, where 1 represents “excellent,” and 5 indicates “poor.” Questions 2, 3, 4, 10, 11, 12, 13, and 14 are fill-in questions in which participants indicate a number of unhealthy days. It should be noted that question 14 was reverse scored, as it originally asked for a number of healthy days. Questions 5, 8, and 9 are “yes/no” questions, question 6 allows participants to select an answer, and question 7 provides ranges of time to select. Table 5 displays a sample question from each module. All surveys utilized in this study are in the public domain.

Table 5. The Healthy Days Measure Sample Questions - CDC (2018b)

Module	Sample Question
Healthy Days Core Module	During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?
Activity Limitations Module	During the past 30 days, for about how many days have you felt worried, tense, or anxious?
Healthy Days Symptoms Module	During the past 30 days, for about how many days have you felt very healthy and full of energy?

3.4 Procedure

Surveys were first distributed at the beginning of 2022 (winter), followed by additional distribution during fall (2022). All surveys began with a consent form briefly explaining the purpose of the project, the time necessary to complete the survey, with a promise of anonymity and minimal risk in participation. Contact information for myself, my advisor, the science department chair, and the school social worker were also provided for those with questions. Consequently, the adolescent survey required electronic parent/guardian consent and student assent before beginning the questionnaire, followed by basic demographic information. All households in the single-sex school community are notified by robocall and email about upcoming student surveys. All student participants completed the Healthy Days Measure (CDC, 2018b). They were then asked to read the provided definition of “food allergy” (to differentiate with food intolerances) before responding if they had a clinically diagnosed FA. The language used is as follows:

“Food Allergy: “An allergy occurs when your body’s natural defenses overreact to exposure to a particular substance, treating it as an invader and sending out chemicals to defend against it” (American College of Allergy, Asthma, & Immunology, n.d.). Some symptoms include vomiting, hives, dizziness, and even anaphylaxis. Note that this is NOT a food intolerance, which is an issue the body has in digesting particular

foods (e.g., lactose intolerance, gluten intolerance).”

The form displayed a debriefing page explaining the goal of the study and requesting that participants refrain from discussing their responses with others to maintain confidentiality and unbiased results, and was then submitted for those who responded “no.” Those who answered “yes” were directed to complete the FAQLQ-TF (Flokstra-de Blok *et al.*, 2008) to determine their FA-specific HRQOL. Finally, the participant stated their specific FA and was shown the debriefing form before submitting their response. Prior to data analysis, adolescents without FA were grouped into three categories based on their response to question 7 of the Healthy Days Measure: Group 1 included those who reported a health impairment lasting 0-3 weeks, Group 2’s impairment lasted 1-7 months, and Group 3’s impairment lasted over 8 months.

Parent participants completed a separate Google Form, first providing their own consent to participate, followed by demographic questions. All parents/guardians completed the Healthy Days Measure (CDC, 2018b) to determine their general HRQOL. The definition of “food allergy” was provided before indicating if their child has a FA. Those who responded “no” were shown the debriefing form and submitted their form. Those who answered “yes” were directed to complete the FAQLQ-PB (Cohen, B. L. *et al.*, 2004), were then shown the debriefing page before their form was submitted.

Unpaired *t*-tests were used to investigate Hypotheses 1 and 3. In the adolescent sample, the responses to the Healthy Days Measure (CDC, 2018b) from those without FA were compared to the responses of those with FA to determine the differences in the two groups’ HRQOL. The Healthy Days Measure (CDC, 2018b) responses from parents without a child with FA were also compared to the responses of parents with a food-allergic child to determine the differences in HRQOL. The *t*-test allowed for the comparison of the means of unhealthy days within the adolescent group and the means within the parent group, and allowed for accurate conclusions to be drawn regarding the differences in each group. The *t*-test also yielded *p*-values, or “probability” values. These offered insight into whether these conclusions were statistically significant and could be utilized to effectively answer the hypotheses. $P > .05$ was deemed statistically insignificant, $p < .05$ was deemed significant, $p < .01$ offered strong significance, and $p < .001$ was deemed the most significant.

Correlations tested for linear relationships to examine Hypotheses 2 and 4. This test yielded an R^2 value, the correlation coefficient, and a *p*-value was also calculated. The R^2 value reveals the variance between the independent and dependent variables tested. To test for the correlation between the presence of FA and poor HRQOL, the responses of the FAQLQ-TF (Flokstra-de Blok *et al.*, 2008) and the Healthy Days Measure (CDC, 2018b) were compared. To test for the correlation between being a parent of a food-allergic child and having poor HRQOL, the FAQLQ-PB (Cohen, B. L. *et al.*, 2004) and the Healthy Days Measure (CDC, 2018b) were compared.

4. Results

A series of unpaired *t*-tests were run to determine if the mean differences between each groups’ Healthy Days Measure were significant. Adolescents without FA from the initial winter subsample were found to suffer from

Table 6. Means (Standard Deviation) of the Adolescent Healthy Days Measure

	Winter 2022 Subsample (N=80)		Fall 2022 Complete Sample (N=113)	
	FA	No FA	FA	No FA
Number of Overall Unhealthy Days	16.36 (11.72) ^a	22.2 (9.95) ^a	16 (11.2) ^a	21.6 (9.38) ^a
Number of Mentally Unhealthy	16.25 (12.54) ^a	23.2 (9.69) ^a	36.5 (14.14) ^A	23.59 (9.73) ^B
Number of Physically Unhealthy Days	20.7 (11.83) ^a	27.6 (6.47) ^a	48.7 (23.72) ^A	26.49 (7.79) ^B

Means with different superscripts (*lowercase*) differ at 95% confidence level. ($p < .05$)

Means with different superscripts (*uppercase*) differ at 99% confidence level. ($p < .01$)

poorer HRQOL than adolescents with FA in terms of unhealthy mental and physical health days ($p < .05$). Adolescents without FA also reported a greater average number of overall unhealthy days, with an average of 22.2 days compared to the 16.36 days reported by adolescents with a FA, but this subscale was deemed only marginally significant ($p = .057$). (See Table 6, columns 1 and 2.)

Table 7. Healthy Days Measure and FAQLQ-TF Correlation

	Winter 2022 Subsample (N=14)		Fall 2022 Complete Sample (N=18)	
	R ²	p-value	R ²	p-value
Troublesome 1/Overall Health	.197	.112	.076	.268
Troublesome 1/Mental Health	.197	.112	.158	.103
Troublesome 1/Physical Health	.282	.019	.415	.004
Troublesome 2/Overall Health	.222	.089	.144	.120
Troublesome 2/Mental Health	.229	.076	.230	.044
Troublesome 2/Physical Health	.448	.009	.429	.003
Frightened/Overall Health	.234	.080	.389	.006
Frightened/Mental Health	.146	.178	.523	.001
Frightened/Physical Health	.425	.012	.453	.002
Disappointed/Overall Health	.179	.132	.420	.004
Disappointed/Mental Health	.16	.156	.557	<.001
Disappointed/Physical Health	.229	.030	.600	<.001

Boldface type signifies robust and statistically significant data, with R² >.4 and p<.05.

the complete Fall 2022 sample, moderate correlations were identified between physical health and feelings of trouble and fright, while a stronger correlation was identified between physical health and feelings of disappointment. Additionally, overall health and mental health were found to correlate with feelings of fright and disappointment (see Table 7).

The following Table 8 details the specific food allergies reported by adolescent participants, with the most common being peanut and tree nut allergies.

Table 9. Mean (Standard Deviation) of the Parent Healthy Days Measure

	Winter 2022 Subsample (N=43)		Fall 2022 Complete Sample (N=231)	
	FA	No FA	FA	No FA
Number of Overall Unhealthy Days	7 (9.0) ^a	14.76 (10.57) ^a	19.5 (12.38)^{***A}	12.68 (11.38)^{***B}
Number of Mentally Unhealthy	9 (11.17) ^{*a}	13.79 (11.13) ^{*b}	17.8 (11.47)^{***A}	23.42 (10.42)^{***B}
Number of Physically Unhealthy Days	20.2 (12.3) ^{*a}	22.7 (9.88) ^{*b}	27.09 (6.6)^{***A}	22.7 (9.71)^{***B}

*p<.05; **p<.01; ***p<.001

Means with different superscripts (*lowercase*) differ at 95% confidence level. (p<.05)

Means with different superscripts (*uppercase*) differ at 99% confidence level. (p<.001)

In the complete fall sample, which included data from the previous winter subsample as well as additional responses solicited during September of the same year, adolescents with FA were found to report a greater average

number of unhealthy mental and physical health days (p<.001). Adolescents without FA continued to demonstrate a greater number of overall unhealthy days compared to their food allergic counterparts (p<.05). (Table 6, columns 3 and 4.) Group 3 adolescents had poorer HRQOL, in terms of their overall unhealthy days (M = 26.75, SD = 6.73), than food-allergic adolescents, but reported fewer unhealthy mentally (M = 24.75, SD = 9.48) and physically (M = 24.56, SD = 8.73) unhealthy days. 81.8% of Group 3 participants reported having anxiety/depression, which are mental health conditions.

Among the Winter 2022 subsample, moderate correlations were found between physical health and feelings of trouble and fright among participants with FA, subscales of the FAQLQ-TF (Nowak-Wegrzyn *et al.*, 2021) and the Healthy

Days Measure (CDC, 2018b). Within

Table 8. Adolescent Reported FA

Allergy	Percentage
Milk	3.0%
Eggs	9.1%
Fish	3.0%
Shellfish	9.1%
Tree Nuts	24.2%
Peanuts	24.2%
Wheat	3.0%
Sesame	12.1%
Other	15.0%

Totals may not equal 100 due to those who reported having multiple FA.

Within the Winter 2022 subsample, a series of unpaired *t*-tests found that parents of a child without a FA had poorer HRQOL in terms of overall health ($M = 14.76, SD = 10.57$), than parents of a child with a FA ($M = 7, SD = 9, p < .05$). Though parents of a child without a FA also reported a greater number of average unhealthy mental ($M = 13.79, SD = 11.13$) and physical ($M = 22.7, SD = 9.88$) health days, these results were deemed statistically insignificant, with *p*-values of .241 and .512, respectively (see Table 9, columns 1 and 2). The Fall 2022 Complete Sample, however, differed; parents with a child with a FA reported a greater number

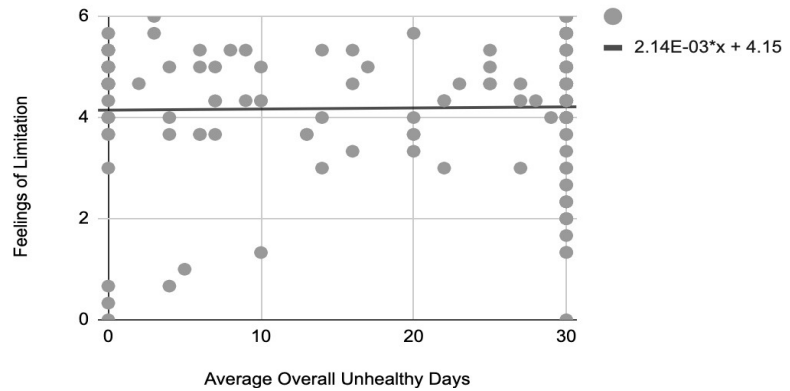


Figure 1. Fall 2022 Complete Sample Parent Overall Unhealthy Days vs. “Limitation” Correlation

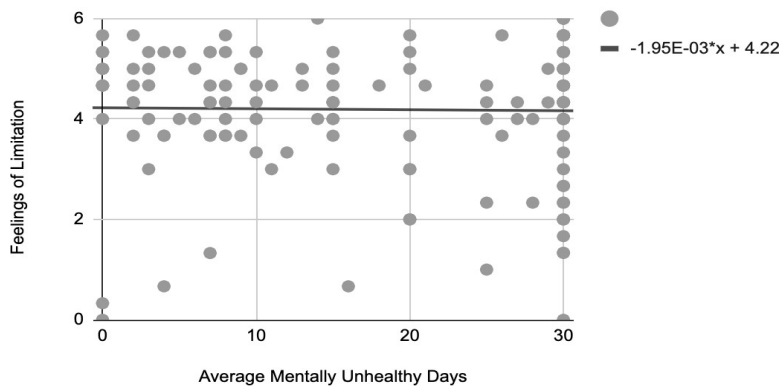


Figure 2. Fall 2022 Complete Sample Parent Mentally Unhealthy Days vs “Limitation” Correlation

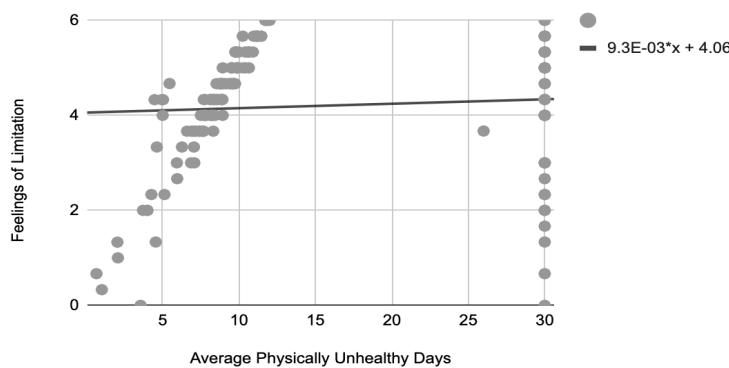


Figure 3. Fall 2022 Complete Sample Parent Physically Unhealthy Days vs “Limitation” Correlation

of overall ($M = 19.5, SD = 12.38$) and physically ($M = 27.09, SD = 6.6$) unhealthy days ($p < .001$). Parents of a child without FA displayed a greater average number of mentally unhealthy days ($p < .001$). (See Table 9, columns 3 and 4.)

A significant conclusion could not be drawn in either sample regarding the correlation between HRQOL and the parental burden experienced by parents of a child with a FA ($p > .05$), as displayed in Table 10. Numerous outliers in data were also identified (see Figures 1-3).

5. Discussion

Contrary to hypotheses 1 and 3, adolescents from the Winter 2022 subsample with a FA and parents of a child with a FA reported fewer average unhealthy days, and therefore, had better HRQOL than their allergy-free counterparts. Additionally, hypothesis 4 was unsupported, as significant feelings of parental burden could not be determined. Hypothesis 2 was partially supported in that unhealthy *physical* health days were related to

feelings of trouble, fright, and disappointment; however, unhealthy overall and mental health days were not significantly associated to these feelings.

In the Fall 2022 complete sample, however, hypothesis 1 was better supported, as adolescents with a FA *did*

Table 10. Healthy Days Measure and FAQLQ-PB Correlation

	Winter 2022 Subsample (N=10)		Fall 2022 Complete Sample (N=150)	
	R ²	<i>p-value</i>	R ²	<i>p-value</i>
Limitation/Overall	.048	.560	<.001	.808
Limitation/Mental Health	.01	.926	<.001	.836
Limitation/Physical Health	.017	.716	.005	.395
Troubled/Overall	.230	.160	.030	.034
Troubled/Mental Health	.287	.110	.008	.290
Troubled/Physical Health	.042	.570	.027	.045

exhibit poorer HRQOL in terms of both mentally and physically unhealthy days than those without FA. Additionally, hypothesis 2 was supported, as correlations were identified between physical health with feelings of disappointment, overall health with fright and disappointment, and mental health with fright and disappointment. Regarding hypothesis 3, parents of a child with a FA *did* display poorer

HRQOL than parents with a child without FA in terms of a) overall and b) physically unhealthy days. Correlations from this complete sample also supported parts of hypothesis 4. Physical health, overall health, and mental health were all significantly linked with various components of the FAQLQ-PB.

The initial Winter 2022 results came as a surprise, as they proposed conflicting findings to previous research. Nowak-Wegrzyn *et al.* (2021), for instance, concluded that avoidance of allergens, a theme within the FAQLQ-TF, *did* contribute to poor HRQOL among adolescents with a FA. The Fall 2022 complete sample, however, better supported Nowak-Wegrzyn's insights, though slight variations remained. For instance, only certain categories of the Healthy Days Measure were associated with feelings of fright and disappointment among adolescents with FA. Moreover, Franxman *et al.* (2015) found that parents of a child with a FA reported poor HRQOL, while the present study could not draw significant conclusions regarding the HRQOL of parents of a child with a FA in either sample. These differing results ultimately display the necessity of continued FA-specific HRQOL research to better determine the physical and mental burden of having a FA on both the adolescent and their parents.

A source of these variations in results may stem from the demographics of participants in this study. Compared to the demographics of Cohen *et al.* (2004), in which 96% of parent participation was derived from mothers, over half of parent participants in this study were fathers (62%). Additionally, because of unequal participation of female and male adolescents within past FA research, female adolescents were intentionally oversampled, a potential contributing factor to the conclusions formulated herein. Unlike the 35% participation of females in King *et al.* (2009) and the 31% in Penner Protudjer *et al.* (2016), 92.9% of adolescent participants in this study self-identified as female. The demographic of participants allowed for improved gender diversity in this research, and allowed for a historically underrepresented population to become the focus of a novel FA study. In addition, a FA-specific questionnaire, the FAQLQ-TF, was successfully utilized to determine the HRQOL of adolescents with a FA, filling the gap in current FA-specific HRQOL research, which generally lacks the use of FA-specific HRQOL questionnaires. Furthermore, this study successfully addressed a goal for future FA-specific HRQOL research proposed by Teufel *et al.* (2007), as FA and food intolerances were clearly distinguished to participants in the questionnaires.

The findings also demonstrate the seriousness of continuing HRQOL research, both within the FA community and beyond. In particular, 27 of the 33 adolescents who reported long-term health impairments in question 6 of the Healthy Days Measure noted in question 7 that their major impairment was anxiety/depression. There is a dire need for confronting the state of HRQOL of adolescents today so that in the future, their mental and physical health may improve.

Moreover, it is important to consider the differences between the HRQOL of these adolescents with long-term anxiety/depression (the majority of Group 3) and adolescents with FA. Group 3's responses to the Healthy Days Measure (CDC, 2018b) reveal that they experience poorer overall HRQOL than adolescents with FA, while food-allergic adolescents reported a greater number of mentally and physically unhealthy days. Based on these differences, it is therefore evident that various long-term health impairments differ in the way they influence overall, physical, and mental health. A potential reason why FA appears to affect mental and physical health to a greater extent may derive

from the nature of the condition, which revolves around constant hyperawareness of food allergens. Those with FA must constantly avoid consumption of these allergens lest they have a potentially deadly allergic reaction (Lange, 2014), which impacts their physical health. This undoubtedly creates a constant stressor in their lives, influencing their mental health.

5.1 Limitations

The large discrepancy between the number of adolescent participants without a FA and with a FA proved to be a significant limitation. The limited number of participants from the food-allergic population directly impacted the calculated p -values and r^2 values, which are highly dependent on sample size. Attaining adolescent participants with a FA was quite challenging, despite reaching out to various FA support groups and employing a snowball sampling method. Ethical concerns prevented direct payment to minor subjects, but our IRB permitted use of a university grant to “hire” adult survey-takers through Amazon’s well-regarded Mechanical Turk. Thus, a larger sample size of food-allergic participants would allow for more significant conclusions to be drawn.

As previously mentioned, a snowball sampling technique was utilized to increase the sample size of adolescents with a FA and parents of a child with a FA. Though the benefit of circulating the questionnaires through participants was gained, participation was no longer truly random, and the possibility of greater sampling bias was introduced.

The use of Amazon Mechanical Turk also influenced sampling in that “semi-professional” survey-takers look to maximize their income per minute spent on each survey. Because the title of the survey (appropriately) mentioned food allergies, Mechanical Turk subjects skewed heavily towards parents with food-allergic children. If a greater number of participants read the entirety of the description provided, more would have seen we needed control subjects as well.

5.2 Future Research

The findings of this study spark numerous questions to be explored in future research. One possible direction of any additional study would be to investigate whether having *multiple* food allergies more significantly influences HRQOL. This would be an interesting avenue to consider, as it was proven that having at least one FA *does* contribute to feelings of trouble, fright, and disappointment. Additionally, researching how the HRQOL of adolescents with FA compares to autoimmune disorders would allow for a direct comparison of different chronic illnesses, and the comparison of the extent of the burden they may create.

Additionally, the majority of adolescent participants identified as female within this study. Although this allowed a population to be present in a field of research that has not adequately reflected them in the past, it would be beneficial to create a study that has an equal number of male and female adolescent participants. By making this a focus of a future study, findings may be applied to *all* those who suffer from FA, without gender bias.

Moreover, improving racial diversity in future works would allow for a wider, more inclusive demographic to be created, which better reflects the overall population. Prospective research may also aim to incorporate focus groups, as they would provide additional reasoning behind participant responses to the questionnaires administered, allowing for the better overall understanding of the HRQOL of a particular population.

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