



The Relationship Between Dietary Intake of Magnesium, Fiber, and Fluid Intake and Bowel Health Using NHANES Data

Candace Gonzalez • Virginia Gray, PhD, RDN • Michelle Barrack Gardner, PhD, RDN • Dariella Gonitzke, MS, RDN

Department of Family Consumer Sciences

College of Health and Human Services, California State University Long Beach

Background

Chronic constipation is a common condition that is characterized by infrequent stools, sensation of incomplete defecation, and straining to have a bowel movement. National statistics indicate that approximately 63 million individuals suffer from constipation in North America (US Dept. of Health and Human Services, 2013). However, the majority of individuals who experience constipation do not seek medical advice. Additionally, chronic constipation is most notably higher in women than men. It is theorized that women are more prone to constipation due to pregnancy, complications from vaginal delivery, exposure to more stress, increased hormonal modulations, and societal pressures/expectations in public restrooms (Choung, 2007).

The etiology of constipation can include poor nutrition, lack of physical activity, inadequate sleep, anxiety, stress, gender, and certain diseases (Nelms, 2014).

Nutritional treatment for constipation has historically centered on insuring adequate fiber intake. Currently, no data available to determine an Estimate Average Requirement (EAR) to a Recommended Dietary Allowance (RDA) for total fiber. The Adequate Intake (AI) for total fiber has been based on the observed median fiber intake level to achieve the lowest level of observed risk of coronary heart disease (CHD). Thus, the fiber recommendation of 14g/1000kcal/day may help decrease constipation and diverticular disease. However, the benefit of decreasing constipation was not used as the basis for the AI recommendation (Position of the American Dietetic Association: Health Implications of Dietary Fiber, 2008).

Fluid intake is equally important to gastrointestinal health. Fluid helps with increasing motility and absorption of nutrients. There is limited evidence that constipation can be successfully be treated by increasing fluid intake, unless there is evidence of severe dehydration (Muller-Lissner, Kamm, Scarpignato, & Wald, 2005). There is limited research to suggest that inadequate physical activity alone is the cause of constipation.

Magnesium is of concern because it interacts with a number of other nutrients in the body including vitamin D, calcium, phosphorus, and potassium (Gropper & Smith, 2013). Over the past couple of decades, the quality of our crops in the U.S has decreased due to over farming of soil. Magnesium declined an average of 21% in the U.S. since the 1950s across fruits and vegetables that were studied (Davis, Epp & Riordan, 2004). In regards to constipation, certain individuals are more susceptible to developing a magnesium deficiency including individuals with gastrointestinal (constipation, IBS, etc.) disorders (Higdon, Drake, Delage & Volpe, 2014). Furthermore, magnesium chloride and magnesium hydroxide supplements such as Milk of Magnesia are often used to help individuals with constipation (National Institute of Diabetes and Digestive and Kidney Diseases, 2014).





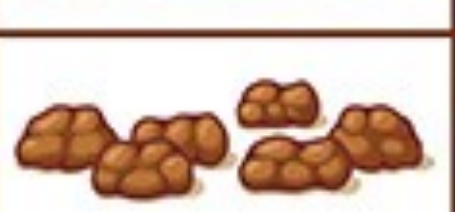


The most common definition used by researchers for chronic constipation includes the presence of at least two of the following indicators in the past 3 months: (1) straining with defecation at least 25% of the time; (2) lumpy or hard stools at least 25% of the time; (3) feeling of incomplete evacuation at least 25% of the time; and (4) less than three bowel movements per week (Choung, Locke, Schleck, Zinsmeister, Talley, 2007; Ford, et al., 2014; Ford & Suares, 2011; Gray, 2011; & Johanson & Kralstein, 2007). This consensus is the most widely used definition regarding constipation. However, the minimum number of bowel movements per week varies widely.

Purpose

The purpose of this study was:

- To investigate the relationship between nutrient intake and bowel health.
- Specifically, this study examined the relationship between constipation (defined as <3 bowel movements per week) and overall dietary intake of magnesium, fiber, fluid intake and physical activity in American women aged 20 to 50 years old.

Bristol stool chart

	Type 1 Separate hard lumps, like nuts (hard to pass)
	Type 2 Sausage-shaped, but lumpy
	Type 3 Sausage-shaped, but with cracks on surface
	Type 4 Sausage or snake like, smooth and soft
	Type 5 Soft blobs with clear-cut edges (easy to pass)
	Type 6 Fluffy pieces with ragged edges, mushy
	Type 7 Watery, no solid pieces (entirely liquid)

Methods

Sample:

1058 female participants from the National Health and Nutrition Examination Survey (NHANES).

Participants were selected using a random sampling method through a four stage sampling process to select a representation of the U.S. population.

Instrumentation/Procedures:

A combination of interviews and physical examinations. The interviews include demographic, socioeconomic, dietary, and health-related questions. The physical examination consists of medical, dental, physiological measurements, and laboratory tests.

A 1-year survey cycle from 2009 to 2010 was reviewed with a total possible sample size of 10,537 male and female respondents. A sub-sample from this group was chosen and included (1) female, (2) 20 to 50 years of age, and (3) successfully completed all dietary recall interviews. Additional exclusions will be made for women who are currently pregnant, and any individual who selected “refused”/”do not know” or have any missing data.

An average intake from two days for dietary fiber intake, magnesium intake and plain water consumption were used in combination with physical activity outside of work. Bowel health questions regarding number of bowel movements per week, perceived constipation frequency and common stool type were used to assess constipation.

Results

Constipation was defined as (1) <3 bowel movements per week, (2) a response of type 1 or type 2 on the Bristol Stool Chart (BSC) or (3) a response of always, most of the time or sometimes on perceived constipation in the past 12 months.

Sample Demographics		
Variable	n	%
Gender – Female	1058	100
Constipation in past 12 months	927	
Always	22	2.1
Most of the time	58	5.5
Sometimes	190	18.0
Rarely	271	25.6
Never	386	36.5
Common Stool Type (Bristol Stool Chart)	927	
Type 1	26	2.5
Type 2	84	7.9
Type 3	268	25.3
Type 4	394	37.2
Type 5	78	7.4
Type 6	69	6.5
Type 7	5	.5

- Data suggest there was a statistically significant difference in fiber intake, magnesium intake, and fluid intake with irregular bowel movements (<3 per week) compared to regular bowel movements of ≥3 per week.
- There was a statistically significant difference in perceived constipation frequency between participants with the BSC Type 1 & 2 and Type 3 & 4.
- There was no statistically significant difference in physical activity outside of work (moderate & vigorous) with irregular bowel movements (<3 per week) compared to regular bowel movements (≥3 per week).

Conclusion

- As nutrition professionals, it is necessary to address all aspects of a patient when treating constipation. This includes determining if the patient is consuming adequate fiber, magnesium, and fluid.
- Physical activity outside of work was not associated with decreased constipation frequency.
- Stool consistency (as shown in the Bristol Stool Chart) and perceived constipation should be considered when understanding constipation. This study showed that there was a difference in perceived constipation frequency between those in the two BSC categories (Type 1 & 2 and Type 3 & 4). Women who perceived they were constipated (indicating “always”, “most of the time” & “sometimes”) were more likely to indicate no constipation (i.e. BSC Type 3 & 4).

Limitations:

Fiber content of food was not broken down into soluble vs. insoluble fiber. Plain water intake only refers to water consumed (i.e tap and bottle). It does not take any other beverages (coffee, milk, juice, soda, etc.) into account. Magnesium content of food varies and is dependent on the quality of the soil and the USDA nutrient database may differ from the food consumed.

Further Research:

Additional research is needed to address potential of different types of fiber (soluble vs. insoluble), different fluid intakes (sugar sweetened beverages, milk, coffee, etc.), and how these factors collectively relate to constipation.

Table 1: Mann – Whitney U Test Results Exploring Differences in Factors Related to Constipation Frequency

	n	Mean	Std. Error	p-value
Fiber Intake (g)				
< 3 BM per week	76	11.8	.63	.002
≥ 3 BM per week	851	14.6	.26	
Magnesium Intake (mg)				
< 3 BM per week	76	222.0	8.0	.006
≥ 3 BM per week	851	256.1	2.4	
Plain Water Intake (oz)				
< 3 BM per week	76	24.4	2.7	.013
≥ 3 BM per week	851	33.5	1.1	
Moderate Physical Activity (minutes per day)				
< 3 BM per week	33	60.8	6.6	.77
≥ 3 BM per week	373	62.9	2.9	
Vigorous Physical Activity (minutes per day)				
< 3 BM per week	15	64.7	11.1	.89
≥ 3 BM per week	196	63.0	2.9	
Perceived Constipation Frequency				
BSC Type 1 & 2	26	3.15	.26	.05
BSC Type 3 & 4	84	3.69	.13	

*Significance cut off set to ≤0.05

References

- Choung, R., Locke Iii, G., Schleck, C., Zinsmeister, A., & Talley, N. (2007). Cumulative incidence of chronic constipation: A population-based study 1988–2003. *Alimentary Pharmacology & Therapeutics*, 26(11–12), 1521–1528.
- Davis, D., Epp, M., & Riordan, H. (2004). Changes in usda food composition data for 43 garden crops, 1950 to 1999. *Journal of the American College of Nutrition*, 23(6), 669–682.
- Ford, A., Moayyedi, P., Lacy, B., Lembo, A., Saito, Y., Schiller, L., Quigley, E. (2014). American College of Gastroenterology monograph on the management of irritable bowel syndrome and chronic idiopathic constipation. *The American Journal of Gastroenterology*, 109 Suppl 1(S1), S2–26.
- Ford, A., Suares, N. (2011). Effect of laxatives and pharmacological therapies in chronic idiopathic constipation: systematic review and meta-analysis. *GUT British Medical Journal*, 60, 209–218.
- Gray, J. (2011). What is chronic constipation? Definition and diagnosis. *Canadian Journal of Gastroenterology = Journal Canadien De Gastroenterologie*, 25 Suppl B, 7B–10B.
- Gropper, S. S., & Smith, J. L. (2013). Advanced Nutrition and Human Metabolism, Sixth Edition. Belmont, CA: CENGAGE Learning.
- Johanson, J., & Kralstein, J. (2007). Chronic constipation: a survey of the patient perspective. *Alimentary Pharmacology & Therapeutics*, 25(5), 599–608.
- Muller-Lissner, S., Kamm, M., Scarpignato, C., Wald, A. (2005). Myths and Misconceptions about Chronic Constipation. *The American Journal of Gastroenterology*, 100, 232–242.
- National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). (n.d.). Constipation. Retrieved from: <https://www.niddk.nih.gov/health-information/digestive-diseases/constipation>
- Nelms, M.N., Sucher, K.P., Lacey, K. (2014). Nutrition Therapy and Pathophysiology, Third Edition. Boston, MA: CENGAGE Learning.
- Position of the American dietetic association: Health implications of dietary fiber. (2008). *Journal of the American Dietetic Association*, 108(10), 1716–1731.
- US Department of Health and Human Services, National Digestive Diseases Information Clearinghouse. (2013). Digestive Disease Statistics for the United States. Retrieved from: <https://www.niddk.nih.gov/health-information/health-statistics/Pages/digestive-diseases-statistics-for-the-united-states.aspx>
- Higdon, J., Drake, V., Delage, B., Volpe, S. (2014). Magnesium: Linus Pauling Institute. Retrieved from: <http://lpi.oregonstate.edu/mic/minerals/magnesium>

Acknowledgements

Thank you Dr. Gray for your dedication to this project. Thank you Dr. Barrack, Dariella Gonitzke, and Dr. Stafford Cox. Lastly, thank you to husband, Efrain Gonzalez, for providing all the encouragement I needed to complete this project.