

Received Date : 30-Apr-2016

Revised Date : 01-Nov-2016

Accepted Date : 28-Nov-2016

Article type : Regular Article

Title: Parents' perceptions are that their child's health-related quality of life is more impaired when they have a wheat rather than a grass allergy

Nora Borres^{1*}

Nora Nilsson^{2,3,4*}

Isabel Drake¹

Sigrid Sjölander⁵

Caroline Nilsson^{4,6}

Gunilla Hedlin^{2,3,4}

Björn Nordlund^{2,3,4}

¹Department of Clinical Science, Medical Faculty, University of Lund, Malmö,

²Department of Women's and Children's Health, Division for Lung Allergology, Karolinska Institutet, Stockholm, Sweden

³Astrid Lindgren Children's Hospital, Stockholm, Sweden

⁴Centre for Allergy Research, Karolinska Institutet, Stockholm, Sweden

⁵Thermo Fisher Scientific, Immuno Diagnostics, Uppsala, Sweden

⁶Department of Clinical Science and Education, Södersjukhuset, Karolinska Institutet and Sacchsa Children's Hospital, Stockholm, Sweden

*Contributed equally

Running title: Impaired quality-of-life with a wheat allergy

Corresponding author:

Björn Nordlund, RN, PhD

Postal address: Lung/Allergy Division Q2:04, Astrid Lindgren Children's Hospital

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/apa.13688

This article is protected by copyright. All rights reserved.

171 76 Stockholm, Sweden

Phone: +46-70-323 44 14 Fax: +46-8-517 777 39

E-mail: bjorn.nordlund@ki.se

Finance

This study was supported by the Swedish Asthma and Allergy Foundation, the Centre for Allergy Research at the Karolinska Institutet, the Konsul Th C Bergh Foundation, the Foundation Samariten and the Hesselman Foundation.

Conflicts of Interest

Sigrid Sjölander is employed by ThermoFisher Scientific, Uppsala, Sweden. All the other authors have declared no conflicts of interest.

ABSTRACT

Aim: It is unknown whether food allergies have greater impact on quality of life than respiratory allergies. This study compared health-related quality of life (HRQoL) in children allergic to wheat or grass.

Methods: We surveyed 63 children with wheat allergies (median age of five) and 72 with grass allergies (median age 12), with their parents. The Child Health Questionnaires for parents (CHQ-PF28) and children (CHQ-CF87) were applied.

Results: The parents of children in the wheat group recorded significantly lower CHQ-PF28 scores for the impact of their child's allergy on general behaviour, general health perceptions, parental impact of emotions and time and family activities, than the parents of children with

grass allergies (p values <0.001). However, parents in the grass group recorded lower scores for the change in health item than the parents of children with wheat allergies (p=0.020). In the grass group, children and parents reported similar scores for the different questions, but there was poorer correlation between parents and children in the wheat allergy group.

Conclusion: HRQoL was lower in children with wheat than grass allergies according to parental reports, with more consistent perceptions of HRQoL among parents and children in the grass allergy than wheat allergy group.

Keywords

Grass allergy, health-related quality of life, parental perceptions, wheat allergy

Key Notes

- It is unknown whether food allergies have a greater impact on quality of life than respiratory allergies.
- We surveyed 63 children with wheat allergies (median age five) and 72 with grass allergies (median age 12) with their parents.
- Health related quality of life was lower in children with wheat than grass allergies, according to parents, with more consistent perceptions among parents and children in the grass than wheat allergy group.

INTRODUCTION

Children with food allergies often experience anxiety and reduced health-related quality of life (HRQoL) (1-3). Measuring HRQoL can reveal patient's perceptions of the effects of a specific disease or the use of a certain treatment on different aspects of life, particularly the consequences on physical, emotional and social wellbeing (2). Children with both food and

respiratory allergies have been found to have a lower HRQoL (4, 5) than non-allergic children.

Living with a food allergy can seriously affect the daily life of an individual (6) and reduced HRQoL has been reported in children with allergies towards staple foods, nuts and peanuts (7). It has also been shown that a peanut allergy can affect the HRQoL of the whole family (8). When Mikkelsen et al studied HRQoL among children with a cows' milk allergy, they found that the families of these children experienced more stress during their daily lives and were more concerned about nutrition than the control families (9). To our knowledge, HRQoL has not been evaluated in patients allergic to wheat, despite the fact that wheat is a common food allergy among children (10), affecting approximately 0.7% of a normal population of school children (11).

The effect of a respiratory allergy on quality of life can be influenced by the causative allergen, as mono-sensitisation towards olive pollen was found to affect Spanish rhinitis patients to a greater extent than mono-sensitization towards grass pollen or house dust mites (12). Furthermore, allergen exposure during the pollen season can have a seasonal effect on the HRQoL of children with relevant respiratory allergies (5). Both pharmacological treatments and immunotherapy are useful in the management of children with respiratory allergies. There are studies showing positive investigational effect of oral immunotherapy for children with food allergy (13, 14), but there are no recommended treatments available today, where the standard therapy is avoidance. This leads to the assumption that there may be a difference in the perception of quality of life between the families of children with food allergies and grass allergy, since these allergies differ in terms of seasonality, mortality, morbidity and treatment.

Quality of life in children can be assessed using both generic and specific questionnaires (15). A generic instrument such as the Children's Health Questionnaire (CHQ) (16) is useful for determining the relative burden of a disease, as well as for making comparisons between different diseases (17). The CHQ also enables comparisons of similarities and discrepancies between different allergic conditions. Both parents and children are affected by a child's illness, but their views on the child's limitations may differ. It is of clinical importance to know whether the families of children with different allergic diseases require different types of support from the healthcare system. This study focused on two groups of allergic children, where the causative allergen was food-related or inhaled. To the best of our knowledge, this has not been previously been examined in a similar population. The aim of this study was to compare the HRQoL in families of children allergic to wheat compared to the families of children allergic to grass, using both parental and child questionnaires. A secondary aim was to study whether parental perception of child HRQoL was different to that of the child's own perception.

PATIENTS AND METHODS

Participants

The study population consisted of a group of subjects with wheat allergy and another group of subjects with grass allergy. All children were identified and recruited at the Astrid Lindgren Children's Hospital and Sachs Children's Hospital, including the surrounding outpatient clinics belonging to both hospitals in the Stockholm area of Sweden between January 2013 and July 2014. The wheat and grass allergy group have previously been described in detail elsewhere (18). In summary, the children had all been diagnosed with wheat allergy based on an open oral wheat provocation test and, or, a medical history of anaphylaxis after wheat ingestion. Moreover, they also displayed Immunoglobulin E antibodies (IgE) to wheat (≥ 0.35 kUA/L) and, or, a positive skin prick test ($> 3\text{mm}$) to wheat and were on a wheat-free diet prior to inclusion. The exclusion criteria for the wheat allergy group were celiac disease or

other autoimmune disorders. The inclusion criteria for the grass allergy group were a physician-diagnosed grass allergy, IgE antibodies against timothy grass (≥ 0.35 kU_A/L) and, or, a positive skin prick test (> 3 mm), as well as clinical symptoms of rhinitis or asthma in response to timothy pollen. The exclusion criteria for the grass allergy group were a wheat-free diet and, or, wheat allergy. The study was approved by the ethics committee of the Karolinska Institutet in Stockholm, Sweden (Dnr 2008-562-31/3). Informed, written consent was collected from all parents.

Questionnaires

Demographic data, such as age, gender, and other allergic conditions, including asthma, were collected through questionnaires, interviews and hospital records. HRQoL was evaluated using two questionnaires: the Child Health Questionnaire Parental Form 28 (CHQ-PF28) and the Child Health Questionnaire Child Form 87 (CHQ-CF87) (19). The questionnaires used were validated, tested for reliability and translated into Swedish and back following international guidelines (20). Both the CHQ-PF28 and CHQ-CF87 had items with four, five or six response options, divided into 10 multi-items (Table S1). The items were summed up, with some recoded and some recalibrated. To ease interpretation, the items were transformed into zero, which was the lowest score, up to 100, which was the highest score, with a higher score indicating improved wellbeing. All questions were based on a retrospective recall of health over the preceding four weeks, except for one single item that measured health change in the preceding year (16).

Statistics

The data were analysed using the statistical software programme SPSS Version 22.0 (IBM, New York, USA). We excluded 57 children and 12 of their parents who did not fill in the HRQoL-questionnaires: these were mainly very young children who experienced difficulty in

completing the form. The characteristics of these non-responders are described (Tables S2 and S3). Differences in characteristics between the subject groups were examined using the Mann-Whitney U-test for continuous variables and the chi-squared test for categorical variables. Due to non-normal distribution scores for a few items, geometric means and standard deviations were calculated for the different item scores and the differences between the two groups were assessed using the Mann-Whitney U test. To adjust for potential confounders including age (continuous), sex, asthma diagnosis and answering the HRQoL during the grass pollen season, we used a general linear model to assess beta coefficients (β) with 95% confidence intervals (CI) to describe the differences in CHQ-PF28 and CHQ-CF87 mean scores in the study population. Log-transformation of the non-normally distributed scores did not appreciably change the estimates. The Spearman rank correlation test was used to estimate correlation coefficients. All tests were two-sided and p values <0.05 were considered to be statistically significant.

RESULTS

Table 1 shows the study population: 63 children (65% boys) had a diagnosed wheat allergy and a median age of five years and 72 children (65% boys) had a grass allergy with a median age of 12 years. We excluded 13 (21%) children from the original cohort due to a lack of follow-up with blood sampling or a oral wheat challenge (n=8), a lack of IgE-antibodies for wheat allergen (n=3) or the development of auto-immune disease (n=2). Two of the 74 children in the grass allergy group were excluded because of a lack of symptoms and no detectable IgE antibodies against grass. Rhinoconjunctivitis was reported by 35 (55%) of the 63 subjects in the wheat group and 25 (40%) subjects in the same group claimed that they were suffering from grass pollen allergy (Table 1). A food allergy was reported by 43 (60%) subjects in the grass allergy group. In the grass allergy group, 25 (35%) children and their parents answered the questionnaires during the grass pollen

season, as did six of the children and their parents (9%) in the wheat allergy group, ($p=0.001$).

No disparity in the sexes between the wheat and grass allergy groups was observed (Table 1). There was a significant difference in the ages of the two groups ($p<0.001$), as the children in the grass group were older than children in the wheat group. More than 60% of the children in both groups suffered from asthma. In the wheat group, children were more likely to report other food allergies compared to the grass group ($p<0.001$).

Parental CHQ-PF28 questionnaire

The wheat group comprised 63 children and 55 of their parents filled out the CHQ-PF28 questionnaire. The item with the lowest score out of 100 was parental impact-time (geometric mean 61.4) and the item with the highest score was role/social limitations - emotional - behavioural (geometric mean 87.4) (Table 2).

In total, 68 parents of the 72 children with grass allergy filled in the CHQ-PF28 questionnaire. In this group, the lowest scores were found for the item change in health (geometric mean 67.3) and the highest score for role/social limitations – emotional - behavioural (geometric mean 94.1) (Table 2).

The results of the linear regression with crude β -coefficients of the parental questionnaire between the wheat and grass group are shown in model 1 (Table S4). In five items, the parental perceptions of children with a wheat allergy differed significantly to the parental perceptions of children with a grass allergy. These items were general behaviour ($p<0.001$), general health perceptions ($p=0.001$), parental impact of emotions ($p=0.001$) and time ($p<0.0001$), as well as family activities ($p=0.001$). For the item change in health, the opposite was true in that parents in the grass allergy group scored this item significantly lower ($p=0.020$) than parents in the wheat allergy group.

Figure 1 shows the mean scores of the parent-reported HRQoL questionnaire, adjusted for age, gender, pollen season and asthma by linear regression. The wheat group scores were still lower than the grass group scores for the following six items: role/social limitations - emotional - behavioural, general behaviour, general health perception, parental impact – emotion, parental impact – time and family activities.

Children CHQ-CF87 questionnaire

In the wheat group, 27 of the 63 children with a median age of 13 years (range 5-17) were able to read and fill out the CHQ-CF87 questionnaire, as were 51 out of the 72 children in the grass group, with a median age 14 years (range 5-17). When we compared the children with a grass allergy to those with a wheat allergy, we found a reduced HRQoL in the children with grass allergy, indicating a different pattern compared to their parents responses. Figure 2 shows the mean scores of the children's questionnaire CHQ-CF87 adjusted for age, gender, pollen season and asthma by linear regression. After adjusting for all four cofounders, the scores for the item role functioning - emotional and physical differed significantly between the groups. The perception of wheat allergy compared to grass allergy from child-reported HRQoL scores is also tabulated as crude and adjusted β -coefficients from linear regression models (Table S6).

Correlation between items within the same patient group

In the wheat group, the correlations between parent and child mean scores differed from the correlations observed in the grass group (Table 3). In addition, parent child correlations in the wheat group were poor for the items of physical functioning, general behaviour, mental health, change in health and family activities. The correlations were, however, significant for the remaining items. In the grass group, there was generally a higher correlation between

parent and child scores, with moderate correlations for all but two items. The correlation for the item physical functioning was high, but the correlation for the item general health perception was weak (Table 3).

DISCUSSION

In this study we compared HRQoL in two groups of families with children with two different allergic diseases. We found that HRQoL in general was lower in the families of children with wheat allergies compared to the families of children with grass allergies. Within the grass allergy group, child and parent perception scores correlated well in terms of physical functioning, but less so for general health. We also found that there was a stronger correlation between parent and child scores in the grass group compared to the wheat group, where parent and child scores showed less agreement.

Our study emphasises the fact that children with food allergies and their parents may require a different approach in the clinic and a different type of healthcare support compared to children with respiratory allergies and their parents. We found that the parents of children with a wheat allergy scored significantly lower than the parents of children with a grass allergy on several of the items investigated. This could be interpreted as a food allergy causing more stress within the family due to the increased risk of more severe reactions, including anaphylaxis. Also, daily life activities are potentially impacted by issues such as the careful reading of commercial food product labels, concerns about cross-contamination, careful cooking at home and worries about the food provided by school canteens. These results are supported by the findings of Cummings et al, who found that having a child with a nut allergy had a significant impact on the caregiver's psychological distress and HRQoL (3).

Our findings in the wheat allergy group are to a large extent comparable with the findings in an American group of children with food allergies (17). Both the current Swedish group and

the American group reported similar scores for the items of general health, parental impact - emotional and family activities. However, our group had lower scores for parental impact - time compared to the American group (61 versus 85). A possible explanation could be that the children in our group were younger, with a median age of five versus 11 years (and therefore in need of more attention. Another explanation could be that the most common food allergy in the American group was a peanut allergy. Both peanut and wheat allergies demand strict avoidance, but wheat allergy in particular may have a larger impact on home cooking as wheat is a staple food. Another interesting finding was that the American families reported lower scores for general health perception (60 versus 82) compared to the Swedish parents. A low score means that the child believes that their health is poor and is likely to get worse. One reason could be a bias towards a more severe allergic phenotype in the American sample, since the subjects were recruited by the Food Allergy and Anaphylaxis Network.

To the best of our knowledge, the Child Health Questionnaire has not previously been used to evaluate children with allergic rhinitis and grass pollen allergies, although it is common when studying children with asthma. Hafkamp de Groen et al found that children with persistent wheeze showed a reduced HRQoL, in particular for items of general health perception and physical functioning (20). Norrby et al also studied HRQoL in Swedish children diagnosed with asthma (21). When comparing those results with our findings, parents in the grass group reported higher scores for self esteem and general health perception than the parents of children with asthma in the Hafkamp and Norrby studies. This is surprising, as almost 80% of the children with grass allergies in our study also reported asthma symptoms.

The children with grass allergies, and their parents perceptions of their HRQoL, showed a better correlation than perceptions reported by children and parents in the wheat allergy group. In the grass allergy group, stronger correlations were found between parent and child

Accepted Article
responses, specifically for physical functioning (Table 3). This was also observed in the asthma group described by Norrby et al (21). A low correlation between parent and child responses in the study by Norrby et al was found for questions concerning general behaviour, role functioning – emotional and role functioning – behaviour items (21). This might indicate that parents tend to find it more difficult to evaluate their child's psychological than physical health. Children and parents do not necessarily share similar views about the impact of illness. We adjusted for asthma and our hypothesis was that it had an impact on physical functioning. This was not the case and our interpretation is that children in our study had rather well-controlled asthma.

With respect to the strengths and weaknesses of the current study, a major strength was the use of validated CHQ questionnaires that have been applied in several previous studies. A generic instrument is useful when determining the relative burden of a disease, which made it possible for us to compare two different types of allergic disease. We adjusted for factors that might have an impact on the the results, such as age, gender, asthma and pollen season. However, it was not possible to adjust for education and economy, which may also have influenced the HRQoL (22, 23), and this was a limitation of the study. Another limitation was the comorbidity within our two study groups with regard to allergic diseases. The individuals allergic to wheat also had pollen allergies and those who were allergic to pollen also had food allergies other than wheat allergies. A real-life study such as this limits the possibility of finding subjects in hospital-based clinics with only one allergic condition.

CONCLUSION

In conclusion, this study showed that, according to parental reports, having a wheat allergy affected children's HRQoL to a greater extent than having a grass allergy. The perception of child HRQoL was also comparatively more consistent between parents and children in the grass allergy group compared to the wheat allergy group. These findings suggest that the families of children with a food allergy may need more extensive healthcare support than the

families of children with respiratory allergies. This information is important for the management of healthcare in allergic diseases.

ACKNOWLEDGMENT

We are grateful to the children and their parents for participating in the study and to the paediatric nurses Ann Berglind, Anna-Karin Riis Eklund and Jeanette Tedborn.

ABBREVIATIONS

HRQoL	Health-related quality of life
QoL	Quality of Life
CHQ-PF28	Children's Health Questionnaire parental form, 28 questions
CHQ-CF87	Children's Health Questionnaire child form, 87 questions

REFERENCES

1. Wahn U. Allergic children need more than diets, drugs, and creams. *Pediatr Allergy Immunol* 2015; 26:188-9.
2. DunnGalvin A, Dubois AE, Flokstra-de Blok BM, Hourihane JO. The effects of food allergy on quality of life. *Chem Immunol Allergy* 2015; 101:235-52.
3. Cummings AJ, Knibb RC, Erlewyn-Lajeunesse M, King RM, Roberts G, Lucas JS. Management of nut allergy influences quality of life and anxiety in children and their mothers. *Pediatr Allergy Immunol* 2010; 21:586-94.

- Accepted Article
4. Wassenberg J, Cochard MM, Dunngalvin A, Ballabeni P, Flokstra-de Blok BM, Newman CJ, et al. Parent perceived quality of life is age-dependent in children with food allergy. *Pediatr Allergy Immunol* 2012; 23:412-9.
 5. Kiotseridis H, Cilio CM, Bjermer L, et al. Quality of life in children and adolescents with respiratory allergy, assessed with a generic and disease-specific instrument. *Clin Respir J* 2013; 7:168-75.
 6. van der Velde JL, Flokstra-de Blok BM, de Groot H, Oude-Elbrink JN, Kerkhof M, Duiverman EJ, et al. Food allergy-related quality of life after double-blind, placebo-controlled food challenges in adults, adolescents, and children. *J Allergy Clin Immunol* 2012; 130:1136-43 e2.
 7. Morou Z, Tatsioni A, Dimoliatis ID, Papadopoulos NG. Health-related quality of life in children with food allergy and their parents: a systematic review of the literature. *J Investig Allergol Clin Immunol* 2014; 24:382-95.
 8. King RM, Knibb RC, Hourihane JO. Impact of peanut allergy on quality of life, stress and anxiety in the family. *Allergy* 2009; 64:461-8.
 9. Mikkelsen A, Borres MP, Bjorkelund C, Lissner L, Oxelmark L. The food hypersensitivity family impact (FLIP) questionnaire - development and first results. *Pediatr Allergy Immunol* 2013; 24:574-81.
 10. Keet CA, Matsui EC, Dhillon G, Lenehan P, Paterakis M, Wood RA. The natural history of wheat allergy. *Ann Allergy Asthma Immunol* 2009; 102:410-5.
 11. Jarvenpaa J, Paassilta M, Salmivesi S, Sannisto T, Niitty S, Korppi M. Stability of parent-reported food allergy in six and 7-year-old children: the first 5 years of the Finnish allergy programme. *Acta Paediatr* 2014; 103:1297-300.

- Accepted Article
12. Delgado J, Davila ID, Dominguez-Ortega J, Quirce S, Marti-Guadano E, Valero A. Quality of life in patients with respiratory allergy is influenced by the causative allergen. *J Investig Allergol Clin Immunol* 2013; 23:309-14.
 13. Paassilta M, Salmivesi S, Maki T, Helminen M, Korppi M. Children who were treated with oral immunotherapy for cows' milk allergy showed long-term desensitisation seven years later. *Acta Paediatr* 2016; 105:215-9.
 14. Kukkonen A, Uotila R, Malmberg L, Pelkonen A, Mäkelä M. Double-blind placebo controlled challenge showed that peanut oral immunotherapy was effective for severe allergies without negative effects on airway inflammation. *Acta Paediatr* 2016.
 15. Flokstra-de Blok BM, van der Velde JL, Vlieg-Boerstra BJ, Oude Elberink JN, DunnGalvin A, Hourihane JO, et al. Health-related quality of life of food allergic patients measured with generic and disease-specific questionnaires. *Allergy* 2010; 65:1031-8.
 16. Raat H, Botterweck AM, Landgraf JM, Hoogveen WC, Essink-Bot ML. Reliability and validity of the short form of the child health questionnaire for parents (CHQ-PF28) in large random school based and general population samples. *J Epidemiol Community Health* 2005; 59:75-82.
 17. Sicherer SH, Noone SA, Munoz-Furlong A. The impact of childhood food allergy on quality of life. *Ann Allergy Asthma Immunol* 2001; 87:461-4.
 18. Nilsson N, Sjolander S, Baar A, et al. Wheat allergy in children evaluated with challenge and IgE antibodies to wheat components. *Pediatr Allergy Immunol* 2015; 26:119-25.
 19. Larsson BS. Somatic complaints and their relationship to depressive symptoms in Swedish adolescents. *J Child Psychol Psychiatry* 1991; 32:821-32.

- Accepted Article
20. Andersson Gare B, Ruperto N, Berg S, Hagelberg S, Jonsson NO, Magnusson B, et al. The Swedish version of the Childhood Health Assessment Questionnaire (CHAQ) and the Child Health Questionnaire (CHQ). *Clin Exp Rheumatol* 2001; 19:S146-50.
 21. Norrby U, Nordholm L, Andersson-Gare B, Fasth A. Health-related quality of life in children diagnosed with asthma, diabetes, juvenile chronic arthritis or short stature. *Acta Paediatr* 2006; 95:450-6.
 22. Silva N, Crespo C, Carona C, Canavarro MC. Mapping the caregiving process in paediatric asthma: Parental burden, acceptance and denial coping strategies and quality of life. *Psychol Health* 2015; 30:949-68.
 23. Cope SF, Ungar WJ, Glazier RH. Socioeconomic factors and asthma control in children. *Pediatr Pulmonol* 2008; 43:745-52.

Table 1. Demographics and characteristics of children with wheat allergy and grass allergy.

Patient characteristics	Wheat allergy	Grass allergy	
	n=63	n=72	p value*
Age (years), median (range)	5 (1-17)	12 (5-17)	<0.001
Gender			
Male, n (%)	41 (65)	47 (65)	
Female, n (%)	22 (36)	25 (35)	0.98
Asthma, n (%)	41 (68)	57 (79)	0.07
Grass pollen allergy, n (%)	25 (40)	-	-
Any food allergy, n (%)	-	43 (60)	-
Answered HRQL during grass pollen season, n (%)	6 (9)	25 (35)	0.001
Rhino conjunctivitis, n (%)	35 (55)	65 (92)	<0.001
Eczema, n (%)	40 (63)	41 (58)	0.44
Any pollen allergy, n (%)	43 (67)	-	-
Furry animal allergy, n (%)	29 (45)	22 (31)	0.06
Other food allergy, n (%)	55 (86)	43 (60)	<0.001

P values estimated using the Mann-Whitney U-test for age and Pearson's chi-square test for categorical variables.

Table 2. Parent-reported CHQ-PF28 scores (geometric mean, standard deviation (SD)) among children with wheat allergy and grass allergy. Scores range from lowest score 0 to highest score 100.

Items	Wheat allergy (n=55)		Grass allergy (n=68)		p value*
	geometric mean	SD	geometric mean	SD	
Physical functioning	86.5	18.3	90.1	11.0	0.35
Role/social limitations; emotional/behavioural	87.4	20.3	94.1	13.1	0.32
Role functioning; physical	85.9	19.4	91.8	15.3	0.12
Bodily pain	81.0	18.9	77.4	22.7	0.96
General behaviour	61.8	11.6	75.7	15.1	<0.001
Mental health	77.5	14.2	78.5	15.2	0.52
Self esteem	82.2	13.7	84.3	12.8	0.48
General health perceptions	81.7	18.8	91.8	18.6	0.001
Change in health	74.3	18.0	67.3	18.5	0.02
Parental impact-emotional	70.2	23.0	86.3	14.3	0.001
Parental impact-time	61.4	18.3	73.9	10.4	<0.001
Family activities	72.7	22.9	88.8	14.3	0.001
Family cohesion	66.1	20.7	71.7	20.6	0.20

* Differences in scores between the two groups were tested using the Mann-Whitney U-test.

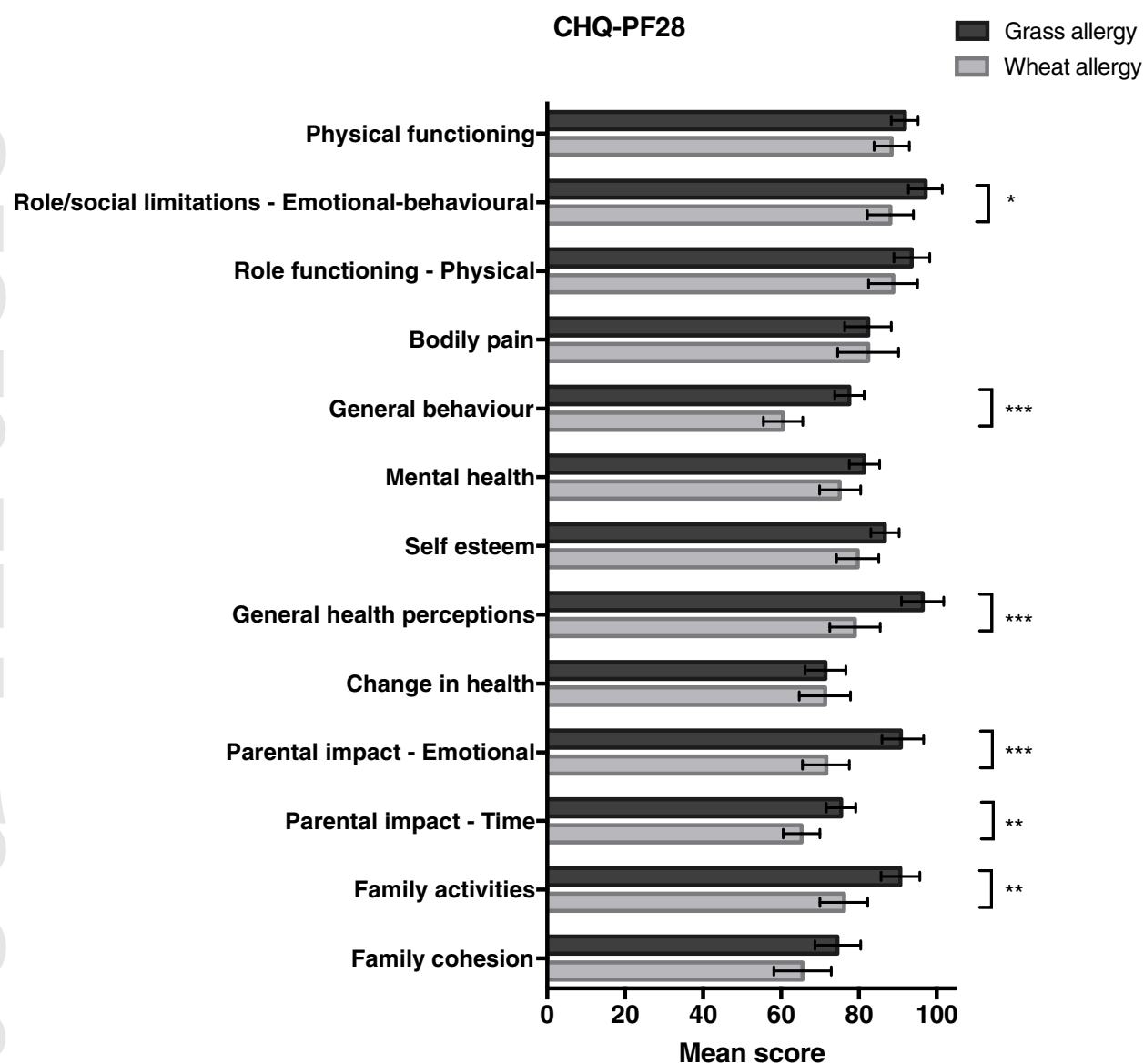


Figure 1. Adjusted mean parent-reported CHQ-PF28 scores for children with wheat and grass allergy. Mean scores were adjusted for age, gender, pollen season, and asthma in a linear regression model and error bars denote 95% confidence intervals. Significant differences between groups are shown in the figure (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

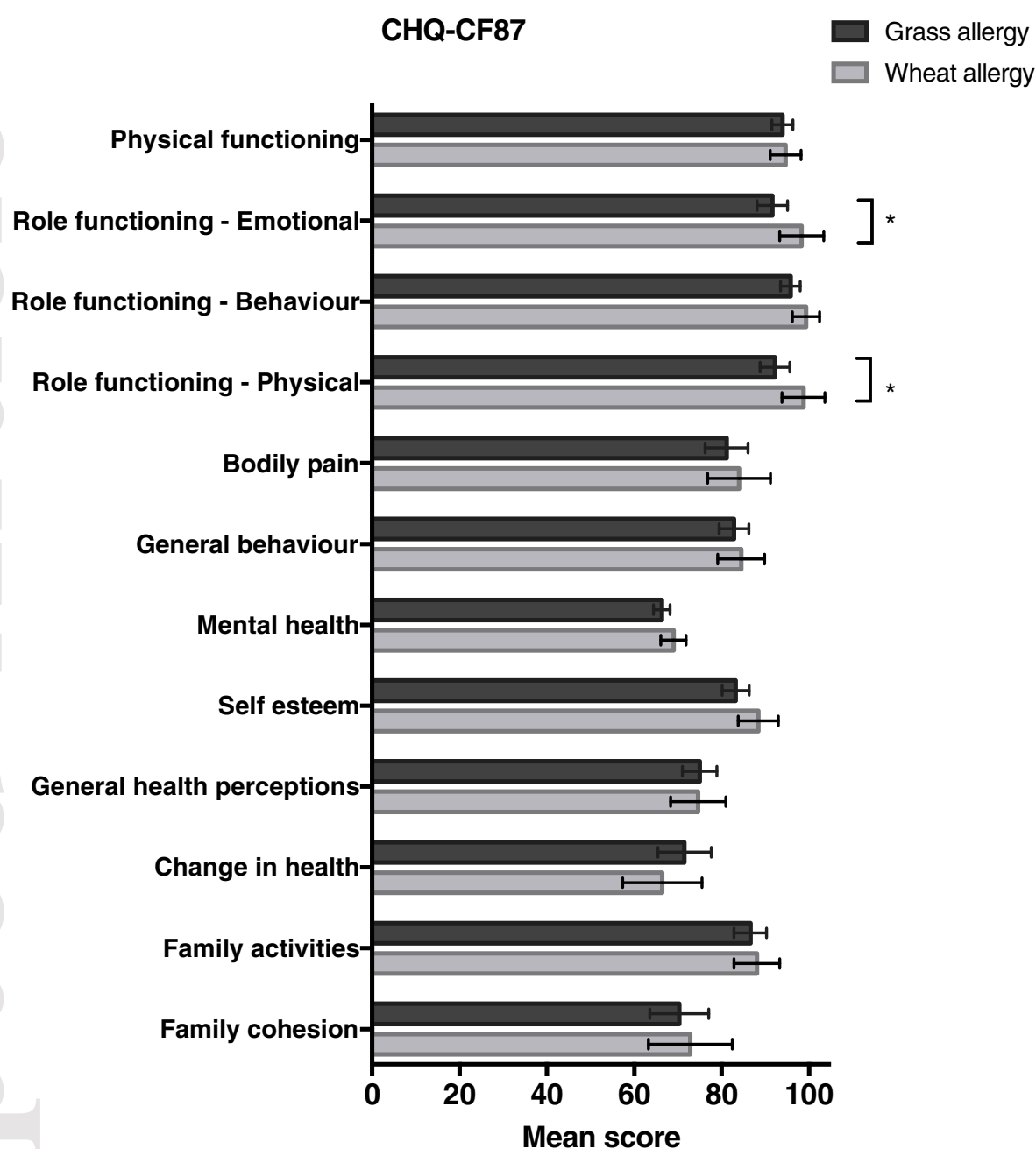


Figure 2. Adjusted mean child-reported CHQ-CF87 scores for children with wheat and grass allergy. Mean scores were adjusted for age, gender, pollen season, and asthma in a linear regression model and error bars denote 95% confidence intervals. Significant differences between groups are shown in the figure (*p < 0.05, ** p < 0.01, *** p < 0.001).

Table 3. Spearman correlation coefficients between scores for similar items on the parent-reported CHQ-PF28 and the child-reported CHQ-CF87 for patients with wheat and grass allergy.

Items	Wheat allergy n=27 Correlation coefficient (r)	Grass allergy n=51 Correlation coefficient (r)
Item 1 Physical functioning	0.204	0.753**
Item 2 Role functioning; physical	0.411*	0.430**
Item 3 Bodily pain	0.620**	0.498**
Item 4 General behaviour	0.240	0.456**
Item 5 Mental health	-0.027	0.364*
Item 6 Self esteem	0.526*	0.575**
Item 7 General health perceptions	0.526*	0.262
Item 8 Change in health	0.137	0.581**
Item 9 Family activities	0.100	0.547**
Item 10 Family cohesion	0.435*	0.464**

* Significant p value (p <0.05), ** (p <0.01), *** (p <0.001)