Report of empirical study

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Barriers and facilitators to adhering to an anti-inflammatory diet for individuals with spinal cord injuries

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Abstract

The purpose of this study was to explore the barriers and facilitators of an anti-inflammatory diet in people with spinal cord injury. Six participants (age range of 23–68 years, three women and three men) who had previously completed an anti-inflammatory diet study were interviewed. Facilitators identified were family support, autonomy over meal choice, peer support, health benefits gained, and implementation of adherence strategies. The main barriers discussed were lack of motivation after study period ended, social events, diet expenses, and lack of knowledge about the diet. Several health benefits including reductions in pain, edema, and improvements in cognition and mobility were reported.

Keywords

chronic inflammation, diet adherence, meal planning, peer support, spinal cord injury

Spinal cord injury is a condition commonly associated with a state of chronic low-grade inflammation as evidenced by elevated concentrations of pro-inflammatory mediators in circulation (Davies et al., 2007). The loss of varying degrees of somatic and autonomic nerve function can result in various acute and chronic secondary health complications which contribute to this state. Acute secondary health complications such as urinary tract infections and pressure ulcers are prevalent following spinal cord injury and may contribute to reoccurring acute spikes in inflammation. Loss of mobility also commonly results in reduced activity levels and associated metabolic diseases such as obesity, type 2 diabetes, and cardiovascular disease, which are each independently associated with a state of chronic inflammation (Cragg et al., 2013; Davies et al., 2007; Myers et al., 2007). Finally, comorbidities which have been shown to be highly prevalent following spinal cord injury such as neuropathic pain (Siddall et al., 2003) and depression (Craig et al., 2009; Kennedy and Rogers, 2000) have each been shown to be associated with elevated concentrations of inflammatory mediators.

As chronic inflammation can negatively influence many systems of the body, there is a need for safe and sustainable, long-term anti-inflammatory treatment options. Pharmaceuticals, such as non-steroidal anti-inflammatory drugs, target inflammatory pathways and help to reduce concentrations of inflammatory mediators. However, numerous unfavorable side effects, such as those related to gastrointestinal health (Buttgereit et al., 2001) may make such options (i.e. pharmaceuticals) inappropriate for long-term use. Regular physical activity has established anti-inflammatory benefits in able-bodied individuals (Mathur and Pedersen, 2008; Petersen and Pedersen, 2005), and there is evidence that it is also effective following spinal cord injury (da Silva Alves et al., 2013). Although the importance of regular physical activity following spinal cord injury should not be understated, a number of barriers (e.g. transportation and immobility) have been identified, which may explain the low adherence rates observed in many studies (Ditor et al., 2003; Martin Ginis and Hicks, 2005; Pelletier et al., 2014).

A complementary intervention to regular exercise may be appropriate dietary alterations. Energy expenditure and

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nutritional requirements typically change drastically following spinal cord injury and are frequently not adequately addressed (Fraser et al., 2012). A number of foods and supplements, such as omega-3 fatty acids, carotenoids, flavonoids, and tocopherols, have well-known anti-inflammatory properties (Galland, 2010). As a dietary intervention may not pose the same barriers as an exercise intervention (e.g. motor impairments, musculoskeletal injuries, lack of access to accessible facilities, and lack of transportation), it may provide a suitable accompaniment to regular physical activity. A diet intervention could provide added anti-inflammatory benefit to complement regular physical activity, as well as provide a compensatory measure, during periods when physical activity cannot be performed, such as times of injury or illness.

Diet has been found to have a substantial influence over the chronic inflammation typically observed following spinal cord injury (Allison and Ditor, 2015; Allison et al., 2016; Hayes et al., 2002). In a previous dietary study conducted in our laboratory, participants with spinal cord injury were placed on an anti-inflammatory diet intervention that consisted of the elimination of common food intolerances and inflammation-inducing foods, as well as the introduction of foods with established anti-inflammatory properties. Participants also consumed daily supplements with established anti-inflammatory benefits (omega-3, chlorella, antioxidants, and vegetable-based protein powder). Results showed that the anti-inflammatory diet successfully reduced inflammatory mediators, modified neuroactive compounds, and improved mood and neuropathic pain in individuals with spinal cord injury. During the study, adherence to the diet was 89 percent, however, this dropped to 43 percent during a 1-year follow-up. Thus, despite the diet being effective at lowering inflammation, pain, and depression, participants did not adhere to the diet when the research study concluded. It is important to understand the barriers and facilitators for adhering to an anti-inflammatory diet so future research can examine how to reduce these barriers and implement facilitators for people with spinal cord injury. This research may lead to the development of modified diet programs which may better facilitate long-term diet adherence and help to improve the health and quality-of-life for these individuals. Therefore, the purpose of this study was to explore potential barriers and facilitators for adhering to an anti-inflammatory diet for people with spinal cord injury.

Methods

Study design

A qualitative design was used whereby a focus group and one-on-one interviews were conducted to gather in-depth information about the experience of adhering to the anti-inflammatory diet mentioned above. Qualitative designs are useful when there is limited information about a particular topic (Liamputtong, 2013), such as the specific barriers and facilitators of adhering to an anti-inflammatory diet for people with spinal cord injury. Focus groups provide an opportunity for rich data as participants engage in dynamic discussions where emphasis is on the interaction between participants (Morgan, 2012); however, they cannot explore complex beliefs about a single person, and some individuals are uncomfortable sharing in a group setting. Therefore, to complement the study design, individual interviews were also conducted to explore individual experiences and perspectives (Liamputtong, 2013).

Participants

Participants were recruited from the university affiliated exercise facility in Southern Ontario. One year following the 3-month anti-inflammatory diet study mentioned above (Allison et al., 2016), the same participants were given the opportunity to participate in this study, and 6 of these 12 individuals were recruited. Detailed participant characteristics are presented in Table 1. Pseudonyms were provided for each participant to maintain anonymity.

Interview guide

An interview guide was designed by the research team to elicit discussion that would provide the researchers insight into the barriers associated with the diet as well as what factors compelled them to continue adhering to the diet. This guide was designed to gain an understanding of the barriers and facilitators during the 3 month span of the diet study, as well as during the subsequent year after the study period had concluded. The same guide was used for the focus group and one-on-one interviews and can be found in Table 2.

Procedure

After university research ethics clearance, participants were recruited using purposive sampling procedures (Patton, 2002). Participants from the previously conducted anti-inflammatory diet study (Allison and Ditor, 2015; Allison et al., 2016) were invited to participate in a focus group and one-on-one interview (see Table 3 for a 1-week meal plan sample). Participants provided voluntary written informed consent. The first author facilitated the focus group while the second author took detailed notes. The focus group was about an hour in length. This focus group was meant to provide an opportunity for the participants to discuss their experiences with the diet. Participants at the focus group were asked to respect the privacy of other participants' stories by keeping personal information confidential following discussions. During the weeks following the focus group interview, individual interviews were conducted by the first

Table 1. Participant characteristics.

Pseudonym	Age	Gender	Age at injury	Level of injury	AIS	Years post injury	Interview or focus group
Justin	46	Male	17	T6	A	30	Interview
Shelly	54	Female	48	L3	D	6	Interview
Peter	23	Male	17	C7	B	6	Focus group
Laura	38	Female	18	T3	A	20	Both
Dennis	68	Male	61	C5	B	7	Focus group
Cait	65	Female	27	C3	D	38	Both

AIS is the ASIA Impairment Scale, where ASIA stands for American Spinal Injury Association. AIS A indicates a complete injury such that there is no sensory or motor function at some neurological level below the injury and including the sacral segments S4-S5. AIS B indicates an incomplete injury such that there is sensory but no motor function below the neurological level of the injury and includes the S4-S5 segments. AIS C and AIS D both indicate incomplete spinal cord injuries such that there is motor and sensory function below the neurological level of injury. In AIS C injuries, at least half of the key muscles below the injury have less than anti-gravity strength. In AIS D injuries, at least half of the key muscles below the injury have anti-gravity strength or greater.

Table 2. Focus group and interview guide.

First, we will start with your *overall* thoughts and experiences with the diet.
1. What are your experiences with the diet? What are your overall thoughts? What did you enjoy? What did you not enjoy?
2. How does this diet compare to other diets you've tried?
3. Who would benefit from this diet the most? The least?
4. Did you notice any cognitive benefits from the diet? Any clarity?
5. Did you notice any motor or sensory changes with the diet?
6. What are some other benefits you might have noticed from the diet? Side effects?

Now we would like to explore your experiences with the diet during the *3-month span* of the study you completed.
7. What were some barriers that you had to face when trying to stick to the diet? What made it hard, challenging, or prevented you from complying?
8. What were some facilitators or aspects that made the diet easier to stick to? What made it easier, what were the strategies or tips to be compliant?
9. What might be some barriers that other people with spinal cord injury might face when trying to complete such a diet?
10. What are some important facilitators other people with spinal cord injury might need in order to complete the diet?
11. What is needed to make this type of diet more accessible for people with spinal cord injury?

Now we would like to explore your experiences with the diet over *the last year.*
12. Over the last year, what was your experience with sticking to the diet?
13. What are some barriers or facilitators you face when trying to stick to the diet?
14. This diet can be understood as a lifestyle change, because if you discontinue the diet then the results quickly go away. How might someone with a spinal cord injury stick to this diet for life?
15. If you could change anything about the diet, what would it be?
16. What were some of your experiences with the supplements for the diet?

Is there anything else you can think of when it comes to your overall thoughts and experiences about the diet?

author with four participants. Interviews ranged from 30 minutes to 1 hour in length. Each interview, including the focus group, was audio recorded for transcription purposes. Participants were informed anonymity could not be guaranteed but that their data would remain confidential as their real names would not be used for publication. All participants were compensated $20 for their time.

Analysis

Focus groups and interviews were transcribed verbatim and then read several times for familiarity. The data were inductively analyzed by the first and second author using the six phases of thematic analysis (Braun and Clarke, 2006). Procedures were taken to ensure the quality of data and credibility and trustworthiness of results (Lincoln and Guba, 1986). For example, member checking was used to maintain accuracy and authenticity, where each summary was sent to its respective participant, and he or she was asked to review the contents to confirm the information was interpreted correctly. The first and second author independently analyzed the transcripts and generated a list of potential themes. Next, they compared themes, discussed discrepancies until consensus was reached, and compiled a final list of themes and agreed saturation was reached. A final thematic map of the resulting themes can be found in Table 4.

Results

Several barriers and facilitators that influenced participants' abilities to adhere to the anti-inflammatory diet were identified. The main themes found as facilitators for diet adherence were (1) family support, (2) autonomy over meal

Table 3. Sample 1-week meal schedule.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast	Lemon juice and water 1 scoop of protein powder with spinach, frozen blueberries and ½ a banana and water	Lemon juice and water One scoop of protein powder with frozen mango, dark leafy greens, one tablespoon of coconut oil and unsweetened almond milk	Lemon juice and water One scoop of protein powder with one cup of plain Greek yogurt, one tablespoon of almond butter, ½ a banana	Lemon juice and water One scoop of protein powder with ½ an avocado, pineapple and spinach and water	Lemon juice and water One scoop of protein powder with frozen blueberries, dark leafy greens and a couple of spears of asparagus	Lemon juice and water 2 scrambled eggs with sautéed spinach, mushrooms and ½ an avocado green or ginger tea	Lemon juice and water One cup of Greek yogurt with one banana green or ginger tea
Snack	Celery and almond butter	Apple and six almonds	Eight baby carrots and hummus	Handful of brazil, almond, (raw and unsalted)	One hardboiled egg	Plain Greek yogurt with added berries	Raw green beans and cut up carrots
Lunch	Chicken salad with cut up peppers, tomatoes, cucumbers, use balsamic or olive oil dressing	Mixed bean salad	Can of tuna on fresh green salad with onions and tomatoes. Use plain Greek yogurt to mix with tuna instead of mayonnaise	Left over Chicken stir fry	Chicken spinach salad with goat or feta cheese, and tomatoes, dress with olive oil or balsamic vinegar	Left-over Squash soup	Left over chili
Snack	Pear or apple	Plain Greek yogurt with ½ a banana	One hardboiled egg	Hummus with sliced cucumbers and peppers	2–3 dates with a handful of raw/unsalted almonds	Cut up cauliflower and broccoli with hummus	Handful of brazil, and/or almonds (raw and unsalted)
Dinner	Baked Salmon with quinoa cooked in turmeric with sautéed asparagus and mushrooms	Turkey burger without the bun on a bed of lettuce or use a grilled Portobello mushroom, top with grilled peppers, and goat cheese	Chicken stir fry with brown or wild rice	Fish with baked sweet potato and steamed broccoli	Squash soup	Turkey chili	Steak with Greek salad

Table 4. Thematic map.

Facilitators for diet adherence	
1. Familial support	• Ability to follow the diet influenced by family members, especially those who share their living environment • It was helpful if co-habitants attempted to adopt the diet
2. Autonomy over meal choice	• Adherence was facilitated if the participants themselves were the primary cook of their household
3. Peer support among fellow dieters	• Participants found it helpful to share ideas and recipes among themselves • They were motivated by each other's encouragement as well as competition
4. Health benefits gained	• The most significant benefits gained which helped adherence: • Reductions in pain • Reductions in edema • Improvements in perceived cognition • Improvements in bowel function
5. Implementation of adherence strategies	• Participants incorporated deliberate or spontaneous cheat days/meals to help cope with the strict nature of the diet
Barriers from diet adherence	
1. Social events	• Social gatherings posed a challenge, as friends and family tended not to support the dieters, but rather encouraged them to cheat
2. Lack of motivation after study period concluded	• Participants were highly motivated by their sense of commitment to research during the study period • They generally lacked the motivation to continue on the diet once research study was over
3. Expense associated with cost of ingredients and supplements	• Participants found that eating according to the diet was more expensive (especially supplements)
4. Lack of knowledge regarding meal planning and preparation	• There was difficulty associated with locating where to buy unfamiliar foods (e.g. quinoa) • Finding enough recipes to maintain variety was a challenge

choice, (3) peer support among fellow dieters, (4) health benefits gained, and (5) implementation of adherence strategies. The main themes identified as barriers for adherence were (1) lack of motivation after the study period had concluded, (2) social events, (3) expenses associated with cost of ingredients and supplements, and (4) lack of knowledge regarding meal planning and preparation.

Facilitators

Family support. The ability of individuals to adhere to the diet was found to be heavily influenced by family members, especially those who share a living environment. Participants expressed that it was beneficial if co-habitants attempted to adopt the diet to some extent. In contrast, co-habitants who were unsupportive or exposed the participant to food choices outside diet specifications became a barrier to adherence. Justin explained that having a supportive family was a significant facilitator, as his wife also went on the diet for the duration of the study period. He said,

> My wife, she went on the diet herself … it was great and the rest of the family they're supportive but they laughed when they were eating their burgers and I wasn't … if you could have a buddy system or pair up with somebody [it] makes it so much easier … if you had someone else at home I think that would be a huge benefit because you're not the only one struggling.

Similar to Justin, Dennis felt that having family support was a major determining factor in whether an individual with spinal cord injury can adhere to this diet. He commented on how it is difficult to adhere when other people in the household are eating separate meals, while it was helpful when he had his family's support in preparing meals that adhered to the diet. He said,

> It's got to be family support. It's got to be supporting those around you to help you stay on the diet … You couldn't do it without your family helping out and everything else because with preparation of meals and so on it's hard to do it individually and to have two different plates on the table, you know?

Peter was particularly fortunate that his mother, who was the primary cook of the household, made only meals that were suitable on the diet, essentially modifying all of their family meals to align with what Peter was able to eat. He said, "My mom just made everything so they all [his family] went on the diet too … my dad and my sister they didn't really follow like my mom and I did but my mom's the one who cooks."

Laura disclosed that she had a very hard time adhering to the diet when her husband was home. She described experiencing more success while he was away for business as she was not tempted by the types of foods (e.g. candy) he would bring into the house that would cause inflammation. She said,

> When he's home I indulge a lot more because he will buy the licorice because he enjoys it and like I said for me there's just something about not being able to say no to myself I guess … it will improve when he goes because I don't buy them.

There was a consensus among the group that having supportive family members in the household was a major facilitator in adhering to the diet. However, if people in the household are not supportive and make no attempt to adopt at least some aspects of the diet, they become a barrier to adherence and an individual may experience more success when actually living alone.

Autonomy over meal choice. It was found that adherence to the diet was improved when the participants themselves were the primary cooks in the household, which were only in the cases where participants lived alone. Cait lived alone and felt that it was helpful to not have to accommodate other people in the household when preparing meals. She suspected it would be difficult to coordinate meals in a family where all members are not on the same diet. She said,

> I live by myself so I didn't have to answer to anybody else. I can make my meals and not worry about fixing something for somebody else; but for other people if they're in a family situation or something, that's a little bit more difficult because I don't think you'd get the whole group in on this.

Laura described that when her husband was away for weeks at a time she felt she had more choice over what she ate (e.g. quinoa). For her, it was actually easier to adhere to the diet when her husband was away and she had total autonomy. She said,

> He prepares all the meals when he's home. Now he's gone, he leaves tomorrow for six weeks, so that's a big part of why I think I fluctuate as well. When he's home I indulge a lot more because he will buy the licorice and other foods I can't eat.

Peer support among fellow dieters. Participants expressed that having the support of other peers on the diet was a major facilitator for adherence as they could share recipes and discuss their challenges and strategies to overcome them. Cait found enjoyment in sharing ideas with other participants, "I did enjoy sharing ideas with the other people in the program and how they were coping." Laura shared a similar opinion, she said, "we could share recipes and talk about difficulties … we used our circle of participants to figure that piece [recipes] out." Some members also experienced a sense of competition, not wanting to stray from the diet more than their peers. Cait was particularly motivated by a sense of friendly competition, she said, "I'm the type of person that likes a challenge so if I see that the person next to me is doing better than me than I'll strive do better than them."

Health benefits gained. All participants experienced considerable health benefits as a result of being on the diet. These improvements were highly influential in motivating them to continue adhering strictly to the diet for the duration of the study. The health benefits that significantly improved their quality of life included reductions in pain and edema, improvements in cognition and bowel function, and weight loss.

Reductions in pain. Pain relief was the most frequently discussed health benefit by participants and may arguably be the most influential factor for adherence. Shelley experienced significant reductions in pain which she considered to be the most enjoyable aspect about the diet. She described this experience, "The pain level dropped which was fantastic! And without the pain I was able to do more!" Justin also commented on his reductions in pain and how that allowed him to take fewer medications throughout the day. He said,

> The pain usually reminds you when you have to take it [drugs] … when you find at the end of the day when there's two doses [of pain medication] that you usually take but you haven't needed them, that makes a difference!

Laura experienced reductions in pain as well. She was particularly satisfied with the absence of rheumatoid arthritis flare-ups while she was on the diet. Laura did not take medication for her pain, so she could definitively attribute her benefits to her change in diet. She said,

> I experienced a significant reduction in pain. Feeling great was also a motivator … I have rheumatoid arthritis, and the flares, I never had a single flare on the diet … [the most enjoyable aspect of the diet was] the way that I felt, was the energy and the being in less pain, a lot less pain, days without pain! I don't take meds … It definitely was the diet!

Reductions in edema. One participant in particular suffered from severe edema prior to starting the diet intervention. Cait disclosed that she used to experience constant discomfort from peripheral edema in her legs, and she estimated that there was a 75 percent reduction in edema since having adopted the anti-inflammatory diet. Her edema has not returned to its pre-diet state since she has mostly maintained the diet after the study ended. She said,

> My legs and feet used to really swell like awful and now they don't … it's gone down 75% so that was good. That was great … and that stayed that way. They might be a little up but it's basically stayed because my legs used to be like tree trunks!

Improvements in perceived cognition. Two participants described improvements in their cognition while on the diet. As Justin mentioned, it is possible that these effects

were the result of fewer pain medications needed on a daily basis. He said,

> You feel a little fresher a little more awake … I felt better. Like I said, I felt more awake in the morning … don't know if that was the amount of medications I reduced … in general I would say by the 5-6 week mark I felt different. I felt better. I'd say it was easier getting up, it was easier sleeping … cognitive wise definitely there was an improvement.

Laura also reported an enhanced cognitive state, "My memory did improve and attention you know so I found myself more present." She also mentioned she felt much more energized throughout the day, and this was a major facilitator that motivated her to adhere to the diet during the study period.

Improvements in bowel function. Bowel function is a sensitive topic of conversation; therefore, it was surprising it came up during the focus group discussion. Justin claimed he did not personally have any preexisting bowel issues, although he did notice that his bowel movements became more predictable while on the diet, which he considered to have been valuable. When asked in the focus group specifically what facilitated being able to adhere to the diet, Cait responded, "A little on a personal note but for me better bowel and bladder stuff" to which Laura agreed, "Yeah that's true!"

Weight loss. Although weight was not measured throughout the study period (as the researchers did not anticipate changes), weight loss was described as an enjoyable benefit experienced by participants. Cait was particularly satisfied with the weight loss she experienced, primarily for its appearance benefits, she said, "It was great because I lost about 35 pounds I would guess, and I was getting very overweight … this is what I really loved about it … made me feel better about myself." Peter also experienced a significant reduction in weight, reporting to have lost, "34 pounds or something like that." Although some members enjoyed their weight loss primarily for esthetic reasons, Justin found that his weight loss resulted in functional benefits such as enhancing his mobility. When asked whether he experienced any improvements in his movement abilities, he responded, "I think just the loss of weight … more mobile you know. It just helped all around."

Implementation of adherence strategies. None of the participants demonstrated 100 percent adherence for the entire duration of the study period. As Dennis suspected, it would be extremely challenging to remain completely adherent to the diet for that length of time, "I don't think anyone was totally true to the diet I mean we had to cheat a little bit, I don't think you could totally live on that diet all the time." Some participants incorporated cheat days to help cope with the strict and challenging nature of the diet. Some chose to schedule deliberate cheat days, for example, Shelley said, "Once a week I would have a cheat day … It would usually end up being fish and chips." Laura didn't schedule deliberate cheat days, but would occasionally succumb to temptation and indulge in a cheat meal, candy, or more commonly a cheat beverage (e.g. alcohol). She described this strategy:

> Didn't have a system, just occasionally would break down, once in a while it was coffee … I really didn't cheat that much except for some alcohol and some coffee on occasion but the food part I was pretty strict with.

Laura also suggested that using a periodization strategy may facilitate long-term adherence to this diet, "You know 2 months on, 1 month off, kinda thing?"

Barriers

Lack of motivation after study period concluded. Participants were highly motivated by the sense of commitment they had to the research being conducted during the study period; however, they generally lacked the motivation to continue on the diet once they were only accountable to themselves and not the research team. Cait felt especially committed to helping the researchers, "I was accountable to [the researcher] and I knew that this was what he was doing so I felt like I had a responsibility to do the best that I could." Laura shared a similar opinion. She found it hard to adhere to the diet for her own sake when there was no one to report to. She said, "You just don't have that someone to answer to was the big thing … it's for you and not the greater good." Dennis and Peter both agreed that they were committed to contributing to the study and were motivated to maintain strict adherence to provide accurate data for the researchers; however, when it came to their own benefit alone, their motivation decreased.

Social events. Social gatherings posed a challenge as friends and family encouraged dieters to cheat. Most restaurants did not have a selection of meals that adhered to the diet protocol. Laura found it was difficult to be around family and friends, especially around the winter holidays (the time of the diet study), as they offered very little support regarding her diet and she felt left out of the celebrations since she could not indulge in food and beverages:

> I was particularly disappointed in the people, my friends and family. It was also really hard at Christmas time when you have all that celebrating and good food and stuff like that and you couldn't participate in it.

Cait also found that socializing posed a challenge, and she began to avoid some of her friends because she knew they would encourage her to deviate from the diet:

Table 5. Supplements and their costs (in Canadian dollars).

Supplement	Cost
Protein powder	$64.99
Omega 3	$22 (120 tablets)
InflanNox	$26.99 (90 tablets)
Anti-oxidant network	$29.99 (60 tablets)
Chlorella	$27.99 (180 tablets)

> I actually made dinner one night for three of my friends and one of them refused to eat it … I got to a point where I thought I don't want you guys visiting me for a while because every time you come I stray farther and farther away [from the diet].

Shelley also began distancing herself from family members because their visits made her feel inclined to cheat on the diet, "I kind of avoided that [family dinners] … My one son would come over every Sunday with his wife and yeah I would just eat whatever and they would eat whatever … Well we didn't have them over as often."

Expense associated with ingredients and supplements. The participants found that eating according to the diet was more expensive than their previous eating habits. The supplements were especially costly (see Table 5 for supplement cost breakdown). Participants were provided supplements for free for the duration of the study, but very few participants started buying any of the supplements after the 3-month study period ended. Justin felt he spent significantly more money on groceries during the study than he had before. Cait found her financial situation to be a slight barrier for adherence, "the money sometimes is a deterrent … as far as the budget goes it's more expensive to eat healthy." While Shelley still currently maintains some aspects of the diet, she does not buy any of the supplements due to the cost, she said, "I'm not on the supplements I couldn't afford them."

Lack of knowledge regarding meal planning and preparation. Some of the participants encountered difficulty when trying to locate where to buy unfamiliar foods. There were also several comments made pertaining to challenges in figuring out how to prepare these unfamiliar foods as well as gathering enough recipes to maintain variety in their diet. Dennis felt that the first 2 weeks of the study were the most difficult as they needed to transition out of their previous eating habits and learn how to prepare new types of food. He said,

> The transition period, the start, was the hardest. I remember saying, "what do I do with quinoa?" Never had it before … The stuff is not always readily available a lot of places … It would be a little more helpful to have a broader menu.

Cait also felt that more recipes would have been helpful in minimizing this barrier. She said, "There were a few recipes but I think a lot more would have been helpful because when anything gets old then you get bored."

Discussion

This study explored the experiences of individuals with spinal cord injury participating in an anti-inflammatory diet and identified the major facilitators and barriers associated with adherence. Our findings suggest that factors contributing to adherence were multifaceted and variable between participants. Facilitators included family and peer support, autonomy over meal choice, health benefits gained, and implementation of adherence strategies, while barriers included loss of motivation following study cessation, social events, food related expenses, and lack of knowledge. Although adherence to the diet was very strong throughout the 3-month intervention, with an average compliance score of 89 percent (Allison and Ditor, 2015), compliance scores fell to only 43 percent 1 year following study completion (unpublished data). Maximizing adherence in future diet programs may benefit from the use of a personalized approach based on individual socioeconomic and environmental factors which include some form of post-intervention compliance strategy.

A major facilitator for diet adherence was the experience of considerable health benefits. Reported benefits ranged from improvements in edema, bowel function, weight loss, cognition, and pain. Improvements in pain can be a particularly strong motivator given its substantial impact on quality of life. Chronic pain following spinal cord injury has been shown to negatively impact recreational and vocational status (Ravenscroft et al., 2000), sleep quality (Norrbrink et al., 2005), sexuality (Westgren et al., 1997), and physical functioning (Ullrich et al., 2008). The participant-reported improvements in pain were corroborated by our previously published quantitative data related to neuropathic pain. Specifically, the 3-month anti-inflammatory diet was shown to result in significant reductions in scores of sensory neuropathic pain as assessed by the neuropathic pain questionnaire (Allison et al., 2016). Furthermore, chronic pain is closely related to psychological health, which was also shown to be significantly improved following the intervention (Allison and Ditor, 2015). Given these health benefits, it is somewhat surprising that adherence to the diet fell so dramatically following study completion. This may highlight how impactful the identified barriers can be and emphasizes a need for the implementation of post-intervention compliance strategies.

Family support was shown to be an important facilitator, among all participants, which heavily influenced diet adherence. This finding corroborates previous studies which have shown similar associations in patients with type 2 diabetes mellitus (Garay-Sevilla et al., 1995; Glasgow and Toobert, 1988). Family support also depended on the degree of desired family involvement. For instance, while some participants felt that having family involvement in the

diet was critical to its success, others felt it was easier to maintain the diet without direct involvement from family members. This may relate to factors associated with autonomy of meal choices. While some participants were functionally capable of preparing meals independently, others were more reliant on the willingness of family members to either actively participate in the diet or prepare separate meals which aligned with the dietary guidelines. A lack of family support may therefore be particularly detrimental to adherence in participants with more severe motor impairments and/or younger participants who may rely on a parent or guardian for meal preparation. It may be beneficial in future trials to consider including family members in the diet, by providing family meal plans, and/or increasing family accountability by encouraging the completion of their own food logs. Inclusion of family members in information seminars may also help increase family participation by increasing awareness about their own potential health benefits

Peer support was also expressed to be an important facilitator. In this study, participants had the opportunity to interact in a voluntary, monitored online support group. This allowed participants to support one another by discussing positive and negative experiences with the diet, adherence strategies, and unique recipe ideas. One participant also expressed being motivated by a sense of "friendly competition" when hearing of the success of other participants. A study by Lindsay et al. (2009) also showed the efficacy of using an online community support group to enhance dietary compliance and stressed the importance of including a moderator. In that study, cardiac patients were allocated to either an online treatment group or control group during a moderated period and un-moderated period. During the 6-month moderated phase, participants of the experimental group showed significantly better self-reported diets than the control group. This difference in behavior was, however, not maintained during a 3-month un-moderated phase (Lindsay et al., 2009). This substantiates the benefit of providing an online support group but may also highlight the need for continued moderation. As the support group in our study was not moderated following the cessation of the diet program, it may explain, in part, the large reduction in adherence 1-year following study completion. Although the costs involved in hiring a researcher for continued moderation may be prohibitive, it may be possible to train a willing participant to continue moderating the group following study cessation.

Newly arising barriers following study cessation such as loss of motivation, diet-related expenses, and lack of knowledge likely substantially impacted continued adherence to the diet. Participants expressed a loss of motivation when there was no longer a sense of accountability to a larger purpose. The idea of contributing to research, which could be used to help others, gave participants a higher sense of purpose, which was lost following study cessation, when adherence to the diet became purely for personal gain. It may be possible to maintain a greater degree of participant motivation by encouraging continued use of the online support group. This may help foster a continued sense of community engagement and provide participants the continued opportunity to support one another.

Costs associated with the diet were also expressed as a barrier for continued, long-term adherence. In particular, expenses associated with the five unique supplements included in the diet were expressed as a concern. All participants adhered to the supplement schedule throughout the duration of the study, when supplement costs were covered. However, no participants continued taking all supplements, as directed, following study cessation. It may be possible for future studies to develop a more affordable diet program by focusing exclusively on whole foods rather than incorporating supplements.

A lack of knowledge pertaining to where to buy particular foods and ingredients as well as how to prepare various types of meals was also stated as a barrier to continued participation. Although participants attended an information seminar prior to beginning the diet, it may be of value for future studies to consider more applied training with participants. Showing participants specifically where to locate new foods in nearby grocery stores, or teaching participants new cooking techniques, in addition to supplying a greater variety of recipes, may help facilitate longer adherence to the diet.

As the barriers expressed by participants differ to those typically, and most strongly, expressed following an exercise intervention, incorporating dietary alterations may complement an exercise regimen. Common barriers to exercise adherence for this population relate to transportation issues, lack of appropriate facilities to accommodate specific needs, and medical complications that can potentially increase health risks. The most significant barriers to exercise in the study by Pelletier et al. (2014) were physical health problems and lack of transportation, which were not identified as barriers to diet in this study. This could suggest that the barriers associated with diet adherence more easily overcome than those associated with exercise adherence, and/or the facilitators associated with diet intervention are more supportive for adherence than those associated with exercise interventions. If diet is a more realistic method of reducing inflammation in the spinal cord injury population to achieve the associated health benefits, then this should be taken into consideration when developing strategies to minimize secondary health complications post spinal cord injury. However, the most effective mode of treatment for inflammation following spinal cord injury is likely a combination of diet and exercise. A study by Neefkes-Zonneveld et al. (2015) found evidence to suggest that there are reductions in low-grade inflammation in response to exercise training for people with spinal cord injury. The use of combined strategies involving both diet and exercise may

produce more substantial anti-inflammatory benefits and/or compensate for occasional periods of non-compliance in either intervention. By allowing participants to stray from the diet or exercise program on occasion, rather than requiring 100 percent compliance, it may be possible increase the likelihood of long-term adherence.

Limitations

This study provided useful information about specific barriers and facilitators of adhering to an anti-inflammatory diet; however, there are some important limitations that should be mentioned. First, it is possible that additional participants from a more diverse range of ages and abilities could provide more information about the challenges of the diet. Second, participants were interviewed 1 year after the conclusion of the diet study, so this study relied on retrospective memory about experiences on the diet.

Future directions

Ultimately, the information gathered in this study will be used to help design and support a community-based dietary program for individuals with spinal cord injury and to ensure optimal adherence to their program on a long-term basis. By understanding the most influential barriers and facilitators associated with adherence to the diet, strategies can be employed to attempt to break down the barriers and enhance the facilitators. A specific strategy would be to develop a nutrition program where meals suitable for the diet are prepared at a cooking facility and are made available for pickup or delivery at various time intervals (e.g. weekly). This may be a way to solve the barrier identified as lack of knowledge regarding meal planning and preparation and possibly even alleviate some of the need for familial support in regard to assistance required to prepare meals, as dieters and their family members would no longer be responsible for this task. If meals are provided 5 or 6 days of the week, this strategy would also accommodate for the facilitator of cheat days to be built into the nutrition program. Clients could follow anti-inflammatory diet protocol during the week and indulge (with moderation) on weekends. This may also address the barrier associated with social gatherings because these types of events could be scheduled for the weekends or days that the individual is not provided meals.

An additional strategy which was suggested by a participant in this study was to appeal to the Ontario Health System as well as health insurance companies to cover the cost of supplements that have been proven to elicit anti-inflammatory benefits, such as the ones taken by participants on this diet. If pharmaceutical medications are covered to treat symptoms of secondary health complications after spinal cord injury, applicable supplements should also be covered as a means of avoiding the development of these complications altogether. In conclusion, hospitals, rehabilitation facilities, and post-spinal cord injury support services should take notice of the profound positive impact the adoption of an anti-inflammatory diet can have on individuals with spinal cord injury regarding health status and quality of life. These types of organizations should direct efforts toward the promotion of anti-inflammatory diets for spinal cord injury patients. Further research should be conducted that strives to establish strategies to break down barriers that discourage diet adherence and enhance the facilitators identified to support diet adherence.

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