

What influences complementary medicine use for children with eosinophilic esophagitis? Findings from a cross-sectional survey

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What influences complementary medicine use for children with eosinophilic esophagitis? Findings from a cross-sectional survey.

Abstract

Background and purpose: Utilization of complementary medicines (CMs) amongst children with eosinophilic esophagitis (EoE) in Australia is high. Carers beliefs, perceptions and use of CM can influence the decision to use CM in children in their care. This study explores the factors influencing the use of CM for a child's EoE when the carer also uses CM.

Materials and methods: Carers of children aged 0-18 years with EoE participated in a national cross-sectional online survey, conducted in Australia between September 2018 and February 2019. Data analysis included bivariate analysis, Cramer's V, backwards stepwise logistic regression and binomial logistic regression.

Results: Of the 181 total survey responses, 165 (91.2%) respondents indicated they had utilized some form of CM for themselves. Children whose carer had used some form of CM for themselves were more likely to have used CM than children whose carer had not used CM (OR 4.6; $p=0.001$). Of the CM self-using carers, 125 (75.8%) had also chosen to utilize CM for their child's EoE. Use of CM in children was more likely amongst children who had used a pharmaceutical for their EoE (OR 7.51; $p=0.010$), and those whose carer had consulted with "other health practitioners or health workers" for their child's EoE (OR 5.34; $p<0.001$) or had consulted with a chiropractor for themselves (OR 2.70; $p=0.029$).

Conclusion: High CM self-use amongst carers is associated with their decision to also use CM for their child's EoE, a concern given the absence of evidence for CM's safety and efficacy in this population. CM use in this population warrants further attention. Effective conventional medicines for EoE are limited and utilization of CM amongst children with EoE in Australia is high. The recommendation of CM for children with EoE warrants further attention given the substantial concomitant pharmaceutical care, and the absence of evidence for CM's safety and efficacy in this population. Further research into the role of CM practitioners, products and therapies in an integrative model between CM and conventional healthcare must be undertaken.

Highlights:

- High CM self-use amongst carers is associated with their decision to also use CMs for their child's EoE.
- Use of CMs in children was more likely amongst children who had used a pharmaceutical for their EoE, and those whose carer had consulted with "other health practitioners or health workers" for their child's EoE or had consulted with a chiropractor for themselves.

- The recommendation of CM for children with EoE warrants further attention and requires research to determine its safety and efficacy in this population.

Keywords: Carer, Complementary medicine, Eosinophilic esophagitis, Health service use, Pediatric.

1 Introduction

Eosinophilic esophagitis (EoE) is a rapidly emerging antigen-driven inflammatory gastrointestinal disorder characterized by esophageal dysfunction, damage and eosinophilia (1). EoE is associated with high health service use and treatment burden (2, 3), reduced health related quality of life (HRQoL) in both children with EoE and their carers (2, 4), with limited effective conventional medicines available (5). The use of complementary medicine (CM), varied medical and healthcare practices and products not currently viewed as part of conventional medicine – defined here as CM products, such as probiotics, or therapies, for example, massage (6) - in children with gastrointestinal disorders is well established (7, 8). Common reasons for use in those children include concerns about side effects and lack of efficacy of conventional treatments, and disease severity (8). There is currently no known research on the safety or efficacy of any CM for EoE. This is particularly concerning for Australian children with EoE given the high levels of CM use, and frequency of CM self-prescribing by their carers (3). The risks and benefits of CM use for children must be carefully considered, particularly if there is an absence of evidence for the safety and efficacy of that CM in a pediatric population (9). Carers use of CM is known to influence their decision to use CM for their children (10), yet little is known about the factors leading to CM use in children with EoE. The aim of this research was to explore the factors associated with the use of CM for children with EoE, including possible influences caused by carers' beliefs, perceptions and own CM use.

2 Materials and methods

This national cross-sectional study involved an online survey and was conducted in Australia from September 2018 to February 2019. Eligible participants were carers of children aged 18 years or less with endoscopy confirmed EoE diagnosis. Carers were defined in this study as providers of regular ongoing assistance to the child within the context of an existing relationship, without payment for the care given, inclusive of individuals who were not a parent. Respondents were asked to complete the survey for the eldest child if more than one child in the family had EoE. Ethics approval was obtained from Griffith University Human Research Ethics Committee (#2018/120). Ethical procedures for providing adequate project information were adhered to. Participation was voluntary, completing the survey was taken as

consent, and all responses were collected anonymously. Privacy of patients, carers and practitioners was maintained.

2.1 SURVEY DESIGN

This paper reports findings from a sub-set of data from a survey consisting of 42 core items, with an additional 107 items made available based on responses to 10 of the baseline items. For example, a “Yes” response to “Do you have more than one family member with EoE?” was followed by “What is their relationship to this child?”. The survey items covered the following domains: socio-demographics; complementary medicine use; conventional health service and treatment utilization; financial support; and HRQoL for the child and the carer.

2.1.1 Socio-demographics

Survey items were adopted from previously published research (11, 12) to confirm participant sociodemographic details such as child age, gender, ethnicity and age at diagnosis, and carer relationship to child, carer’s employment status, and family income management.

2.1.2 Health service and treatment use

All related child survey questions included “...for his or her EoE?” or “...for your child’s EoE?”. Health practitioners seen by carers for their child’s EoE were confirmed by additional items, as were the frequency of consultations; out-of-pocket costs associated with consultations, products and therapies; use, source/s of recommendation and perceived efficacy associated with the use of conventional and CM products, therapies, elimination diets, and elemental formula.

2.1.3 Complementary medicine use

Participants were asked to report on their understanding, and use, of CMs (13, 14). Two types of survey items examined CM use; one type focused on CM use by carers for their own health, and the other captured CM use by carers for their child’s EoE. Carers were also asked to respond to items exploring their perceptions and experiences of CM use including reasons for, and decisions leading to use, concerns, views on future use, and perceived efficacy of CM (7). Respondents who had used any form of CM at any time for themselves or their child were asked “*What are your reason(s) for using complementary medicines, therapies and treatments?*”. Responses were considered reflective of general attitudes towards CM use rather than specific to the condition. All survey participants were asked if they had concerns regarding CM use; those with concerns were asked to explain these concern/s.

2.1.4 Financial support

Items regarding private health insurance, a government issued healthcare card and/or carer allowance, were included. Australians receive tax incentives from the Federal Government by obtaining private health insurance, which can cover costs related to certain medical services and private hospital treatment

(15). Healthcare cards are issued to persons receiving various government subsidies or payments and can reduce the out-of-pocket expenses associated with accessing health services and prescription medications (16). One such government payment is a means-tested carer allowance, available for eligible persons providing additional daily care to a child with a serious chronic illness (17).

2.1.5 Child's health-related quality of life

The PedsQL™ (Pediatric Quality of Life Inventory) Infant Scales (18) measured the effects of symptoms, and physical, emotional, social, and cognitive functioning, on the QoL of children aged 13-23 months. The age-specific PedsQL™ Eosinophilic Esophagitis Module Standard Version 3.0 Parent reports[©] (PedsQL-EoE) (19) are an adequate marker for child self-report (20), and were previously used to assess symptoms, problems with treatment, worry, feelings, communication, and food or eating on QoL (19) for children aged between 2-4, 5-7, 8-12, and 13-18 years.

2.1.6 Carer's health-related quality of life

The Bakas Caregiving Outcomes Scale[©] (BCOS) (21) measured perceived changes related to the HRQoL of the carer, including subjective well-being, social functioning, and physical health. At the time of survey design the BCOS was the most reliable scale available, although it had not been validated for EoE. The term “the stroke survivor” was changed to “your EoE child” on recommendation of the survey creator.

2.2 SURVEY TESTING

Survey content and face validity was tested by the research team, one carer of a child with EoE and two other carers of children with chronic illness. Feedback was obtained from a paper-version, followed by online testing *via* the Survey Gizmo[®] platform, and testing of the online version on different devices (e.g. laptop, tablet, phone); minor changes were made to improve readability and understanding. The survey took approximately 30 minutes to complete.

2.3 RECRUITMENT

The target sample size of 210 carers (to achieve a 95% confidence level, confidence interval of 5) from a population of 462 was determined from a 1 in 10,000 prevalence rate as published at time of survey design (3). Specialized EoE clinicians, pediatric gastroenterology and allergy hospital departments, and General Practitioners (GPs), were contacted by the research team for recruitment assistance. Professional associations who invited their members to assist with recruitment have previously been described (3). The survey was promoted by the Australian pediatric EoE support network (*AusEE Inc.*), to their network of consumer members and stakeholders, e.g. specialist doctors. Carers of children with EoE and medical specialists were encouraged to ask others to participate. Survey completion was taken as consent and

questions were preceded by an information sheet. As a thank-you, survey respondents could win one of ten \$50 (AUD) gift vouchers.

2.4 DATA ANALYSIS

Data analysis was conducted using STATA/IC 16 statistical analysis software, with descriptive statistics determined for each variable. New variables were created to describe *carers who had used CM for themselves only* and *carers who had used CM for both themselves and their child with EoE*. Open-text responses for “other” reasons for, and concerns about, CM use were reclassified into two new variables: CM use for *additional support or to complement conventional treatment* (n=11); and concern surrounding *lack of evidence of CM efficacy and/or safety* (n=9). Chiropractic or osteopathic care were reported as CM practitioner consultations. Respondents who utilized chiropractic or osteopathic therapy, without consulting a chiropractor (n=6) or osteopath (n=5), were reclassified accordingly to one of these practitioners. Details of how open-text responses for “other” types of health-service utilization were managed are outlined previously (3). A new variable including counsellor or other mental health worker, pharmacist, pharmacy or health food store assistant, and “other” practitioners, was created to describe “other health practitioners or health workers.”

Bivariate analysis was conducted using Chi-square tests ($\alpha=0.05$) to determine significant differences in sociodemographic characteristics, health service use, and views and attitudes towards CM between carers who used CM for themselves only, and carers who used CM for themselves and their child with EoE. The effect size was calculated using Cramer’s V and classified as: negligible association (0.00 and under 0.10); weak association (0.10 and under 0.20); moderate association (0.20 and under 0.40); relatively strong association (0.40 and under 0.60); strong association (0.60 and under 0.80) and very strong association (0.80 and under 1.00) (22).

Chi-square test and logistic regression examined carer CM use as a predictor of carer use of CM for their child’s EoE. A separate logistic regression was conducted to identify predictors of CM use in children whose carers were CM self-users. Categorical variables were created from independent variables that were continuous or with intervals. Backwards stepwise logistic regression analysis identified factors predicting CM utilization in children whose carers also used CM, compared with CM use by carers alone. The variables included in the baseline model were identified through Chi-square tests and selected based on their significance ($P\leq 0.25$). Variables were then removed if appropriate as determined by a likelihood ratio test. An additional logistic regression was conducted to determine the likelihood of specific concerns for CM use predicting child CM use amongst participants reporting CM concerns.

3 Results

3.1 DEMOGRAPHICS

Of the 232 survey responses received, 16 ineligible and 35 incomplete responses were removed. The remaining 181 responses were included in data analysis. Surveys were primarily completed by the mother of a child with EoE (n=173). Children were identified mostly as white/Caucasian (93%), male (72%), with a median age of 9.5 years, and all ages from 13 months to 18 years were represented. Mean time since diagnosis was 4.1 years (SD 3.4; range: 0.0-14.2), and mean age at diagnosis was five years (SD 4.0; range: 7 months to 16 years). Further details are reported previously (2, 3).

3.2 CM USE OF CARERS

Most carers (91.2%) indicated they had consulted a CM practitioner or used a CM product or therapy for themselves at some stage. Table 1 shows the prevalence of carer utilization of CMs (n=165), either for themselves only (n=40), or for both themselves and for their child with EoE (n=125). The most commonly used CM products by carers for themselves were probiotics (52.7%) and other nutritional supplements (63.6%). Both were predominantly self-prescribed (probiotics 51.7%; other nutritional supplements 43.8%), followed by recommendation from a GP (probiotics 24.1%; other nutritional supplements 37.1%), and naturopath (probiotics 18.4%; other nutritional supplements 22.9%).

3.3 CM USE OF CHILDREN

A significant association was found between carer CM use and child CM use ($p < 0.001$). Children whose carer had used some form of CM for themselves were more likely to have used CM than children whose carer had not used CM (OR 4.6; 95% CI 1.93, 10.96; $p = 0.001$). Carer self-use of homeopathics ($p = 0.030$, $V = 0.17$) and “any CM therapy” ($p = 0.046$, $V = 0.16$) were weakly associated with any CM use in the child. The most common CM products used by children of carers who had used CM themselves were probiotics (n=78, 47.3%) and other nutritional supplements (n=74, 44.9%) (see Table 2). The most common nutritional supplements used on a daily basis by the child were probiotics (n=19), iron (n=13) and Vitamin D (n=12).

Table 1

Comparison of CMs utilized by carers (n=165); either for self only or for self and their EoE child

Type of CM	CM use by carers				χ^2	p^c	V ^c
	Carers who use CM ^b (n=165)	Carers who use CM for self-only (n=40)	Carers who use CM for self and for child with EoE (n=125)				
	n (%)	n (%)	n (%)				
CM practitioner							
<i>Massage therapist</i>	92 (55.8)	25 (62.5)	67 (53.6)	0.97	0.324	-	
<i>Chiropractor</i>	65 (39.4)	11 (27.5)	54 (43.2)	3.13	0.077	-	
<i>Naturopath</i>	56 (33.9)	9 (22.5)	47 (37.6)	3.08	0.079	-	
<i>Acupuncturist</i>	49 (29.7)	13 (32.5)	36 (28.8)	0.20	0.656	-	
<i>Osteopath</i>	33 (20.0)	6 (15.0)	27 (21.6)	0.83	0.364	-	
<i>Yoga teacher</i>	29 (17.6)	6 (15.0)	23 (18.4)	0.24	0.623	-	
<i>Relaxation/meditation teacher</i>	20 (12.1)	5 (12.5)	15 (12.0)	0.01	0.933	-	
<i>Traditional Chinese medicine practitioner</i>	13 (7.9)	2 (5.0)	11 (8.8)	0.60	0.437	-	
<i>Homeopath</i>	11 (6.7)	3 (7.5)	8 (6.4)	0.06	0.808	-	
<i>Aromatherapist</i>	8 (4.9)	1 (2.5)	7 (5.6)	0.63	0.427	-	
<i>Western herbalist</i>	4 (2.4)	0 (0.0)	4 (3.2)	1.31	0.252	-	
<i>Visited any CM practitioner^a</i>	136 (82.4)	33 (82.5)	103 (82.4)	<0.01	0.988	-	
CM product							
<i>Nutritional supplements</i>	105 (63.6)	26 (65.0)	79 (63.2)	0.04	0.837	-	
<i>Probiotics</i>	87 (52.7)	17 (42.5)	70 (56.0)	2.22	0.137	-	

	<i>Flower essences</i>	24 (14.6)	4 (10.0)	20 (16.0)	0.88	0.349	-
	<i>Homeopathics</i>	20 (12.1)	1 (2.5)	19 (15.2)	4.60*	0.032	0.17
	<i>Western Herbal Medicine</i>	18 (10.9)	2 (5.0)	16 (12.8)	1.90	0.168	-
	<i>Chinese herbal medicine</i>	13 (7.9)	3 (7.5)	10 (8.0)	0.01	0.919	-
	<i>Used any CM product^a</i>	125 (75.8)	30 (75.0)	95 (76.0)	0.02	0.898	-
CM therapy							
	<i>Massage</i>	95 (57.6)	27 (67.5)	68 (54.4)	2.13	0.145	-
	<i>Acupuncture</i>	59 (17.6)	17 (42.5)	42 (33.6)	1.04	0.307	-
	<i>Relaxation/meditation</i>	52 (31.52)	12 (30.0)	40 (32.0)	0.06	0.813	-
	<i>Yoga</i>	43 (26.1)	10 (25.0)	33 (26.4)	0.04	0.861	-
	<i>Aromatherapy</i>	25 (15.2)	5 (12.5)	20 (16.0)	0.29	0.591	-
	<i>Used Any CM therapy^a</i>	125 (75.8)	35 (87.5)	90 (72.0)	3.96*	0.046	0.16

Note. V = Cramer's V, CM = Complementary Medicine, EoE = Eosinophilic Esophagitis.

^a Carer utilized one or more of the listed CMs in this category.

^b Describes CM use by carers regardless of the CM use of their child.

^c Statistical significance for different CM types between CM users for self, and CM users for self and child.

* $p < 0.05$

Table 2

CM utilization by carers for their children's EoE (n=125)

CM practitioner	<i>n (%)</i>	CM product	<i>n (%)</i>	CM therapy	<i>n (%)</i>
Naturopath	40 (24.2)	Probiotics	78 (47.3)	Relaxation/meditation	25 (15.2)
Chiropractor	31 (18.8)	Nutritional supplements	74 (44.9)	Aromatherapy	18 (10.9)
Homeopath	11 (6.7)	Homeopathics	16 (9.7)	Massage	12 (7.3)
Massage therapist	8 (4.9)	Flower essences	14 (8.5)	Acupuncture	6 (3.6)
Osteopath	8 (4.9)	Western Herbal Medicine	7 (4.2)	Yoga	5 (3.0)
Acupuncturist	7 (4.2)	Chinese herbal medicine	4 (2.4)	Used any CM therapy ^a	42 (25.5)
Relaxation/meditation teacher	7 (4.2)	Used any CM product ^a	109 (66.1)		
Western herbalist	4 (2.4)				
Yoga teacher	4 (2.4)				
Aromatherapist	3 (1.8)				
Tai chi practitioner	1 (0.6)				
Traditional Chinese medicine practitioner	1 (0.6)				
Visited any type of CM practitioner ^a	73 (44.2)				

Note. CM = Complementary Medicine, EoE = Eosinophilic Esophagitis.

^a Carer utilized one or more of the listed CMs in this category for their child's EoE.

3.4 CONCERNS SURROUNDING CM USE

Less than half (n=63, 38.2%) of all carers that used CM specified associated concerns. Table 3 compares the concerns of carers who used CM solely for themselves and carers who also used CM for their child with EoE. Concerns surrounding cost of CM was more often ($p<0.01$, $V=0.35$) reported by carers who utilized any CM for themselves and their child (54.2%), compared with carers only using CM for themselves (13.3%).

3.5 REASONS FOR CM USE

Carers reported using CM to help a chronic problem (49.7%), when effectiveness was reported by others or following personal recommendation (23.0%), and due to lack of suitable conventional treatment (20.6%). There were no significant differences in the reported reasons for CM use amongst carers who use CM for themselves only, compared with carers who have also used CM for their child's EoE (see Table 4).

3.6 CHARACTERISTICS ASSOCIATED WITH CM USE BY CARERS FOR THEIR CHILD WITH EOE

Sociodemographic factors of carers who used CM for themselves only and carers who used CM for themselves and their child are described in Table 5. Carers more frequently reported consulting with a nutritionist or dietician for their child's EoE ($p=0.013$, $V=0.19$) or other health practitioners or health workers ($p<0.001$, $V=0.30$) if any CM was utilized by both the carer and the child rather than the carer alone. Use of pharmaceuticals for the child was also reported more often by carers who utilized any CM for themselves and their child compared with carers only using CM for themselves ($p<0.001$, $V=0.30$). Compared to carers who only utilized CM for themselves, carers who utilized CM for themselves and their child more commonly reported a longer time since their child's diagnosis with EoE ($p=0.025$, $V=0.21$), and a higher total out-of-pocket cost associated with child EoE-related health services and treatment use in the previous 12 months ($p=0.002$, $V=0.28$).

3.7 FACTORS CONTRIBUTING TO CHILD CM USE AMONGST CM USING CARERS

Use of CM in children was more likely amongst children who had used a pharmaceutical (OR 7.51; 95% CI 1.63, 34.70; $p=0.010$) or the carer had consulted with other health practitioners or health workers (OR 5.34; 95% CI 2.29, 12.43; $p<0.001$) for their child's EoE. The likelihood of CM use in children was greater for children of carers who had consulted with a chiropractor (OR 2.70; 95% CI 1.11, 6.60; $p=0.029$) for their own health. CM use in children was less likely among carers who used any CM therapy, i.e. massage (OR 0.20; 95% CI 0.06, 0.64; $p=0.007$) for themselves.

Table 3Concerns of carers towards CM use: comparing self-users with users for self and child, and the concerns that predict CM choice for their child ($n=63$)

Specific concerns about CM use	Carers who use CM ($n=63$)	Carer CM self-use ($n=15$)	CM use for self and child ($n=48$)	χ^2	p^a	V	OR (95% CI)	p
	n (%)	n (%)	n (%)					
<i>Effectiveness</i>	56 (88.9)	12 (80.0)	44 (91.7)	1.58	0.209	-	1.87 (0.31, 11.30)	0.493
<i>Practitioner level of training</i>	40 (63.5)	7 (46.7)	33 (68.8)	2.40	0.121	-	2.18 (0.58, 8.23)	0.251
<i>Side effects</i>	31 (49.2)	6 (40.0)	25 (52.1)	0.67	0.414	-	1.78 (0.45, 7.13)	0.412
<i>Cost</i>	28 (44.4)	2 (13.3)	26 (54.2)	7.72**	0.005	0.35	8.16 (1.52, 43.67)*	0.014
<i>Attitude of other health professionals</i>	21 (33.3)	5 (33.3)	16 (33.3)	0.00	1.00	-	0.57 (0.13, 2.50)	0.454
<i>Lack of evidence of efficacy and/or safety</i>	9 (14.3)	2 (5.0)	7 (5.6)	0.02	0.884	-	2.36 (0.31, 17.83)	0.404

Note. Response options were reflective of general views and attitudes towards CM, not specific to the user or condition and offered only to participants who indicated they had concerns with CM use ($n=63$). V = Cramer's V, χ^2 = Chi-square, CM = Complementary Medicine, OR = Odds Ratio; The dependent variable in the logistic regression analysis is CM use coded so that 0 = Carer CM use only and 1 = Carer and child CM use; Logistic regression model $\chi^2 = 11.97$ $p = 0.06$; Pseudo $R^2 = 0.17$; $n = 63$.

^a Statistical significance for different CM use concerns between CM users for self, and CM users for self and child.

* $p < 0.05$

** $p < 0.01$

Table 4

Attitudes of carers towards CM utilization: comparing users for self only with users for self and child

Reasons for any CM use	CM use reported for self only (n=40)	CM use reported for self and child (n=125)	χ^2	p
	n (%)	n (%)		
<i>To help a chronic problem</i>	16 (40.0)	66 (52.8)	1.99	0.159
<i>It worked for other people/personal recommendation</i>	8 (20.0)	30 (24.0)	0.27	0.601
<i>Lack of suitable conventional treatment</i>	10 (25.0)	24 (19.2)	0.61	0.430
<i>Dissatisfaction with conventional treatments</i>	2 (5.0)	21 (16.8)	3.52	0.061
<i>Fear of side effects of conventional treatment</i>	4 (10.0)	17 (13.6)	0.35	0.552
<i>Lack of confidence in conventional medicine</i>	5 (12.5)	13 (10.4)	0.14	0.711
<i>CMs are generally more effective than conventional treatment</i>	0 (0.0)	5 (4.0)	1.65	0.199
<i>Additional support/to complement conventional treatment</i>	3 (7.5)	8 (6.4)	0.06	0.808
<i>Other</i> ^a	7 (17.5)	16 (12.8)	0.56	0.455

Note. Reflective of general views and attitudes towards CM, not specific to the user or condition. CM = Complementary Medicine.

^a Examples of other themes from other open text responses include - Desperation in the hope it works (n=2), Nutritional deficiency (n=3).

Table 5

Differences in health service utilization, medicine use and sociodemographic factors between carer only CM users and carer and child CM users

Variable	Carer CM use only (n=40)	Carer and child CM use (n=125)	χ^2	p	V
	n (%)	n (%)			
Child consulted with a medical doctor	39 (97.5)	122 (97.6)	0.00	0.971	-
Child consulted with a nutritionist or dietician	25 (62.5)	102 (81.6)	6.24*	0.013	0.19
Child consulted with other health practitioners or health workers ^a	15 (37.5)	89 (71.2)	14.77***	<0.001	0.30
Child utilized a pharmaceutical	32 (80.0)	122 (97.6)	15.10***	<0.001	0.30
Child HRQoL (PedsQL™)					
	<i>0-50</i>	10 (27.8)			
	<i>>50-65</i>	10 (27.8)			
	<i>>65-80</i>	9 (25.0)	0.59	0.900	-
	<i>>80</i>	7 (19.4)			
Parent HRQoL (BCOS®)					
	<i>HRQoL the same or better</i>	15 (39.5)			
	<i>HRQoL got worse</i>	23 (60.5)	0.52	0.471	-
Child age					
	<i>1-23 months</i>	3 (7.5)			
	<i>2-4 years</i>	5 (12.5)			
	<i>5-7 years</i>	9 (22.5)	7.14	0.128	-
	<i>8-12 years</i>	11 (27.5)			
	<i>13-18 years</i>	12 (30.0)			
Age at diagnosis					
	<i>1-23 months</i>	10 (25.0)	4.38	0.357	-

	<i>2-4 years</i>	6 (15.0)	36 (28.8)			
	<i>5-7 years</i>	10 (25.0)	21 (16.8)			
	<i>8-12 years</i>	12 (30.0)	27 (21.6)			
	<i>13-18 years</i>	2 (5.0)	8 (6.4)			
Time since diagnosis						
	<i>2 years or less</i>	22 (55.0)	39 (31.2)			
	<i>Between 2-4 years</i>	7 (17.5)	31 (24.8)	7.41*	0.025	0.21
	<i>4 years or more</i>	11 (27.5)	55 (44.0)			
Private health cover (child)		25 (65.8)	80 (65.57)	0.00	0.980	-
Carer allowance		5 (55.6)	39 (66.1)	0.38	0.537	-
Ability to manage on income since diagnosis						
	<i>The same</i>	11 (27.5)	24 (19.2)			
	<i>More difficult</i>	29 (72.5)	101 (80.8)	1.25	0.264	-
Ability to manage on current income						
	<i>It is easy/not too bad</i>	15 (37.5)	49 (39.2)			
	<i>It is difficult some of the time</i>	18 (45.0)	46 (36.8)	1.12	0.572	-
	<i>It is difficult all of the time/impossible</i>	7 (17.5)	30 (24.0)			
Missed workdays (in the past 30 days)						
	<i>None</i>	12 (36.4)	26 (28.6)			
	<i>One</i>	10 (30.3)	18 (19.8)	3.40	0.182	-
	<i>More than one</i>	11 (33.3)	47 (51.7)			
Missed school days (days in past 30 days)						
	<i>Three days or less</i>	28 (71.8)	74 (61.2)			
	<i>More than three days</i>	11 (28.2)	47 (38.8)	1.44	0.229	-

Child has comorbidities		29 (72.5)	83 (67.5)	0.35	0.552	-
Number of child comorbidities						
	<i>None</i>	11 (27.5)	41 (33.3)			
	<i>One or two</i>	22 (55.0)	56 (45.5)	1.09	0.581	-
	<i>More than two</i>	7 (17.5)	26 (21.1)			
Total annual cost of child health service and treatment use ^b						
	<i>Up to \$1000</i>	10 (25.0)	37 (29.6)			
	<i>>\$1000 to \$3000</i>	24 (60.0)	38 (30.4)	12.87**	0.002	0.28
	<i>More than \$3000</i>	6 (15.0)	50 (40.0)			

Note. V = Cramer's V, χ^2 = Chi-square, CM = Complementary Medicine, EoE = Eosinophilic Esophagitis, HRQoL = Health Related Quality of Life, PedsQL™ = Pediatric Quality of Life Inventory, BCOS® = Bakas Caregivers Outcomes Scales.

^a Counsellor or other mental health worker, pharmacist, health food store or pharmacy assistant, and other health practitioners or health workers.

^b Total out-of-pocket costs associated with health services and treatment use by child with EoE in the previous 12 months.

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

4 Discussion

These findings represent the first known study to explore the beliefs and attitudes of carers of children with EoE towards CM, the characteristics of carers who only used CM for themselves in contrast to carers who used it for themselves and for their child's EoE, and the factors influencing their child's CM use. Carers of children with EoE were found to have high CM utilization, and that self-utilization of CM was a strong indicator of CM use for their child's EoE.

Carers in our study that used CM for themselves and had used a pharmaceutical for their child's EoE were more likely to also use CM for their child's EoE. High use of CM among people with chronic and complex disease is well established (14) and has been largely attributed to the unmet health needs of these patients when seeking conventional care (14). Parent use of CM for children with autism spectrum disorders is also more common alongside conventional medicine use (23). Such concomitant use has been attributed to perceived CM safety and ability to ameliorate symptoms, ease of access, and the perceived ineffectiveness and side-effects associated with conventional medications (23). Similarly, our study found that some carers identified a lack of suitable conventional treatment – including a perceived lack of efficacy or worsening of symptoms - as the main reasons for CM use. This finding, when coupled with the carer's perceptions of CM safety and ease of access, suggests carers may not seek appropriate advice prior to self-prescribing CM for their child's EoE. Parents of children with chronic health issues have been shown to choose interventions quite randomly, often without understanding or consideration of evidence-based research (24).

Similarly, probiotics and other nutritional supplements most commonly used by carers themselves were more often self-prescribed than recommended by a GP or CM practitioner. Similar patterns were observed for their children's EoE; probiotics were the most common CM product used by the carer for their child's EoE and mostly self-prescribed. This may be related to carers' positive personal experiences of use (25), influencing their decision to use CM for their child. Mothers, who were the most common study respondents, are reported as more often being committed CM users; "championing" the use of CM; and having greater skepticism toward conventional medicine (26). However, extrapolating the beneficial effects and potential risks from an adult to a paediatric population with an antigen-driven disease such as EoE is risky (27), particularly given the absence of high-quality evidence for the efficacy and safety of CM use in EoE children. Nevertheless, more than half of study respondents did not report any concerns regarding the use of CM, whether for themselves or their child.

Children with EoE receive care from multiple health practitioner types (3), all of whom should be trained to answer questions regarding safe CM use within their scope of practice, especially given the high CM use in this population. While carer's trust in practitioners is paramount in providing optimal care for

children with rare diseases (28), the importance of qualified practitioners to oversee CM prescribing for EoE must not be overlooked. Furthermore, the importance placed on coordinated team care for individuals with chronic illness (29) also means that the interprofessional communication and collaboration amongst different health professionals providing care to the same child needs urgent exploration to ensure best possible health outcomes for this vulnerable population.

There is currently no cure for EoE and while the recommended treatments can provide symptomatic relief and improve disease markers (30), ongoing administration of first-line therapies such as proton pump inhibitors can result in side-effects, i.e. gut dysbiosis (31), potentially leading patients to seek CM (32). Probiotics were the most commonly reported CM product used for children with EoE in this study, an interesting finding given reports that patients with EoE have increased *Haemophilus* in the salivary microbiome (33) and decreased *Clostridia* in the gut microbiome (34). In children with cow's milk protein allergy *Lactobacillus rhamnosus GG* can improve gastrointestinal symptoms (35) and promote cow's milk protein tolerance (35, 36). Specific probiotic strains may also reduce eosinophils in the nasal mucosa (37) and, in doing so, benefit conditions such as allergic rhinitis (38).

Similarly, other supplements could play a role. In addition to probiotics, iron and Vitamin D were the most commonly used nutritional supplements in our study that were used on a daily basis by the child with EoE. Vitamin D deficiency has been observed in EoE patients (39). Vitamin D may play a role in modulating the eosinophil immune response (40), with potential to reduce EoE induced esophageal fibrosis (41), and improve pediatric eczema (42) and allergic rhinitis outcomes (43).

5 Limitations

There are several study limitations. Cross-sectional studies are not able to establish a true cause and effect relationship without longitudinal data (44). The high percentage of female respondents may impact findings given the higher CM use seen in females (14), however the risk of sample bias should be reduced if that carer is also primarily responsible for the treatment decisions of their child. This study was based on self-report and may therefore be subject to recall bias. However, representation by children of all ages (13 months-18 years) and the broad range of time since diagnosis indicates that responses were representative of the general pediatric EoE population (45) across various stages of EoE management and is representative of the pediatric EoE population in Australia only.

6 Conclusion

High CM self-use amongst carers is associated with their decision to also use CM for their child's EoE, a concern given the absence of evidence for its safety and efficacy in this population. The recommendation

of CM for children with EoE should be considered carefully. As evidence becomes available, conventional and CM practitioners must enquire about patient CM use as they have a pivotal role in educating consumers on the benefits and potential harm of CMs. Further research into the role of all aspects of EoE therapy especially into the role of CM practitioners, products and therapies in a holistic approach to EoE healthcare must be undertaken.

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