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1. Introduction

Over the last century, human life expectancy has increased, from approximately 29 years of age in 1800 (The World Bank, 2004) to 63 years of age in 2018 (World Health Organization, 2018). For the most part, this increase is the result of consumers valuing and adopting healthy lifestyles (Szakály, Szente, Kövér, Polereczki, & Szigeti, 2012), underpinned by a perception that food directly affects health (Mollet & Rowland, 2002). This perception has helped to increase demands for food products, which are being perceived, as well as, having health benefits. In 2017, the health and wellness market retail value increased by 3.3% and by 4.2%, respectively, in the Asia Pacific, and the Middle East and Africa (Angus & Westbrook, 2018). In Europe, the evidence shows that the market value in 2013 was approximately 130 billion Euros, and in 2018 this value is forecasted to reach 149 billion Euros (Statista, 2017).

One such area in which the profile of healthy eating has changed is the “free from gluten” category of food products, which has contributed to the overall growth in the health foods market. Products may bear the term ‘gluten-free’ if the gluten content does not exceed 20 mg/kg in food items sold to the final consumer (“(EU) No 828/2014,” 2014). However, it is important to notice that, in this review, the term “GF product” refers to dietetic (processed) gluten-free foodstuff that is manufactured using GF ingredients like cereals, principally corn and rice, in substitution of the regular gluten-containing ingredients. To mention some products of these categories: bread, biscuits, pasta, pizza, bakery products. According to Angus & Westbrook (2018), the compound annual growth rate for the category “Free from Gluten” has the largest growth for the period (2012-2017); the US, Italy and the UK are the most important contributors to this growth. In fact, in 2016 compared to packaged foods,

which has a growth rate of just over 4%, global sales of gluten-free (GF) food jumped to 12.6% (Terazono, 2017). Moreover, the GF retail market is forecasted to expand from \$1.7billion in 2011 to \$4.7billion by 2020 (Terazono, 2017).

Given the general pattern of global growth in the demand for GF food, it is worth understanding how and why this has occurred. This review aims to understand GF market trends by examining several economic and psychological factors and the risks that this market faces.

For instance, celiac people that are required to follow a strict gluten-free diet (GFD) for health reasons contribute to the rise in the market for GF products, but also their family members and other non-celiac people are also embracing this diet. Moreover, other people suffering from non-celiac gluten sensitivity and wheat intolerance are recommended to reduce the intake of gluten in their diet, even though the latter, unlike celiac disease, are not considered autoimmune diseases (Newberry, McKnight, Sarav, & Pickett-Blakely, 2017). However, recent work on GF food highlights that GF products, such as pasta, have low nutritional value (Wu et al., 2015), as well as limited availability and are more expensive than comparable alternatives (do Nascimento, Medeiros Rataichesk Fiates, dos Anjos, & Teixeira, 2014). Nevertheless, despite these limiting factors, as mentioned, the GF market is one of the fastest growing food product lines in the health foods market. Therefore, understanding the factors, which affect adherence to a GFD, is of relevance because it gives some indication of how and why there is an increasing appetite for this type of food product. For instance, why is that despite GF products having low nutritional properties and high prices is the market growing? Especially when gluten-containing alternatives have higher nutritional values and are cheaper?

Thus, one of the key objectives of this paper is to give an overview of factors most commonly related to adherence to a GFD. This subject has been of interest to researchers, but the most

prominent review of this literature by Hall, Rubin, & Charnock (2009) involved a systematic review of articles from 1980 to 2007, which is now ten years out of date. They analysed factors affecting adherence to GFD but specifically on work examining only celiac patients rather than non-celiac as well. Hall et al. (2009) found that the lowest adherence was among ethnic minorities and those diagnosed with celiac disease (CD) in their childhood. Furthermore, they found that emotional and socio-cultural influences, membership of an advocacy group and regular dietetic follow-up are factors most typically associated with strict diet adherence. The most recent systematic review to date by Sainsbury & Marques (2018) focused on the relationship between depressive symptoms and adherence to GFD by celiac patients. They found that there was a moderate relation between high depressive symptoms and low GFD adherence. However, the evidence base was limited, and any conclusion drawn from this work should be considered with some caution.

Nevertheless, both Hall et al. (2009) and Sainsbury & Marques (2018) did not account for potential economic factors associated with a GFD although they might play an essential role in explaining the increasing demand for GF products.

Moreover, both studies did not discuss how specific characteristics of GF products might affect the adoption of GFD, as well as why non-celiac people also adopt a GFD. Finally, Hall et al. (2009) review the literature on GFD adherence until 2007, so it is useful to check whether their findings still apply. By providing a more comprehensive evaluation of the factors that inform the current trend in adopting a GFD, this review not only is of benefit to researchers but also has a value from an applied angle. For instance, a review of this kind would help GF industries to identify and respond to the specific needs of their target market, celiac consumers, as well as non-celiac populations that proactively follow a GFD.

The rest of the article is organised as follows: Background section will introduce the increasing trends of CD and adherence to the GFD worldwide and will give some details regarding GFD and GF products; the search strategy explains the way relevant articles were selected and analysed; the Main findings section of this systematic review presents a description of the results from the selected papers; the Discussion section provides an overview of the key findings and how they inform the objectives of this review, and the final section includes a discussion on new directions for research that would help strengthen our understanding of the growing interest in adopting a GFD.

2. Background

The GFD is the only currently available treatment for the CD. Thus, the increasing number of people affected by the disease is one of the most important indicators when forecasting the growth of the GF market. The CD is considered to have an "international face" since it is globally recognised as a disease (Alaedini & Green, 2005; Niewinski, 2008). Worldwide, 1-2% of the population is considered to suffer from this disease (Green & Cellier, 2007; Leffler & Schuppan, 2010), but there is speculation that the real percentage is higher. For instance, according to the Italian Ministry of Health, in 2016 the celiac population of Italy was 198 427, but other estimates state that the real population might be 407 467 (De Stefano & Silano, 2016).

Also, the growing adoption of a GFD depends on changes in people's lifestyles and attitudes towards "health".. For instance, celiac consumers are becoming more demanding regarding the choice of GF products. The market has responded to this increasing demand by increasing their range of GF products, such as bread, pizza layers, flour, pasta, snacks, cakes, cookies, bars, ready meals and fast foods (Arendt & Dal Bello, 2008).

Moreover, as mentioned earlier, it is worth highlighting that the celiac population is not the only one consuming GF products, but recently non-celiac people are voluntarily adopting the GFD. For instance, in Italy, 6 million non-celiac people follow the GFD, spending approximately 105 million Euro/year on GF foods (Associazione Italiana Celiachia, 2017). Moreover, 37% of people under the age of 20, and 31% of people under the age of 34 are willing to pay a premium price for GF products (Nielsen, 2015). The motivations for this are various. For instance, family members of celiac patients follow a GFD at home to avoid food contamination. Furthermore, since the disease is inherited, adopting a GFD is thought to prevent the presence of the disease in other family members (Arendt & Dal Bello, 2008). Also, according to Arendt & Dal Bello (2008), there are perceptions that a GFD positively impacts other conditions such as autism, and other food allergies, as well as intolerances to wheat, eggs, soy, and milk.

Another reason that non-celiac people likely follow a GFD is that it is a fashionable lifestyle trend. Non-celiac consumers are often influenced by non-celiac celebrities who consider the GFD as a way to stay in shape and as a means to increase energy levels (“Celebrities Who Are GF | InStyle.com,” n.d.). For instance, famous sports people have publicly discussed how GFD has positively changed their life, such as Novak Djokovic, a world-famous tennis player, who reported on this in his book “Serve to Win” (2013).

Thus far, this discussion has considered, in broad terms, a range of possible factors that contribute to understanding the growing market of GF food products, and the reasons for adopting a GFD. In the following discussion, we also introduce some limiting factors associated with GF products. These include the nutritional value, taste, availability, and price of GF products which could present threats for the future of the GF market unless the market takes these issues into account.

With regards to nutritional value, according to Wu et al. (2015), the Health Star Rate (HSR)¹ for GF dry pasta is 0.5 stars less than conventional counterparts. Furthermore, many studies suggest that when compared to conventional equivalent food items, GF products consistently have a lower content of proteins (bread and pasta) (Missbach et al., 2015; Wu et al., 2015), higher content of fat and sodium, fewer minerals and vitamins (Pellegrini & Agostoni, 2015). Regarding the content of carbohydrates, results are contradictory. Some studies show that people following a GFD have a lower intake of carbohydrates and fibers, while other studies found that the level of carbohydrates in GF product is higher when compared to the conventional (Naqash, Gani, Gani, & Masoodi, 2017; Vici, Belli, Biondi, & Polzonetti, 2016).. Wild, Robins, Burley, & Howdle (2010) reported that followers of the GFD have a lower intake of magnesium, folate, iron, selenium, zinc and manganese. Moreover, when taking GF biscuits as an example, they claimed that commercially available GF biscuits were richer in saturated fat than their gluten-containing equivalents. Thus, from a nutritional standpoint, the evidence suggests that, unlike the perception of GF products being healthy, they are objectively lower in nutritional value. If consistently adopted into consumers diets, GF products pose problems because they lack necessary nutrients that should be present in a healthy diet.

Furthermore, there is evidence to suggest that, GF products, like bread, pizza and biscuits are judged as less tasty than conventional foods (Arendt & Dal Bello, 2008; Arendt, O'Brien, Gormley, & Gallagher, 2002; Do Nascimento, Fiates, Dos Anjos, & Teixeira, 2014). In a survey commissioned by the Gluten Intolerance Group of North America in 2009, 71% of participants agreed with the statement "It is hard to find good tasting gluten-free products". Several studies also suggest that when choosing functional foods, taste is one of the most important

¹A nutrient profiling scheme endorsed by the Australian Government. The Health Star Rating is a front-of-pack labelling system that rates the overall nutritional profile of packaged food and assigns it a rating from ½ a star to 5 stars. It provides a quick, easy, standard way to compare similar packaged foods. The more stars, the healthier the choice (Wu et al., 2015).

sensory features compared to look and smell, in particular for GF products (Grunert, Bech-Larsen, & Bredahl, 2000; Olsson, Hörnell, Ivarsson, & Sydner, 2008; Urala & Lähteenmäki, 2003). Nevertheless, recent work looking at attempts to improve GF products' taste characteristics, suggests that they pose additional problems (Capriles, dos Santos, & Arêas, 2016; Elisa Carvalho De Morais, Cruz, & Bolini, 2013; E. C. Morais, Cruz, Faria, & Bolini, 2014). To entice customers, by making GF products tastier, the methods used to improve the sensory properties of GF products still present a challenge for producers. That is to say, the increase in sugar and salt content aimed at increasing the taste of GF products, in turn, makes them even unhealthier. However, research on this topic is advancing, and there are attempts to develop new food products with improved sensorial and, importantly, improved nutritional profiles (A. Singh & Kumar, 2018).

Finally, research has studied the availability and costs of GF products. According to Missbach et al. (2015), GF cereals and bakery and bread products are +205% and +267% higher in price compared to their gluten-containing counterparts. Furthermore, Singh & Whelan (2011) found that the price of GF pasta, in both quality supermarkets (\$ 0.8 per 100 g) and health food shops (\$ 1.04 per 100 g) is higher when compared to regular supermarkets (\$ 0.62 per 100 g). They also found that the cost of GF bread is approximately 360% higher compared to gluten-containing alternatives. Also, the availability of GF products in Brazil, the UK and Poland is considered limited (do Nascimento, Medeiros Rataichesk Fiates, et al., 2014; Ferster, Obuchowicz, Jarecka, Pietrzak, & Karczewska, 2015; J. Singh & Whelan, 2011). For instance, in a study conducted in the UK in 2010 on 30 different food outlets, regular supermarkets' stock of gluten-free products and corner shops did not offer any discount on GF products (J. Singh & Whelan, 2011).

As highlighted earlier, the demand for GF products is increasing rapidly, and it is forecasted to rise. This likely means that more firms will be tempted to enter the promising GF market and thus it is important to have adequate information about consumers' expectations of GF products, as well as understanding the critical factors affecting adherence to the GFD.

Thus, this systematic review addresses the following issues:

- Identify the most important factors affecting adherence to GFD
- Analyse the most relevant attributes regarding willingness to pay (WTP) and intention to buy GF products
- Understand differences between celiac and non-celiac followers of a GFD

3. Search Strategy

3.1 Selection of articles

The review was conducted by considering the PRISMA protocol, which contains a checklist with 17 items considered to be essential and minimum components of a systematic review or meta-analysis protocol (Shamseer et al., 2015). At first, an initial pool of studies was built by running searches in several key databases: Scopus, Web of Science, Elsevier's Science Direct, AgEcon Search and Econ Papers. Three searches were conducted in each of the databases above:

- Selecting articles related to adherence to GFD by using keywords: "gluten-free", "diet", "adherence", "adults."
- Selecting articles related to willingness to pay (WTP) for GF products by using keywords: "gluten-free", "willingness to pay."
- Selecting articles related to intention to buy GF products by using keywords: "gluten-free" and "intention to buy".

Studies considered for this review were assessed for the period January 2008 to September 2017, since, as reported in the previous section, Hall et al. (2009) conducted a systematic review from 1980 to 2007.

Figure 1 shows the process of collecting, extracting and selecting articles for this review.

(Figure 1 here)

First of all, duplicates were excluded, and only articles from academic journals, conference proceedings, books, thesis, and dissertations were considered for the next screening process.

Thus, articles, which contained empirical studies were selected based on the following criteria:

- Published in English/Italian/Spanish language (languages spoken by the authors)
- Exclusion of review articles
- Studies on adult populations

During this screening, articles were selected by considering the presence of the words “gluten-free”, “diet”, willingness to pay” and “intention to buy” in their titles. At the third step, 863 abstracts were assessed for eligibility, and 681 articles were dropped since they did not meet the criteria outlined. From this, 182 articles’ text were evaluated and only 54 articles were considered as meeting the full criteria of this systematic review.

3.2 Data Extraction

Information extracted from the articles of this review was on 1) Location, since the research has shown that CD rates are higher in western countries and among white people (Di Sabatino & Corazza, 2009); 2) Whether participants were celiac or not because many non-celiac consumers appear to be following a GFD.

Moreover, given that one of the objectives of this review is to determine factors affecting GFD, the selected articles were assessed concerning the type of variables (factors) they studied. To the best of our knowledge, there is no scientific methodology which describes the way independent factors are classified. However, to fulfil the first objective, the classification was established according to the type of variables most commonly studied, the themes the studies typically discussed, and the core description of the findings provided by the studies.

4. Main Findings

Figure 2 shows the location where the selected articles for this review were carried out. As can be seen, most of the studies were conducted in Europe (mainly in the UK and Spain), and North America (mainly in the USA). Also, another key factor that is common to most studies, shown in Figure 3, is that they focus primarily on celiac patients.

(Figure 2 here)

(Figure 3 here)

Regarding the type of method used, most studies used a quantitative approach. Seven studies used a qualitative approach to assess factors affecting adherence to the GFD, with the sample size varying from 7 to 203 participants. Furthermore, the majority of the articles used a survey method in order to identify factors affecting adherence to the GFD and in most cases adherence was measured by a validated scale developed by Morisky, Ang, Krousel-Wood, & Ward (2008)².

Looking across the factors that emerge from the studies, those appearing more frequently that were related to the GFD adherence can be classified into eight factors (Figure 4): “Factors

² Please refer to Appendix 1 for a detailed information on the methods and the main results of the studies included in this review.

specific to the GFD"; "Socio-demographic factors"; "GF products"; "Psychological Factors"; "Symptoms related to Celiac"; "Celiac Disease factors"; "Quality of Life"; "Other Factors". The rest of this section reports findings organised according to the classification of these eight factors.

(Figure 4 here)

Factors specific to the GFD: Many studies show that adherence to GFD is also correlated with different aspects of the GFD. These include attitudes towards the diet, knowledge about the diet, length of following the GFD, and other factors described in Appendix 2 and Figure 4. Time of adopting the GFD, perceptions of GFD, and knowledge about the diet, are the factors most commonly studied. According to Tursi, Elisei, Giorgetti, Brandimarte, & Aiello (2009), after 6.5 years of following the GFD physiological health complications appeared. In contrast, Zarkadas et al. (2013) and Van Hees, Van der Does, & Giltay (2013) found that psychological factors improved. Negative emotions and depressive symptoms decreased, while perceptions of improvements increased among participants following a GFD for more than five years. (Leffler et al., 2008; Lis, Stellingwerff, Shing, Ahuja, & Fell, 2015a; Sainsbury, Mullan, & Sharpe, 2013a, 2015a, 2015b; Ukkola et al., 2011). Moreover, adherence to GFD is also positively correlated with knowledge about the diet (Ford, Howard, & Oyeboode, 2012; Rocha, Gandolfi, & Dos Santos, 2016; Sainsbury, Mullan, & Sharpe, 2013b; Sainsbury et al., 2015a; Silvester, Weiten, Graff, Walker, & Duerksen, 2016; Tomlin, Slater, Muganthan, Beattie, & Afzal, 2014; Verrill, Zhang, & Kane, 2013; Villafuerte-Galvez et al., 2015). This association suggests that for the celiac population, being informed about the diet (whether or not it substantively improves health and wellbeing) is associated with the likelihood of adopting the diet.

Regarding non-celiac participants, according to Lis, Stellingwerff, Shing, Ahuja, & Fell (2015b), GFD was mostly self-initiated by non-celiac people and commonly associated with perceptions

regarding the positive health benefits of adopting the diet. However, one limitation with this study is that it did not report significance levels and effect sizes in the analysis of this association. In their study with non-celiac gluten sensitivity participants, Biesiekierski, Newnham, Shepherd, Muir, & Gibson (2014) found that 44% of participants self-initiated the GFD, and only 27% had any detailed knowledge about the diet. Thus suggesting that for non-celiac participants, perception rather than knowledge may be the primary contributor to adopting the diet. Consistent with this speculation, when comparing celiac and non-celiac people, it was observed that non-celiac and their knowledge about the diet was poor (Silvester et al., 2016; Verrill et al., 2013), and that they were also less likely to consult health professionals about adopting a GFD (Silvester et al., 2016).

Socio-demographic factors: Based on our sample of studies, 30 take into account Socio-demographic factors when studying the adherence to a GFD. Corposanto et al. (2015) found that young adults with higher education and seeking employment for the first time have a higher probability of ingesting gluten and fail to follow a GFD consistently. In line with this, Ukkola et al. (2012) found that young people are more dissatisfied with the diet and consequently are more prone to the transgression of a GFD later in life. Among other demographic factors, Paarlahti et al. (2013) showed that the age of diagnosis affected the measure of Quality of life (QOL) and adherence to a GFD. In addition, Kurppa et al. (2013) found that diagnosis at a younger age, especially teenage years, was associated with increase transgression of a GFD later in life. Further, Kautto et al. (2016) found that younger men have difficulty in recognizing that they have a chronic disease. However, other studies consider education as an important predictive factor when analysing adherence to a GFD. These studies show that participants with a higher level of education have higher rates of adherence (Barratt, Leeds, & Sanders, 2011; Shah et al., 2014; Tomlin et al., 2014; Villafuerte-Galvez et al.,

2015). However, there are conflicting findings from Mahadev et al. (2013) that found that age, gender, and education level were not associated with diet adherence.

Regarding non-celiac consumers, the majority of GFD followers were females aged between 31-40 years (Lis et al., 2015a). When comparing celiac and non-celiac, the data show that females of both groups had fewer difficulties in following the GFD (Shah et al., 2014; Verrill et al., 2013). Thus, the overall pattern indicated here is that younger populations struggle to maintain a GFD, particularly younger men, and that whether or not they are celiac, women are more likely to stick to a GFD.

Factors associated with GF products: As mentioned in the Background section of this article, there is work suggesting that GF products are associated with reduced sensorial experience, high prices and low availability. Consequently, these factors affect adherence to GFD. Costs of GF products are the most important when following a GFD and most of the dieters are dissatisfied with the high prices (Araújo & Araújo, 2011; do Nascimento, Fiates, dos Anjos, & Teixeira, 2014; Leffler et al., 2008; Lin, 2007; Villafuerte-Galvez et al., 2015). Moreover, reduced availability is a serious issue. According to Araújo & Araújo (2011), approximately 67% of participants consumed gluten in their diet because of the lack of availability of GF products. In line with this do Nascimento, Fiates, dos Anjos, & Teixeira (2014) found that 71% of participants in their study reported having moderate to high difficulty in finding GF products.

Moreover, another relevant factor affecting the adoption of a GFD is related to GF product labelling. Most of GFD's followers are more careful and read food product labels to avoid incurring into serious consequences (Araújo & Araújo, 2011). Research suggests that GFD adherence and reading/understanding labels were positively correlated. In line with this, Verrill, Zhang, & Kane (2013) showed that attention to food labels further increased the likelihood of following a GFD. In additional support, Muhammad, Reeves, Ishaq, Mayberry, &

Jeanes (2017) found that not understanding food labels and not being a member of celiac association increased the risk of ingesting gluten and consequently not following a strict GFD. Poor food labelling also has serious consequences. Ferster et al. (2015) reported that in Poland GF products are inadequately labelled, which may also impact adherence to the diet. What appears to be a consistent finding from this work is that there is convergence in showing a relationship between attention to, and labelling of GF product and adherence to a GFD.

The price of GF products ought to be another key factor that is instrumental when considering adherence to GFD. However, to date, there has been little by way of empirical research investigating how price/labelling of GF products affects willingness to pay (WTP), and no studies have been carried out to understand how WTP is associated with GFD adherence. Only three papers were found to be broadly relevant on this topic, De-Magistris, Xhakollari, De, & Rios (2015); de Magistris, Belarbi, & Hellali (2017) and de Magistris, Xhakollari, & Munoz (2015). The studies were conducted in Spain (Zaragoza) with non-celiac consumers. These studies found that when comparing GF against conventional snacks, consumers' evaluation of characteristics related to taste, smell and sight was similar for both products. However, taste and smell did not influence WTP for the GF snack (De-Magistris et al., 2015).

Moreover, de Magistris, Xhakollari, & Munoz (2015), showed that non-celiac consumers were not willing to pay a premium price for the GF snack, suggesting that the labelling does not affect the confidence and loyalty of non-celiac consumers towards these product types. Also, socio-demographic factors appear to affect intention to buy for GF products, suggesting that better knowledge and positive attitudes towards GF products is positively correlated with intention to buy (de Magistris, Belarbi, & Hellali, 2017). Hence, increasing knowledge towards GF products and considering them as healthy, cheap, and not having adverse side effects might increase the possibility of non-celiac consumers buying GF products. However, it is worth

highlighting that no studies to date have been carried out regarding the association between the price of GF products and adherence to a GFD with celiac consumers.

Psychological Factors: Following a strict diet has consequences for mental health, and many studies have taken this into account when studying celiac disease (Ford et al., 2012; Mahadev, Gardner, Lewis, Lebwohl, & Green, 2015; Rocha et al., 2016; Rose & Howard, 2014; Sainsbury & Mullan, 2011; Sainsbury et al., 2013b; Sainsbury, Mullan, & Sharpe, 2015c). Mental health issues, such as depression and anxiety, are the most commonly associated illnesses with celiac patients. For celiac patients, the findings show that depression and anxiety negatively affect adherence to the diet (Arigo, Anskis, & Smyth, 2012; Barratt et al., 2011; Bürk et al., 2009). Regarding non-celiac gluten sensitivity, Peters, Biesiekierski, Yelland, Muir, & Gibson, (2014) found that this population report suffering depression when exposed to gluten. However, Silvester et al. (2016) found that non-celiac participants experienced less depression and anger when compared to celiac participants. The reasons behind why it is that celiac patients suffer from depression and anxiety are likely different to the reasons that non-celiac people report suffering from depression. However, as yet, no work closely compares the two populations to determine what the critical aetiology is in both.

Factors related to CD and other symptoms: Symptoms and perceptions related to CD also impact adherence to GFD. According to Tursi, Elisei, Giorgetti, Brandimarte, & Aiello (2009), almost half of the participants with CD and subclinical CD did not fully adopt a GFD. In line with this, Ukkola et al. (2012) found that patients with extraintestinal or asymptomatic symptoms were highly disapproving of a GFD compared to those with CD. Moreover, it is relevant to mention that CD is accompanied by other symptoms that include: Ataxia, Attention deficit disorder, Stance and Gait problems, Vestibular disturbance, Carpal tunnel syndrome, Migraine (Bürk et al., 2009); other food allergies (Addolorato et al., 2008; Edwards George et al., 2009;

Hernandez & Ruiz, 2014; Leffler et al., 2008; Paarlahti et al., 2013; Silvester et al., 2016; Verrill et al., 2013) and Bloating, Fatigue and Pruritus (Barratt et al., 2011; Bürk et al., 2009; Kurppa et al., 2013). While these symptoms have been identified as relevant in association to GF, to date, no evidence has examined if these also impact adherence to a GFD.

Quality of Life and other social factors: According to Whoqol Group (1995), quality of life (QOL) is “individuals’ perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns”.

Research on CD patients has shown that QOL plays an important role in explaining adherence to GFD. In fact, where to eat becomes a serious decision, and lifestyles and social activities change dramatically (Araújo & Araújo, 2011; Bacigalupe & Plocha, 2015; Ferster et al., 2015; Leffler et al., 2008, 2017; Zarkadas et al., 2013). Once diagnosed with CD, most GF dieters adopt eating in a more domestic environment, and develop feelings of social isolation (Bacigalupe & Plocha, 2015; Barratt et al., 2011; do Nascimento, Medeiros Rataichesk Fiates, et al., 2014; Rocha et al., 2016; Rose & Howard, 2014; Silvester et al., 2016; Zarkadas et al., 2013). To help with this, medical services’ support (Bacigalupe & Plocha, 2015; Srihari Mahadev et al., 2013; Rajpoot & Makharia, 2013; Ukkola et al., 2012) and membership to celiac associations (Muhammad et al., 2017) have been shown to mitigate failure to consistently adopt a GFD. However, the findings are mixed when it comes to self-efficacy (i.e. a sense of personal control) and coping strategies. Some studies show a correlation between GFD adherence and both self-efficacy and coping strategies (Ford et al., 2012; Sainsbury et al., 2013a, 2015c; Villafuerte-Galvez et al., 2015), while other studies found no correlation (Kurppa et al., 2013). Finally, when it comes to work looking at non-celiac people, or comparisons between celiac and non-celiac people, only one study has examined the relations between QOL scores on both these populations. When comparing celiac and non-celiac participants on QOL scores, no reliable differences were reported (Barratt et al., 2011).

In summary, as mentioned in the section on search strategy, there are a host of variables that could have been used to evaluate the studies included in this systematic review. We have focused on the most commonly referred to factors that appear to be of interest to researchers examining potential influences on adherence to a GFD (see Appendix 2). In the next section, we discuss the implications of the findings reported here, and how they relate to the core objectives of this review.

5. Discussion

The market for GF products has increased rapidly in the last few years. This growth has mainly been because of the increasing number of consumers adopting a GFD. Hence, the first objective of this review was to understand factors affecting adherence to GFD and how this can inform the future profile of the GF market, particularly because there is special interest on sensorial characteristics, price and nutritional values of GF products that in turn likely impacts future adherence to a GFD. Among the eight categories of factors that were identified in this systematic review, the ones which have been most commonly researched are presented in Table 1.

(Table 1 here)

Results from articles included in this systematic review show that for celiac followers of the GFD after six years on a diet, health complications appeared. However, over time, mental health and well-being appear to improve. Also, it was shown that when compared to non-celiac followers, celiac people have a higher level of knowledge about GFD and that this, in turn, impacts a host of other factors regarding the way in which this population engage with GF products (e.g., attention to labelling, WTP). Findings regarding socio-demographic factors showed that young celiac patients are more likely to lapse in strictly following the diet, particularly young men.

However, regarding other socio-demographic factors, such as level of education, there are mixed results regarding a strong association with adherence to a GFD.

Strictly adopting a GFD also impacts mental health and the QOL. The review revealed that the level of depression and anxiety is higher for celiac followers compared to others who voluntarily follow the GFD, or who follow the diet because of other symptoms. Furthermore, studies suggest that celiac followers have a low QOL, but only one study has compared celiac to non-celiac population, finding no differences between the groups. Therefore, it is hard to generate any strong conclusions in this regard.

Another important result of the review is that while the characteristics of GF products are referred to as important factors affecting adherence to GFD, the available evidence on this appears to be scant. Nevertheless, previous research identify price, availability and attention to food labelling are key problems for both celiac and non-celiac followers of a GFD. Moreover, it appears that these factors are more salient in adopting a GFD than the nutritional value of GF products. This saliency is particularly worrying given that the nutritional value of many GF products is low on a variety of core dimensions, which is likely to impact maintaining a healthy diet.

The second objective of this systematic review was to understand the attributes that affect WTP and the intention to buy GF products. Again, the general literature suggests that there is a significant mark up on GF products regarding pricing compared to equivalent alternatives. The search of the databases found few articles focusing on WTP, and intention to buy GF products. Clearly, there is a mismatch in the trends regarding the economic factors that have been reported in research, and research directly looking at how these factors impact adherence to a GFD. Of the work that does exist, studies have measured how sensorial characteristics and labelling of GF products affect WTP. The findings show that taste, smell and socio-demographic

factors did not affect the WTP, specifically for GF snacks. Participants positively evaluating the GF snacks based on texture were more likely to pay a premium price for GF snack. Again, the nutritional content did not appear to be a salient factor in determining WTP.

The third objective of this systematic review aimed to shed light on differences that exist between celiac, non-celiac population and family members of celiac people adhering with GFD. Overall, most studies have tended to focus specifically on celiac populations, with few studying non-celiac samples – despite this making up a large proportion of those buying GF products. Also, few studies directly compare both groups. Hence, drawing any broad comparisons between celiac and non-celiac groups is likely to be biased, for the reason that the populations, at least from the existing literature, as limited as it is, suggests that they differ on several impact factors (e.g., motivation, knowledge about GFD, attention to labelling, mental and physical health issues). Thus, further research is necessary for comparing these two groups because without direct comparisons of both groups it is difficult to meaningfully suggest ways to support and increase adherence to GFD for celiac patients. It is also difficult to help guide non-celiac followers into making healthy food choices given their differences in knowledge and perceptions of the benefits of a GFD, given that their understanding and motives are likely to differ from celiac patients. Moreover, there is work suggesting that patients with CD are more likely to be overweight and obese as a result of a GFD (Theethira & Dennis, 2015). According to Kabbani et al. (2012), for celiac patients, following a GFD, after three years their body mass index (BMI) was higher when compared to the initial phase. This situation is true for all age groups. According to Norsa et al. (2013), in Italy, the prevalence of obesity increased by approximately 3% among celiac children following a GFD for at least one year. Furthermore, Wild et al. (2010) showed that, in the UK, when compared to non-followers of the GFD and non-celiac population, female celiac patients consumed a higher level of calories due to the high intake of sweet snacks. However, to the best of our knowledge, there is no work

examining the impact of a GFD on weight gain amongst non-celiac people following a GFD.

More to the point, in light of these findings, identifying factors associated with adherence to

GFD from non-celiac people is crucial in helping firms develop healthier food choices.

In conclusion, the increasing demand in adopting GFDs and consumption of GF products is a

phenomenon that is not only of interest to firms but also has important implications for

populations of celiac and non-celiac people that are adopting the diet. This systematic review

has revealed that research regarding determinants of GFD by celiac people is high. However,

more research is needed to understand the nuanced differences between celiac and non-celiac

populations regarding their adherence to the diet, the impact of the diet on their health and

wellbeing, as well as their different needs and understanding of the impact of their diet on

their health. Also, research of this kind will help to inform a better understanding of

consumers' requirements regarding GF products to direct companies and other relevant

institutions towards market demand adequately.

6. Future Research

This systematic review has found several research gaps which ought to be taken into

consideration in future studies. Firstly, there is a large number of studies examining adherence

to GFD on celiac patients, but there is substantially less research on non-celiac participants

who also follow the diet voluntarily, and even less comparing both populations. This lack of

research is of high importance given the fact that GF products have been found to have an

unbalanced presence of nutrients. For instance, GF products, especially GF bread, usually

contain a higher percentage of fats aiming at improving taste. Thus, following a GFD without

need might become a threat to the health of non-celiac followers if this means relying upon GF

food products, which are designed to create a tasty alternative to traditional food products

usually based on wheat or other cereals containing gluten. Of course, this should also be of

importance to firms that on their side must carefully consider the nutritional content of GF products and how they are marketed and labelled, should they decide to enter into the GF market.

Secondly, one of the objectives of the current review was to emphasise the differences, which exists between celiac and non-celiac followers of the GFD. However, due to the limited number of studies that have directly compared both groups, it was not possible to give firm conclusions regarding what the critical differences are between these populations. Thus, more research is needed to understand the fundamental differences and what consequences they entail regarding the adherence to a GFD. A richer understanding of this kind could help to target each of these populations in more nuanced ways to ensure that both benefit from GF products targeted to their needs and preferences.

Finally, since the GF market has been expanding rapidly over several years, many food companies are directing their production towards GF products. Hence, it is important to guide them towards a path that is sensitive to different types of consumer motivations and needs. Moreover, this review has shown that research regarding economic factors is limited, and so is currently insufficient to give proper directions regarding the influence of various factors on the pricing of GF products. We found only three articles that have studied WTP for GF products. Furthermore, future research should carefully consider the appropriate methodological techniques to use when studying attributes and WTP for GF products.

In conclusion, regardless of population (celiac, non-celiac), rates of adherence to GFD has increased over time. However, transgression rates in continuing the adoption of a GFD is higher in younger populations, which is of particular concern for those that are required to follow this diet out of necessity because they are diagnosed with CD. Depression, anxiety and QOL are among factors that have been shown to be affected by adherence to a GFD; for

495 instance, comparisons between celiac and non-celiac shows that depression and anxiety are
496 lower for non-celiac followers of a GFD. Nonetheless, due to the limited number of studies that
497 compare celiac and non-celiac individuals, generalisations from the reported findings should
498 be considered with caution.

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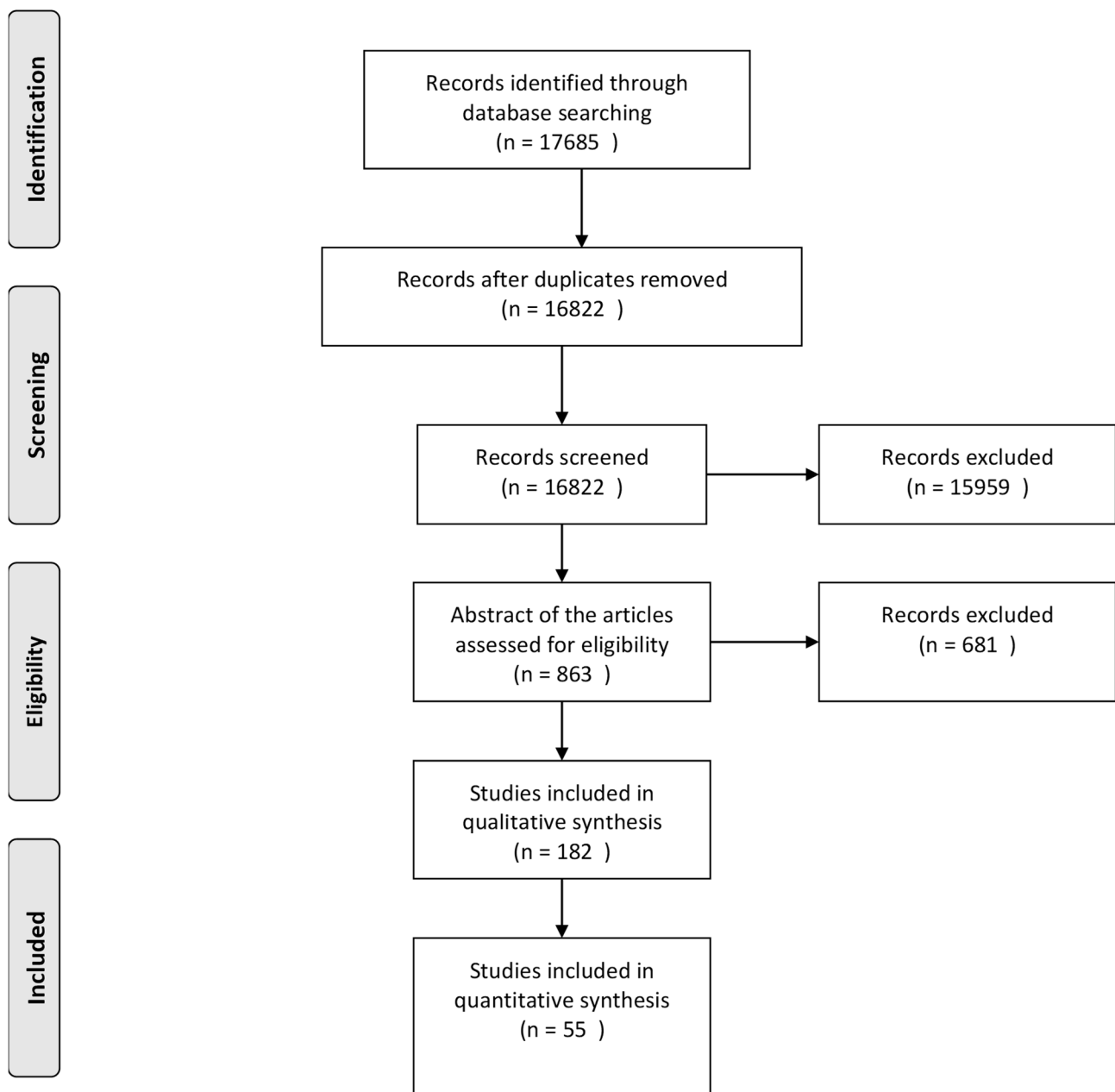
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Figure 1 Adherence to the gluten-free diet PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram

Figure 2 Location of the studies

Figure 3 Specification of the subjects

Figure 4 Factors affecting adherence to GFD



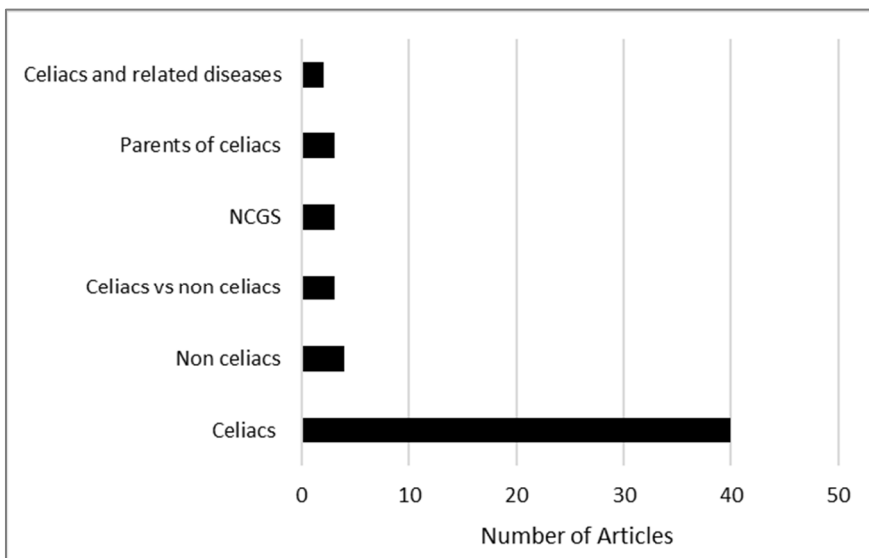
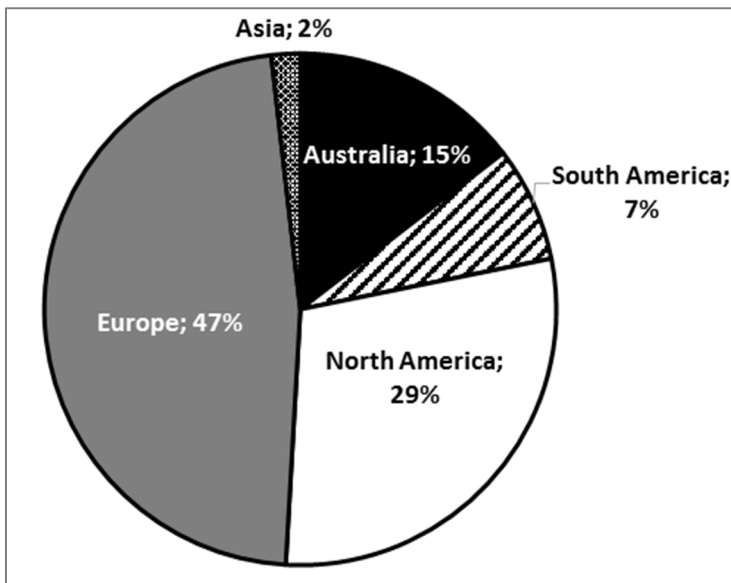




Table 1 Factors studied the most

Factors specific to the GFD	Time in GFD Perceptions of GFD Knowledge
Personal Factors	Age Age at diagnosis Education Gender
Psychological Factors	Anxiety Depression
Factors related to Celiac Disease	Level of CD symptoms
Quality of Life	Coping strategies Doctors' support Social Isolation