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Effects of dairy products on Crohn's Disease symptoms are influenced by fat content and disease location but not lactose content or disease activity status in a New Zealand population

Deborah Nolan
*University of Wollongong, djn297@uow.edu.au*

Linda C. Tapsell
*University of Wollongong, ltapsell@uow.edu.au*

Rong Hu

Dug Yeo Han
*Uni of Auckland, NZ*

Lynnette Ferguson
*Uni of Auckland, NZ*

**Publication Details**

Effects of dairy products on Crohn's Disease symptoms are influenced by fat content and disease location but not lactose content or disease activity status in a New Zealand population

Abstract

Background Dairy products have been perceived as having the potential to cause adverse effects in individuals with Crohn's disease (CD) and are often avoided, potentially increasing the risk of osteoporosis and related morbidity associated with inadequate dietary calcium intake. Objective To evaluate the self-reported effects of dairy products on CD symptoms and to determine whether these effects differed between types of dairy products consumed and disease state or location. Design Secondary analysis of dietary survey and clinical data from participants in the Genes and Diet in Inflammatory Bowel Disease study based in Auckland, New Zealand. Subjects/setting One hundred and sixty-five men and women diagnosed with CD for which both dietary survey data and clinical information were available. Statistical analyses performed 2 analysis was conducted to assess whether significant differences in the proportions of responses relating to a worsening of CD symptoms from individual dairy products were evident between individuals with active or quiescent CD, or ileal or colonic disease locations. Odds ratios with confidence interval were calculated to determine whether CD location was associated with risk of any type of adverse reaction to milk products. Logit scales were utilized to depict selfreported CD symptoms associated with individual dairy product consumption for ileal and colonic CD patients. Results Dairy products had no effect on self-reported CD symptoms for most people. Dairy products with a high fat content were most frequently reported to worsen perceived CD symptoms. Clinically, self-reported CD activity status did not influence responses to dairy products; however, colonic inflammation was more frequently associated with adverse CD effects in comparison to ileal CD involvement. Conclusions Research outcomes question the necessity of dairy product avoidance in CD patients and illustrate the highly individual nature of dairy product tolerance in this clinical population

Keywords

but, zealand, location, content, fat, influenced, symptoms, disease, crohn, products, dairy, effects, status, activity, lactose, not, population

Disciplines

Arts and Humanities | Life Sciences | Medicine and Health Sciences | Social and Behavioral Sciences

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Background

Dairy products have been perceived as having the potential to cause adverse effects in individuals with Crohn’s Disease (CD) and are thus often avoided, potentially increasing the risk of osteoporosis and related morbidity associated with inadequate dietary calcium intake.

Objective

To evaluate the self reported effects of dairy products on CD symptoms and to determine whether these affects differed between types of dairy products consumed and disease state or location.

Design

Secondary analysis of dietary survey and clinical data from participants in the ‘Genes and Diet in Inflammatory Bowel Disease’ study based in Auckland, New Zealand.

Subjects/setting

One hundred and sixty five men and women diagnosed with CD that had both dietary survey data and clinical information available.

Statistical analyses performed

Chi Squared analysis was used to assess whether significant differences in the proportions of responses relating to CD symptoms and dairy products were evident. Odds ratios with confidence interval were calculated to determine whether CD location was associated with
the risk of adverse reactions to milk products. Logit scales were utilised for depiction of reported CD symptoms associated with individual dairy product consumption.

Results
Dairy products had no effect on CD symptoms for most people. The greatest proportions of adverse affects were seen for dairy products with a high fat content. Clinically, CD activity status did not influence responses to dairy products; however colonic inflammation was more frequently associated with adverse CD effects in comparison to ileal CD involvement.

Conclusions
Research outcomes question the necessity of dairy product avoidance in CD patients and illustrate the highly individual nature of dairy product tolerance in this clinical population.
Crohn’s Disease (CD) is a debilitating form of inflammatory bowel disease which can affect any location of the gastrointestinal tract resulting in considerable morbidity (1). The incidence of CD in a New Zealand based epidemiological study was 16.5/100,000 per year, (2), higher than in many Western Countries and thus affecting a significant proportion of the New Zealand population.

Dairy products have often been perceived as having the potential to cause adverse effects in individuals with CD and are thus often avoided, potentially increasing the risk of osteoporosis and related morbidity associated with inadequate dietary calcium intake.

There are several hypotheses proposed to explain this perceived adverse affect. Perhaps the most frequently reported theory relates to the prevalence of lactose intolerance in CD patients. A higher prevalence of lactose malabsorption as diagnosed by hydrogen breath testing, in individuals with CD has been reported in comparison to controls (3). Allergy to major milk proteins may be a further reason that a small number of CD patients report adverse affects from dairy products (4). Additionally, individuals with CD may be susceptible to secondary lactose intolerance. During the periods of the acute gastrointestinal inflammation characteristic of CD, quantities of the lactase, the lactose digesting enzyme, may decline in the duodenal mucosa, resulting in the gastrointestinal discomfort associated with lactose maldigestion (5). Thus disease state (active or quiescent) may affect response to dairy products in this clinical population.

The disease location may further influence tolerance to dairy products in individuals with CD. As lactase is located within small intestinal villi, this is the primary site of lactose digestion (6). Thus individuals with inflammatory disease located within this region of the gastrointestinal tract may have difficulties with lactose intolerance and thus perceive that adverse CD symptoms are associated with consumption of dairy products.
The aim of this study was to evaluate the self reported effects of dairy products on CD symptoms and to determine whether these affects differed between types of dairy products consumed, disease state or location. The identification of dairy mediated affects on CD symptoms may facilitate the provision of more targeted dietary advice on dairy products for this clinical population.

Methods

This study was based on a secondary analysis of dietary survey and clinical data from 165 adults with CD. All subjects were Caucasian participants in the ‘Genes and Diet in Inflammatory Bowel Disease’ study based in Auckland, New Zealand (7). Subjects were selected on the basis that a complete set of dietary and clinical data was available.

The ‘Genes and Diet in Inflammatory Bowel Disease’ study was approved by the New Zealand Multi-Region Human Ethics Committee (MEC/04/12/011). Access to the data for this secondary analysis met ethical approval and all information utilised was coded to protect the anonymity of participants.

Clinical Data

Clinical information including age, IBD diagnosis and latest Montreal classification illustrating latest CD location (8) was provided following evaluation of patient medical notes and secondary patient investigation by an experienced gastroenterologist as a part of the ‘Genes and Diet in Inflammatory Bowel Disease’ study. Individuals with a latest Montreal classification of L1, indicating ileal involvement, were grouped into the ‘ileal involvement’ group. While individuals with a classification of L2, indicating isolated colonic involvement, were classified as the ‘colonic involvement’ group. For simplicity individuals with a classification of L3 and L4 (indicating ileocolonic and upper gastrointestinal disease in the
presence of classifications of L1-L3 respectively (9) were excluded from this part of the
analysis.

Additional clinical information was sought from the dietary questionnaire whereby subjects
reported current disease activity status (active or quiescent).

**Assessment of affects of individual dairy products**

For the purpose of this study dairy products were categorised to include ruminant milk
(inclusive of sheep, cow and goat varieties), yoghurt, butter, custard, ice cream, cream and
cheese.

Self reported data on effects of dairy products were extracted from a dietary questionnaire,
which required participants to nominate whether particular foods items made their IBD
conditions either: ‘definitely worse’, ‘probably worse’, ‘had no effect’, ‘probably better’ or
‘definitely better’. Subjects reporting that particular dairy products made their condition
either ‘definitely’ or ‘probably worse’ were categorised as having an adverse reaction to that
food. Similarly those reporting a ‘definitely’ or ‘probably better’ effect of a particular dairy
product on their CD condition were categorised as having a beneficial effect from consuming
that food. This dietary questionnaire is described in more detail elsewhere (7). Several open
ended questions within the dietary questionnaire were also analysed to determine qualitative
information regarding perceived effects on CD condition associated with particular dairy
products. These questions included:

- *Is there a difference with the type of cheese eaten? If so, please outline:*
- *Is there a difference with the type of yoghurt eaten? If so, please outline:*
Both quantitative and qualitative information about the frequency and nature of adverse reactions to milk products was extracted from this supplementary questionnaire following an analysis of open ended questions including:

- *Have you ever had an adverse reaction to a milk product?*
- *What were your adverse symptoms after consuming milk products?*
- *Have you seen a health professional about your reactions to milk products (if applicable)?*
- *Have you been formally diagnosed with an intolerance or allergy?*

**Data Analysis**

Qualitative data (including reports on symptoms of adverse reactions to dairy products and of symptomatic differences from different types of dairy products consumed) was categorised accordingly and the proportion of individuals responding to each category was calculated. Chi Squared analysis was conducted to assess whether significant differences in the proportions of responses relating to CD symptoms and dairy products were evident. Odds ratios with confidence interval were calculated to determine whether CD location was associated with the risk of adverse reactions to milk products. Results were considered statistically significant at p <0.05.

For interpretation of data grouped by disease location (ileal vs. colonic), logit scales were utilised to create a clear visual representation of reported CD symptoms associated with consumption of individual dairy products whilst addressing the issue of the variance of proportions between the groups.

All analyses were conducted using SPSS (V15.0 1989-2006, SPSS Inc., Chicago II, USA), R (R Development Core Team (2009). R: A language and environment for
Results

Dietary and clinical data was available for 165 patients with CD, (mean age 48.8±16.3). The study sample was predominantly female, (males n=49, mean age 50.6±17.8), females n=116 (mean age 48.0±15.6).

Clinical Profiles

Of the study sample, 80 patients (48.5%) reported that their CD was currently active and 82 (49.7%) identified their CD as being in the quiescent phase. Three patients did not answer this survey question. There was no difference between the sexes in the proportion reporting an active CD period at the time of survey completion ($\chi^2 = 0.38$, p=0.54).

Data was available for 160 patients on the latest Montreal classifications indicating the location of CD. Isolated ileal disease involvement was present for 32.7% of the study sample, while 27.9% displayed evidence of isolated colonic involvement (Table 1).

There was no significant difference between males and females in terms of CD location ($\chi^2 = 0.98$, p=0.81).

Effects of Dairy products on CD symptoms

Forty two participants (25.5%) reported having an adverse reaction to a product containing milk, whilst 111 (67.3%) felt that they had no experience of an adverse event with milk product consumption. Of patients reporting an adverse reaction associated with a milk
product, 24 (61.5%) of those reported that the reaction was persistent, while 7 individuals
(4.2%) felt that it was an isolated event.

A formal diagnosis of lactose intolerance was reported for 11 patients (6.7% of the study
population). A total of 41 CD patients described adverse symptoms experienced following
consumption of milk products (Figure 1).

As an aside to this data, naturopaths were the listed as the health practitioner most frequently
sought for advice regarding adverse affects to dairy products (n=9), specialist consultants
including gastroenterologists and allergy specialists were the next most frequently sought
(n=8), followed by general practitioners (n=7). Only one individual reported seeking advice
in relation to dairy product intolerance from a dietitian.

**Reported associations between dairy product consumption and CD symptoms**

No effect on CD symptoms was reportedly associated with consumption of butter, standard
cow’s milk and reduced fat cow’s milk in 71.5%, 64.2% and 58.2% of all patients
respectively. Dairy products most frequently reported as associated with worsening CD
symptoms were cream (43.6%), ice cream (37.6%) and cheese (34.5%). Conversely, yoghurt,
the dairy product most frequently perceived as beneficial was reported by 14.5% of
individuals as having favourable effects on CD symptoms. The response to this question was
quite varied (Table 2).

**Cheese**

When asked whether the type of cheese may influence CD symptoms, 26.1% of participants
reported positively. The flavour strength of the cheese was most frequently reported as
influencing tolerance, with 15 patients reporting that increased strength cheese decreased
tolerance. Richer/soft cheeses were reported to increase adverse affects for 9 patients, with a
preference for Feta and Edam cheese varieties reported by 8 and 7 patients respectively.

Cheeses with a lower fat content were reported to increase tolerance (n=6) as did hard cheeses (n=5) and plain cheeses without added herbs (n=3). Melted cheese was associated with an increase in adverse effects for 4 CD patients.

Yoghurt

In total 23.0% of respondents reported that the type of yoghurt consumed may also be a key factor relating to whether it would be tolerated. Patients reported that yoghurts containing live cultures such as acidophilus were most beneficial to CD symptoms (n=19), whilst natural yoghurt was preferable to sweetened alternatives for 11 patients. A preference for reduced fat yoghurt was reported (n=9), with yoghurt lacking seeds or fruit preferred by a further 4.8% (n=8) of individuals.

Disease Activity and effect of dairy products on CD symptoms

There were no significant differences in the proportion of dairy product mediated CD symptoms between patients in the active or quiescent CD state (Table 3).

Site of Disease and effect of dairy products on CD symptoms

Likewise, no significant differences were detected between CD symptoms from individual dairy products and ileal or colonic disease location (data not shown). However, significantly more patients with colonic disease activity reported ever having an adverse reaction to dairy products compared to those with ileal disease ($\chi^2 = 5.90$, p = 0.015), (OR = 0.32, 95% CI = (0.13-0.82), p = 0.017)).

Logit scales of adverse and beneficial CD effects from individual dairy products in individuals with either small intestinal (ileal) or colonic CD involvement are displayed in figures 2(a) and (b). Only dairy products with at least one reported beneficial/ adverse effect
on CD symptoms can be plotted with the Logit scale. Thus for patients with ileal
involvement butter, Goat and Sheep milk were not included in the Logit graph. Similarly,
cream, ice cream, sheep and goat milk were not graphed for individuals with colonic
involvement.

Discussion

The analysis of self reported effects of consuming dairy products on CD symptoms has
clearly illustrated the extent of variation in tolerance to dairy products within this clinical
population.

Most importantly, the majority of the study sample reported that consumption of dairy
products made no difference to CD symptoms. This finding reinforces the need to determine
tolerance to dairy products in CD patients prior to encouraging widespread avoidance of this
food group, an idea that may be still encouraged by some physicians and many alternative
health consultants. Whilst it may be pertinent to avoid some dairy products for CD patients
with congenital hypolactasia or during periods of active disease, unnecessary avoidance of all
dairy products by this clinical group without appropriate nutrition support may have
deleterious consequences. Individuals with CD are more susceptible to osteoporosis (10).

Prolonged corticosteroid utilisation to induce remission of inflammation has been
demonstrated to reduce bone mineral density (BMD) in CD patients (11). CD itself may be an
independent risk factor for osteoporosis (12) with an increase in pro-inflammatory cytokines
associated with disease pathogenesis mediating excessive bone resorption (13). According to
the National New Zealand Nutrition Survey (14) milk, cheese and other dairy products were
the highest food contributors of dietary calcium in the New Zealand population, contributing
37%, 11% and 5% of total calcium consumed respectively. While evidence is conflicting,
Abitbol and colleagues (15) demonstrated a protective effect of calcium intake on BMD in individuals with inflammatory bowel disease, and increased dairy products consumption has been reported to retard bone loss (16). Thus, eliminating dairy products as the highest contributor of dietary calcium from the diet may further exacerbate risk of osteoporosis and related morbidity in individuals with CD in New Zealand.

Intermittent secondary lactose intolerance may be experienced by some individuals with CD during periods of active gastrointestinal inflammation (5). Formally diagnosed lactose intolerance was reported for only a small proportion of the study sample. However, in our study, symptoms consistent with lactose maldigestion, including bloating, diarrhoea and gas (17), were the most frequently reported adverse effect associated with milk product consumption. This finding indicates that secondary lactose intolerance may have influenced the response to dairy products for a greater number of this CD study sample.

Seeking assistance from alternative health practitioners is a practice frequently observed in individuals suffering from inflammatory bowel conditions (18). Advice of this nature is often sought as an adjunct to conventional medical therapies in an effort to establish a sense of control over this debilitating condition (19). This practice was evident in our clinical population whereby naturopaths were the most frequently utilised source of advice regarding issues with dairy product tolerance. Ensuring accurate advice in relation to dairy product consumption is imperative to prevent micronutrient deficiencies in this clinical population.

Appropriate dietetic intervention is instrumental to ensuring optimal BMD in patients with CD (20). Thus, for individuals reporting adverse CD effects associated with dairy products, dietetic intervention should be encouraged as part of the continuum of care.

In our study sample, tolerance for individual dairy product tolerance was highly variable. In fact, the majority of individuals experienced no effect on CD symptoms associated with each
of the individual dairy products under question. An exception to this finding was evident for
cream, with the highest proportion of individuals in the study sample reporting adverse CD
symptoms associated with its consumption. The perceived adverse affects may relate to the
high fat content of this item. High dietary fat intakes decrease gastric emptying rates (21). In
addition, disorders in gastrointestinal motility have been observed in this clinical population,
with affected individuals more likely to experience gastric hypomotility than controls (22).
Thus effects of dietary-fat mediated gastroparesis following consumption of dairy products
rich in fat may be more pronounced in individuals with CD. Symptoms of gastroparesis
include nausea; abdominal pain and bloating (23) all of which were frequently reported as
adverse affects following dairy product consumption in our study.

Other dairy products containing higher amounts of fat including ice cream, cheese and
standard cow’s milk were associated with larger proportions of worsening CD symptoms in
comparison to lower fat dairy counterparts. Furthermore, reduced fat cheese and yoghurt
varieties were perceived as more tolerable. These findings illustrate that the fat content of
dairy products may be a key factor influencing tolerance in this clinical population.

Of interest we found, that butter, a dairy product that contains a very high proportion of fat,
was not reported as having adverse effects on CD symptoms for the majority of individuals. It
may be that butter is not being consumed in amounts great enough to influence gastric stasis
in the study sample. Conversely, butter contains a relatively high proportion of conjugated
linoleic acid (CLA). CLA has been implicated in the amelioration of inflammation in
experimental models of IBD, particularly in relation to colitis (24). Thus the lack of adverse
effects on CD symptoms associated with butter consumption may be the result of this CLA
mediated anti-inflammatory effect.
Probiotic–containing yoghurt has been demonstrated to attenuate markers of inflammation in individuals with inflammatory bowel disease (25) and the dairy product most frequently associated with having a beneficial effect on CD symptoms in our study was yoghurt. However, we found yoghurt to also be associated with a worsening of CD symptoms for a slightly greater proportion of individuals than had experienced beneficial effects from it. A limitation of the survey which we utilised for analysis was that it failed to distinguish between CD effects experienced from probiotic yoghurt and non-probiotic varieties. An analysis of qualitative responses indicated that for individuals experiencing a difference in CD symptoms dependent on the type of yoghurt consumed, those containing live cultures and probiotics were most frequently associated with beneficial effects. Thus probiotic yoghurts appeared to benefit individuals with CD in preference to yoghurt without live cultures; however this is an area that requires further research.

It was expected from previous observations (7) that goat and sheep milk may result in less adverse CD effects than their bovine counterparts. Goat milk in particular contains oligosaccharides which have demonstrated anti-inflammatory effects in rat models of inflammatory bowel disease (26). In addition sheep and goat’s milk contain higher proportions of medium chain triglycerides than cow’s milk which may enhance digestibility (27). Finally, like butter, sheep milk contains relatively high amounts of CLA (28) which may further ameliorate gastrointestinal inflammation (24). In our study, only a very small proportion of individuals reported a beneficial CD effect associated with consumption of these milk products, with a slightly greater proportion reporting adverse affects. However, because the majority of individuals did not answer this question, indicating that they did not consume these items, it was not possible to determine the true effect of goat and sheep milk on CD symptoms. Given emerging evidence to suggest a potentially beneficial role for sheep
and goat milks in relation to CD symptoms, evaluating the true effects of these products may be an important area for future research.

The lactose content of the individual dairy products did not seem to influence CD symptoms in our study sample. Cow’s milk, which contains a significantly greater amount of lactose per serve than cream, ice cream or cheese (17) was associated with comparatively less symptom worsening. Additionally, lactose tolerance may be influenced by gastrointestinal transit time, with higher fat milk products travelling less rapidly throughout the small intestine, affording lactase a greater opportunity for lactose digestion (17). Thus, if lactose was a key factor relating to CD symptoms in our study sample, reduced fat cow’s milk would have been associated with less favourable CD effects than its standard variety. As this was not the case it appears that the lactose content of individual dairy products does not have a major impact on CD symptoms. In contrast, qualitative responses regarding the types of cheese and yoghurt consumed that may affect tolerance indicate a lactose effect in a small proportion of the study sample. The preference for yoghurt containing live bacteria previously outlined may be associated with tolerance to lactose for some individuals, given that these organisms perform the activity of lactase (29), enhancing digestibility. Similarly several individuals reported a preference for hard cheeses such as cheddar in comparison to soft cheeses. Hard cheeses may contain slightly less lactose than soft varieties such as cream cheese (17) and may thus be better tolerated by individuals with lactose digestion issues.

In our study disease activity (active vs. quiescent) did not appear to influence perceived effects of dairy products on CD symptoms, with a similar proportion of individuals reporting either adverse or beneficial dairy mediated CD effects irrespective of disease activity. This finding challenges the necessity of dairy avoidance during active CD. However, as disease activity was subjectively reported, these findings should be interpreted with caution.
Reference to the logit scales developed in our analysis shows that individuals with isolated colonic inflammation appeared to have an increase in adverse CD symptoms from consuming reduced fat cow’s milk, custard, sheep’s milk and yoghurt was evident in the logit scales in comparison to those with isolated small intestinal (ileal) involvement. This was an unexpected finding as it was anticipated that individuals with small intestinal inflammation would be more likely to have issues with lactose and thus dairy product tolerance, given that lactase lines the small intestinal mucosa (6). Furthermore Annese et al (22) reported most severe gastrointestinal motility disorders occur in Crohn’s ileitis. This unexpected finding warrants further investigation and may relate to functional differences in gut microbiota amongst individuals with CD affecting varied locations throughout the gastrointestinal tract.

A possible explanation for the unexpected outcomes observed in relation to dairy product tolerance in this study may be attributable to individual genetic variation. Although clear genomic loci such as NOD2 and IL23R have been repeatedly associated with this CD in genome wide association studies (30), there is a paucity of evidence in relation to genetic factors that may influence tolerance to dairy products in individuals with this inflammatory condition. Future research efforts should consider the impact of genetic interactions on dairy product tolerance in CD to conclusively address the research question.

This study is limited by the subjective nature of the dietary questionnaire utilised, and the relatively small size of the CD sample that make it difficult to extrapolate findings to the wider Crohn’s disease community. However, to our knowledge, this is the first study to assess the perceived affects of dairy products on CD symptoms taking into account both clinical and qualitative data.
Conclusion

In conclusion, within our study sample of CD patients in Auckland, New Zealand, dairy products in general had no effect on CD symptoms for most people. When analysed according to type of dairy product, the greatest proportion of adverse affects were seen for products with a high fat content. The lactose content of individual dairy products did not influence perceived affects on CD symptoms for the majority of patients. Clinically, CD activity status did not influence responses to dairy products; however site of disease appeared to have an effect. Colonic inflammation was more frequently associated with an increase in reported adverse CD effects from dairy product consumption in comparison to ileal CD involvement. Results from this exploratory study reinforce the idea that that ‘one size does not fit all’ when it comes to making dietary recommendations relating to dairy product consumption for individuals with Crohn’s Disease. Future research should consider the identification of genetic variants that may further explain tolerance to dairy products in this clinical population.
References


Table 1. Latest subject Montreal classifications for location of CD (n=160)

<table>
<thead>
<tr>
<th>Montreal classification for CD location</th>
<th>Group: n (%)</th>
<th>Males: n (%)</th>
<th>Females: n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 – Ileal</td>
<td>54 (32.7%)</td>
<td>14 (28.6%)</td>
<td>40 (34.5%)</td>
</tr>
<tr>
<td>L2 - Colonic</td>
<td>46 (27.9%)</td>
<td>16 (32.7%)</td>
<td>30 (25.9%)</td>
</tr>
<tr>
<td>L3 Ileocolonic</td>
<td>51 (30.9%)</td>
<td>15 (30.6%)</td>
<td>36 (31.0%)</td>
</tr>
<tr>
<td>L4 – Isolated upper disease</td>
<td>9 (5.5%)</td>
<td>3 (6.1%)</td>
<td>6 (5.2%)</td>
</tr>
</tbody>
</table>
Figure 1. Adverse symptoms reported by CD patients following consumption of dairy products (n=41)*

*Some patients reported more than 1 symptom. Other adverse symptoms reported include: asthma (n=1), reflux (n=1), bowel irritation (n=1) and inflammation (n=1).
Table 2. Self-reported effect of individual dairy products on CD symptoms (n=165)

<table>
<thead>
<tr>
<th>Food Item</th>
<th>CD Symptoms Worse N (%)</th>
<th>No difference to CD symptoms N (%)</th>
<th>CD Symptoms better N (%)</th>
<th>Question not answered N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Cow’s Milk</td>
<td>51 (30.9%)</td>
<td>91 (55.2%)</td>
<td>2 (1.2%)</td>
<td>21 (12.7%)</td>
</tr>
<tr>
<td>Reduced Fat Cow’s Milk</td>
<td>30 (18.2%)</td>
<td>96 (58.2%)</td>
<td>10 (6.0%)</td>
<td>29 (17.6%)</td>
</tr>
<tr>
<td>Butter</td>
<td>29 (17.6%)</td>
<td>118 (71.5%)</td>
<td>2 (1.2%)</td>
<td>16 (9.7%)</td>
</tr>
<tr>
<td>Custard</td>
<td>32 (19.4%)</td>
<td>106 (64.2%)</td>
<td>8 (4.8%)</td>
<td>19 (11.5%)</td>
</tr>
<tr>
<td>Goat’s Milk</td>
<td>11 (6.7%)</td>
<td>27 (16.4%)</td>
<td>4 (2.4%)</td>
<td>123 (74.5%)</td>
</tr>
<tr>
<td>Sheep’s Milk</td>
<td>11 (6.7%)</td>
<td>27 (16.4%)</td>
<td>5 (3.0%)</td>
<td>122 (73.9%)</td>
</tr>
<tr>
<td>Ice Cream</td>
<td>62 (37.6%)</td>
<td>94 (57.0%)</td>
<td>3 (1.8%)</td>
<td>6 (3.6%)</td>
</tr>
<tr>
<td>Yoghurt</td>
<td>31 (18.8%)</td>
<td>94 (57.0%)</td>
<td>24 (14.5%)</td>
<td>16 (9.7%)</td>
</tr>
<tr>
<td>Cheese</td>
<td>57 (34.5%)</td>
<td>95 (57.6%)</td>
<td>5 (3.0%)</td>
<td>8 (4.8%)</td>
</tr>
<tr>
<td>Cream</td>
<td>72 (43.6%)</td>
<td>72 (43.6%)</td>
<td>1 (0.6%)</td>
<td>20 (12.1%)</td>
</tr>
<tr>
<td>Food Item</td>
<td>CD Symptoms Worse n (%)</td>
<td>No difference to CD symptoms n (%)</td>
<td>Active CD (n=80)</td>
<td>Active CD (n=82)</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------</td>
<td>-----------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Standard Cow’s Milk</td>
<td>21 (30)</td>
<td>45 (43)</td>
<td>(χ² = 1.28, p = 0.26)</td>
<td></td>
</tr>
<tr>
<td>Reduced Fat Cow’s Milk</td>
<td>14 (15)</td>
<td>46 (48)</td>
<td>(χ² = 0.004, p = 0.95)</td>
<td></td>
</tr>
<tr>
<td>Butter</td>
<td>15 (9)</td>
<td>57 (61)</td>
<td>(χ² = 1.61, p = 0.20)</td>
<td></td>
</tr>
<tr>
<td>Custard</td>
<td>17 (14)</td>
<td>50 (54)</td>
<td>(χ² = 0.48, p = 0.51)</td>
<td></td>
</tr>
<tr>
<td>Goat’s Milk</td>
<td>7 (4)</td>
<td>13 (13)</td>
<td>(χ² = 0.58, p = 0.45)</td>
<td></td>
</tr>
<tr>
<td>Sheep’s Milk</td>
<td>5 (6)</td>
<td>13 (13)</td>
<td>(χ² = 0.64, p = 0.80)</td>
<td></td>
</tr>
</tbody>
</table>
| Product    | 30 | 31 | 45 | 47 | \(\chi^2\)  
<table>
<thead>
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<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice Cream</td>
<td>30</td>
<td>31</td>
<td>45</td>
<td>47</td>
<td>(\chi^2 = 0.053, p = 0.82)</td>
</tr>
<tr>
<td>Yoghurt</td>
<td>14</td>
<td>16</td>
<td>46</td>
<td>47</td>
<td>(\chi^2 = 0.14, p = 0.71)</td>
</tr>
<tr>
<td>Cheese</td>
<td>29</td>
<td>27</td>
<td>46</td>
<td>47</td>
<td>(\chi^2 = 0.02, p = 0.883)</td>
</tr>
<tr>
<td>Cream</td>
<td>36</td>
<td>36</td>
<td>35</td>
<td>35</td>
<td>(\chi^2 = 0.00, p = 1.00)</td>
</tr>
</tbody>
</table>
Figure 2(a). Self-reported effects of individual dairy products on CD symptoms for individuals with ileal disease involvement.
Figure 2(b). Self-reported effects of individual dairy products on CD symptoms for individuals with colonic disease involvement