

---

## The knowledge, health beliefs and lifestyle choices among adults to maintain a healthy gut microbiome: a scoping review protocol

Rita G. Kmeid<sup>1</sup>, Heather P. Loveday<sup>2</sup>, Jennie A. Wilson<sup>3</sup>

1. College of Nursing, Midwifery and Healthcare, University of West London, London, United Kingdom
2. College of Nursing, Midwifery and Healthcare, University of West London, London, United Kingdom
3. College of Nursing, Midwifery and Healthcare, University of West London, London, United Kingdom

### Abstract

**Objective:** The objective of this scoping review is to examine and map research and other literature that alludes to policy or investigates individual knowledge, health behaviour, beliefs and information needs related to maintaining a healthy gut microbiome.

**Introduction:** In humans, the microbiome is a large community of microorganisms that reside in various organs in the body, especially in the gut, also known as the gut microbiome (GM). The gut microbiome is crucial for healthy digestion, metabolism, immunity and brain function. International studies have linked the disturbance of GM to long-term conditions such as diabetes type II, obesity, cancer, central nervous system dysfunction, anxiety, ADHD, depression, autism, and neurodegenerative disorders including Alzheimer's disease. Understanding the extent of public knowledge, health beliefs and lifestyle choices is crucial to the design of interventions that will improve knowledge and influence health habits and dietary behaviours. The results of this scoping review will assist in identifying the current focus of research and policy in the field. In particular, it will map the types of questions being asked, study designs, geographical location, cultural influences on individual health behaviour and beliefs related to the gut microbiome and gut health. The review will assist in identifying gaps to inform the conduct of further research syntheses and primary research.

**Inclusion criteria:** Eligible literature will include policy and published research literature that address the concepts of individual knowledge, health behaviours, lifestyle choices and cultural influences on adults; the context covers Europe, North America and the Middle East.

**Methods:** This scoping review will employ the PRISMA-ScR reporting guidance. A three-step search strategy will be implemented in this review using the databases PubMed/MEDLINE (OVID) and CINAHL, Embase, Cochrane Library, Scopus, and grey literature such as OpenGrey repository, Google scholar, National Institute of

health (NIH) and the ISRCTN registry. Grey literature sources and the reference lists of key studies to identify studies appropriate for inclusion. No language limits will be applied. This search will be conducted between the months of January and July 2024. This review does not require ethical approval.

**KEYWORDS:** gut microbiome; gut microbiota; gut health; microbiome; scoping review; knowledge; awareness; understanding; review; search strategy; lifestyle choices; health beliefs; lifestyle practices; healthy lifestyle, non-communicable diseases (NCD's).

## Introduction

Clinical and scientific research suggest that there is a close relationship between human health and microbial communities known as the gut microbiome (GM) (1,2). These microbial communities have commonly been defined by scientists to be the collection of microorganisms living together (3,4). A healthy gut microbiome is predominated by four groups which include Firmicutes, Bacteroides, Actinomycetes and Proteus (5). The ratio of Firmicutes/Bacteroidetes is an important indicator of GM disorder (6,7). If the balance of the microbiome is disturbed the body may become more susceptible to acute and chronic diseases (8, 9, 10, 11) including cardiovascular (12,13), gastrointestinal (14), cancer (15) and diabetes (16, 17).

According to the World Health Organization (WHO), long term conditions (LTC) kill 41 million people each year, which is equivalent to 41% of global deaths of these 77% are in low- and middle-income countries, including Lebanon (18,19). A range of factors have been associated with changes in gut microbiome (healthy gut bacteria) and the development of LTC (1). In Lebanon, LTC are a major public health issue and a leading cause of mortality due to risk factors including socio-economic status, stress (20), dietary choices, decrease in physical activity, antibiotic misuse, and smoking (21, 22,23).

Several studies have explored the knowledge, awareness, and perceptions of the influence of the gut microbiome on human health including Qatar (24), Jordan (25), United Arab Emirates (26) and Kuwait (27). Other studies in Western countries such as in Spain (15) suggested that there is a considerable lack of knowledge among the community regarding the changes in diet and lifestyle and how these changes can affect the gut microbiome and cause LTC's.

## The Definition of Gut Microbiome and its Importance

In recent decades, scientific and clinical research have identified the close relationship between the human host and the intestinal microbial communities or gut microbiome (GM). These microbial communities have commonly been defined by scientists to be the collection of microorganisms living together (3, 4). Whereas the term microbiome was first coined by Whipps et al. in 1988 as a "characteristic microbial community occupying a well-defined environment which has distinct physio-chemical properties" (3). The microbiome refers to the entire habitat, including bacteria, archaea, and viruses along with their genomes (6, 28). In humans, this large community of microorganisms or GM reside in various locations across the body especially in the gut outnumbering the human cells (29, 30). The GM is crucial for healthy digestion, metabolism, immune system function, gut physiology and brain-gut connection (29, 31).

---

## Factors that alter the Gut Microbiome

### *Microbial diversity and dysbiosis*

The microbial diversity in the GM can be in a steady state or a disturbed state if the balance is changed. Both states will occur as a result to the interactions between the microorganism and the host (7). If this balance is disturbed, then the body may become more susceptible to long term conditions also known as non-communicable diseases (NCD's) (19) such as cardiovascular, or gastrointestinal, cancer and diabetes (17,19).

Alteration of the gut microbiome is known as dysbiosis and is defined as the alteration in microbial community that results in decreased diversity and numbers of commensal bacteria. Studies suggest relationships between gut alteration and chronic health conditions such as inflammatory bowel diseases, cardiovascular disease, obesity, and cancer (16). The changes in gut microbiome that are proven to change its composition can be caused by several factors from antibiotic usage, diet, lifestyle, and other environmental factors (32, 33,34).

### *Lifestyle factors and the gut microbiome*

Social determinants have been associated with the stability of the human microbiome, these include the mode of delivery at birth, breastfeeding, antibiotic use, and dietary habits. All these factors are influenced by the socioeconomic status (SES) of the individual, which in turn influences the GM (35). Six non-dietary factors including age, sex, stress levels, previous gastrointestinal disease, family history and lifestyle can also play a major role in the GM composition (30, 34, 36).

### *Diet and the Gut Microbiome*

Lifestyle and dietary intake can change the balance of the main four bacterial species found in the human GM (5, 30, 31), if the According to Singh et al. (2016), studies have shown that if the diet is rich in dietary fiber, growth of beneficial bacteria will increase by 30-40 %. However, if the GM is disturbed it can cause the emergence of metabolites that may trigger the development of different diseases (32,33).

In recent years, there is a growing concern that the western diet, which contains foods that are high in sugar and fats, alters the bacterial composition of the GM (30, 41). According to a study by Castro et al. (2019), excessive consumption of sugar, animal fat and linoleic acid is considered a risk factor for the development of irritable

bowel disease (IBD), whereas a high fiber diet and citrus fruit consumption may play a protective role (42).

### *The use of antibiotics*

Antibiotics can disrupt the composition of the GM, by depleting organisms that defend the body against pathogens (28, 34, 36, 43). The increased use of antibiotics over the past decades has exerted selective pressure against bacteria sensitive to antibiotics and encouraged the emergence of resistant types (44,45). According to the WHO, antimicrobial resistance (AMR) is a major threat to global public health and the risk of resistance is driven by overuse and misuse of antibiotics (45, 46).

A lack of understanding among the public about antibiotics and the significant impact it can cause if misused (47) is one of the potential reasons for the continued over-prescription and misuse of antimicrobials. Studies have shown that misuse includes sharing medications, failing to take the medications as prescribed and using leftover antibiotics, is common in low- and middle-income countries (46, 47).

Primary research examining the gut microbiome and its effects on long term conditions has been studied over the years because of its link with long term conditions also known as non-communicable diseases (NCD's). However, knowledge and awareness of the gut microbiome and the effects of lifestyle choices and beliefs on maintaining a healthy gut are still limited and have not been systematically examined.

A synthesis of the research examining health choices and beliefs and the gut microbiome relationships is necessary to understand the state of the science and address gaps in the literature for future research. The objective of this scoping review is to map the available assess the extent of the literature focused that on the GM and the influences knowledge and skills needed by individuals and communities to enable health behaviour and beliefs health behaviours that maintain a healthy GM. A preliminary search of MEDLINE, CINHALL, Prospero, OSF and *JBI Evidence Synthesis* was conducted and no systematic reviews or scoping reviews on the topic were identified as being completed or in progress.

## Review Question

- What knowledge skills and behaviours are needed by individuals and communities to enable healthy lifestyle choices to maintain a healthy gut microbiome?

Sub-questions:

- How do knowledge and health beliefs about maintaining a healthy gut influence lifestyle choices in communities globally?
- What factors do people perceive to be important in maintaining a healthy gut?
- What information and resources do people have access to help them make lifestyle and health choices to maintain a healthy gut?

## Keywords

Gut microbiome; gut microbiota; gut health; microbiome; scoping review; knowledge; awareness; understanding; review; search strategy; lifestyle choices; health beliefs; lifestyle practices; healthy lifestyle, non-communicable diseases (NCD's).

## Eligibility criteria

### Participants

This scoping review will consider studies that include adults aged 18 and over and will include studies from Europe, North America and the Middle East.

### Concept

The concepts examined by the scoping review will be individual and community knowledge and information needs, health beliefs and behaviours, and lifestyle choices related to factors that affect the gut microbiome.

### Context

The scoping review will include literature that covers Europe, North America and the Middle East and cultural groups.

### Types of Sources

This scoping review will consider experimental and quasi-experimental study designs including randomized controlled trials, non-randomized controlled trials, before and after studies and interrupted time-series studies. In addition, analytical observational studies including prospective and retrospective cohort studies, case-control studies and analytical cross-sectional studies will be considered for inclusion. This review will also consider descriptive observational study designs including case series, individual case reports and descriptive cross-sectional studies for inclusion.

Qualitative studies that focus on societal and individual experiences such as phenomenology, grounded theory, ethnography and qualitative description will be included. Studies that use designs such as action research and feminist research to investigate change and empowerment will also be considered.

Research syntheses such as systematic reviews will also be considered, depending on the review question. Text and opinion papers and policy documents will also be considered for inclusion in this scoping review.

## Methods

The proposed scoping review will be conducted in accordance with the JBI methodology for scoping reviews (48). This protocol will adhere to the PRISMA-ScR extension (49). This protocol was published on OSF in March 2025.

### *Search strategy*

The search strategy will aim to locate both published and unpublished studies, policy, text and opinion. An initial limited search of MEDLINE and CINAHL was undertaken to identify articles on the topic. The text words contained in the titles and abstracts of relevant articles, and the index terms used to describe the articles were used to develop a full search strategy for PubMed, Embase, PsychInfo, Cochrane Library, Scopus, Google Scholar (See Appendix 1). Sources of unpublished studies to be searched include ProQuest Dissertations for thesis and dissertations, Ethos and Trove. In addition, papers will be identified through Conference Papers Index and for Guidelines the *International Guidelines Library*, *NICE and Medical Guideline Clearinghouse and Library* will be searched. Grey literature (GL) will be searched for in the OpenGrey Repository, Google Scholar, National Institute of Health Research and ISRCTN registry. The search strategy, including all identifies keywords and index terms, will be adapted for each included database and/or information source. The reference list of all included sources of evidence will be screened for additional studies.

Studies published in any language will be included where possible, if it is not possible to translate non-English studies descriptive data taken from the abstract will be reported. Studies published since 1970 and 2024 will be included as this aligns with the development of scientific understanding of the GM and its importance in gut and general health.

Initial Keywords to be used will include, but not limited to, the following keywords and subject headings:

awareness OR understanding OR knowledge;  
lifestyle choices OR health behaviour OR health beliefs

gut microbiome OR gut bacteria OR gut microbiota OR microbiota

### Study/Source of Evidence Selection

Following the search, all identified citations will be collated and uploaded into RefWorks, version 4.6.241 and duplicates removed. Following a pilot test, titles and abstracts will be screened by two or more independent reviewers for assessment against the inclusion criteria for the review. Potentially relevant sources will be retrieved in full and their citation details imported into the JBI System for the Unified Management, Assessment and Review of Information (JBI SUMARI) (JBI, Adelaide, Australia). The full text of selected citations will be assessed in detail against the inclusion criteria by two or more independent reviewers. Reasons for exclusion of sources of evidence at full text that do not meet the inclusion criteria will be recorded and reported in the scoping review. Any disagreements that arise between the reviewers at each stage of the selection process will be resolved through discussion, or with an additional reviewer/s. The results of the search and the study inclusion process will be reported in full in the final scoping review and presented in a Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for scoping review (PRISMA-ScR) flow diagram ([PRISMA \(prisma-statement.org\)](https://prisma-statement.org)).

### Data Extraction

Data will be extracted from papers included in the scoping review by two or more independent reviewers using a data extraction tool developed by the reviewers. The data extracted will include specific details about the participants, concept, context, study methods and key findings relevant to the review questions.

An extraction form is provided (see Appendix 1) and will be piloted and developed iteratively to capture data from all study designs and other documents. Proposed key data elements included within the extraction form will include title, author, year, location, language, evidence type, population and concepts discussed. Modifications will be detailed in the scoping review report. Any disagreements that arise between the reviewers will be resolved through discussion, or with an additional reviewer/s. If appropriate, authors of papers will be contacted to request missing or additional data, where required.

### Data Analysis and Presentation

The result of this search will be represented as a PRISMA flow diagram (48). The data will be extracted from each of the studies will be charted to summarise the included studies while identifying any potential gaps in the literature. A narrative report will be produced to summarise the extracted data which will directly relate to the research question and its aims. These include quantifying text and frequency counts of certain data items. Furthermore, analysis techniques such as descriptive data and basic qualitative content analysis will be used (50). Descriptive data can be represented as proportions for example the number of sources from a particular

country. A qualitative content analysis will be useful for this scoping review to map key characteristics, aid their interpretation around the review concepts. This approach includes a process of open coding to allocate the key characteristics into categories. A deductive approach will be used, and a framework developed to provide a holistic understanding of the potential relationships among data. Tables or charts which show individual elements of the data extracted and diagrammatic approaches such as word clouds, heat maps or waffle charts will allow the reader to have a clearer understanding of some of the results.

## Acknowledgements

The author acknowledges the extensive guidance provided by the Richard Wells Research Centre and the Centre for Evidence Based Healthcare: a JBI Centre of Excellence, College of Nursing, Midwifery and Healthcare, University of West London. This protocol will contribute towards a Doctorate in Health degree.

## Funding

This review has no funding from any funding agency in the public, commercial or not-for-profit sectors.

## Conflicts of interest

There is no conflict of interest to report regarding this scoping review.

---

## References

1. Aziz Q, Doré J, Emmanuel A, Guarner F, Quigley EMM. Gut microbiota and gastrointestinal health: current concepts and future directions. *Neurogastroenterology & Motility*. 2012 Dec 20;25(1):4–15.
2. Li M, Wang B, Zhang M, Rantalainen M, Wang S, Zhou H, et al. Symbiotic gut microbes modulate human metabolic phenotypes. *Proceedings of the National Academy of Sciences*. 2008 Feb 5;105(6):2117–22.
3. Berg G, Rybakova D, Fischer D, Cernava T, Vergès MCC, Charles T, et al. Microbiome definition re-visited: old concepts and new challenges. *Microbiome* [Internet]. 2020 Jun 30;8(1). Available from: <https://microbiomejournal.biomedcentral.com/articles/10.1186/s40168-020-00875-0>
4. Xu J, Mahowald MA, Ley RE, Lozupone CA, Hamady M, Martens EC, et al. Evolution of Symbiotic Bacteria in the Distal Human Intestine. Eisen JA, editor. *PLoS Biology*. 2007 Jun 19;5(7):e156.
5. Mansour SR, Moustafa MAA. Impact of diet on the gut microbiome of human and risk diseases. *New Microbes and New Infections* [Internet]. 2021 Feb 2;41:100845. Available from: <https://www.sciencedirect.com/science/article/pii/S2052297521000093>
6. Marchesi JR, Ravel J. The vocabulary of microbiome research: a proposal. *Microbiome* [Internet]. 2015 Jul 30;3(1). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4520061/>
7. Margulis L. Symbiogenesis. A new principle of evolution rediscovery of Boris Mikhaylovich Kozo-Polyansky (1890–1957). *Paleontological Journal*. 2010 Dec;44(12):1525–39.
8. Chatterjee G, Negi S, Basu S, Faintuch J, O'Donovan A, Shukla P. Microbiome systems biology advancements for natural well-being. *Science of The Total Environment*. 2022 Sep;838(838):155915.
9. Eckburg PB. Diversity of the Human Intestinal Microbial Flora. *Science*. 2005 Jun 10;308(5728):1635–8.

10. Gill SR, Pop M, DeBoy RT, Eckburg PB, Turnbaugh PJ, Samuel BS, et al. Metagenomic Analysis of the Human Distal Gut Microbiome. *Science* [Internet]. 2006 Jun 2;312(5778):1355–9. Available from: <https://pubmed.ncbi.nlm.nih.gov/16741115/>.
11. World Health Organization (2014) Non-Communicable Diseases (NCD) Country Profiles: Lebanon. Retrieved from [http://www.who.int/nmh/countries/lbn\\_en.pdf](http://www.who.int/nmh/countries/lbn_en.pdf) (Accessed: 25 April 2023).
12. Gebrayel, P., Nicco, C., Al Khodor, S., Bilinski, J., Caselli, E., Comelli, E.M., Egert, M., Giaroni, C., Karpinski, T.M., Loniewski, I., Mulak, A., Reygner, J., Samczuk, P., Serino, M., Sikora, M., Terranegra, A., Ufnal, M., Villeger, R., Pichon, C., Konturek, P. and Edeas, M. (2022) *Microbiota medicine: towards clinical revolution* Springer Science and Business Media LLC.
13. Kazemian N, Mahmoudi M, Halperin F, Wu JC, Pakpour S. Gut microbiota and cardiovascular disease: opportunities and challenges. *Microbiome*. 2020 Mar 14;8(1).
14. Kho ZY, Lal SK. The Human Gut Microbiome – A Potential Controller of Wellness and Disease. *Frontiers in Microbiology*. 2018 Aug 14;9.
15. Garcia, S, Ordonez, S, Enrique Carrillo de Santa Pau and Marcos Zambrano, L. Photovoice methodology to raise citizen awareness about the role of the gut microbiome in Non-Communicable Diseases: A pilot study. Cold Spring Harbor: Cold Spring Harbor Laboratory Press. 2022.
16. Carding, S, Verbeke, K, Vipond, D T, Corfe, B M and Owen, L J. *Dysbiosis of the gut microbiota in disease*. 2015. Co-Action Publishing.
17. World Health Organization: WHO. Diabetes [Internet]. Who.int. World Health Organization: WHO; 2018 [cited 2023 Apr 25]. Available from: <http://www.who.int/news-room/fact-sheets/detail/diabetes>
18. Mansour Z, Said R, Dbaibo H, Mrad P, Torossian L, Rady A, et al. Non-communicable diseases in Lebanon: results from World Health Organization STEPS survey 2017. *Public Health*. 2020 Oct;187:120–6.
19. World Health Organization. Noncommunicable Diseases [Internet]. World Health Organisation. 2022 [cited 2023 Apr 25]. Available from: <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>.

- 
20. Hantsoo L, Zemel BS. Stress gets into the belly: Early life stress and the gut microbiome. *Behavioural Brain Research* [Internet]. 2021 Jul 16 [cited 2021 Aug 8];414:113474. Available from: <https://pubmed.ncbi.nlm.nih.gov/34280457/>.
21. Sibai, A, Tohme, R A, Mahfoud, Z, Chaaya, M and Hwalla, N. Non-communicable Diseases and Behavioral Risk Factor Survey Comparison of estimates based on cell phone interviews with face to face interviews. *World Health Organization-Lebanon office BY*. 2019.
22. Sibai AM, Ghandour LA, Chaaban R, Mokdad AH. Potential use of telephone surveys for non-communicable disease surveillance in developing countries: evidence from a national household survey in Lebanon. *BMC Medical Research Methodology*. 2016 May 31;16(1).
23. Bendriss G, Al-Ali D, Shafiq A, Laswi I, Mhaimed N, Salameh M, et al. Targeting the gut microbiome: A brief report on the awareness, practice, and readiness to engage in clinical interventions in Qatar. *Qatar Medical Journal* [Internet]. 2021 Jan 21 [cited 2023 Mar 6];2020(3). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7863707/>.
24. Abu-Humaidan, A.H.A., Alrawabdeh, J.A., Theeb, L.S., Hamadneh, Y.I. and Omari, M.B. (2021) 'Evaluating Knowledge of Human Microbiota among University Students in Jordan, an Online Cross-Sectional Survey', *International journal of environmental research and public health*, 18(24), pp. 13324. Available at: doi: 10.3390/ijerph182413324.
25. Barqawi, H.J., Adra, S.F., Ramzi, H.R., Abouaggour, M.A. and Almehairi, S.K. (2021) 'Evaluating the knowledge, attitudes and practices of the UAE community on microbiota composition and the main factors affecting it: a cross-sectional study', *BMJ Open*, 11(8), pp. e047869. Available at: doi: 10.1136/bmjopen-2020-047869.
26. Plummer-D'Amato, P. (2013) 'Focus group methodology Part 1: Considerations for design', *International Journal of Therapy and Rehabilitation*, 15 (2), <https://doi.org/10.12968/ijtr.2008.15.2.28189>.
27. Clemente J C, Ursell L K, Parfrey L, K R. The Impact of the Gut Microbiota on Human Health: An Integrative View. *Cell* [Internet]. 2012 Mar 16;148(6):1258–70. Available from: <https://www.sciencedirect.com/science/article/pii/S0092867412001043>.
-

28. Bianconi E, Piovesan A, Facchin F, Beraudi A, Casadei R, Frabetti F, et al. An estimation of the number of cells in the human body. *Annals of Human Biology*. 2013 Jul 5;40(6):463–71.
29. Rook GAW. Evolution, the Immune System, and the Health Consequences of Socioeconomic Inequality. Ishaq SL, editor. *mSystems*. 2022 Apr 26;7(2).
30. Sender R, Fuchs S, Milo R. Are We Really Vastly Outnumbered? Revisiting the Ratio of Bacterial to Host Cells in Humans. *Cell*. 2016 Jan;164(3):337–40.
31. Chen J, Li Y, Tian Y, Huang C, Li D, Zhong Q, et al. Interaction between Microbes and Host Intestinal Health: Modulation by Dietary Nutrients and Gut-Brain-Endocrine-Immune Axis. *Current Protein & Peptide Science*. 2015 Aug 10;16(7):592–603.
32. Chung H, Pamp SJ, Hill JA, Surana NK, Edelman SM, Troy EB, et al. Gut Immune Maturation Depends on Colonization with a Host-Specific Microbiota. *Cell* [Internet]. 2012 Jun 22 [cited 2021 Jan 14];149(7):1578–93. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3442780/>
33. Flandroy L, Poutahidis T, Berg G, Clarke G, Dao MC, Decaestecker E, et al. The impact of human activities and lifestyles on the interlinked microbiota and health of humans and of ecosystems. *Science of The Total Environment* [Internet]. 2018 Jun;627:1018–38. Available from: <https://www.sciencedirect.com/science/article/pii/S0048969718303413>.
34. Bowyer R, Jackson M, Le Roy C, Ni Lochlainn M, Spector T, Dowd J, et al. Socioeconomic Status and the Gut Microbiome: A TwinsUK Cohort Study. *Microorganisms*. 2019 Jan 11;7(1):17.
35. Hasan N, Yang H. Factors affecting the composition of the gut microbiota, and its modulation. *PeerJ* [Internet]. 2019 Aug 16;7:e7502. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6699480/>.
36. Krajmalnik-Brown R, Ilhan ZE, Kang DW, DiBaise JK. Effects of Gut Microbes on Nutrient Absorption and Energy Regulation. *Nutrition in Clinical Practice* [Internet]. 2012 Feb 24 [cited 2019 Sep 6];27(2):201–14. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3601187/>
37. Singh RK, Chang HW, Yan D, Lee KM, Ucmak D, Wong K, et al. Influence of diet on the gut microbiome and implications for human health. *Journal of Translational Medicine*. 2017 Apr 8;15(1).

38. Singh V, Yeoh BS, Vijay-Kumar M. Gut microbiome as a novel cardiovascular therapeutic target. *Current Opinion in Pharmacology*. 2016 Apr;27:8–12.
39. Gagliardi A, Totino V, Cacciotti F, Iebba V, Neroni B, Bonfiglio G, et al. Rebuilding the Gut Microbiota Ecosystem. *International Journal of Environmental Research and Public Health* [Internet]. 2018 Aug 7 [cited 2019 Dec 22];15(8):1679. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6121872/#B69-ijerph-15-01679>
40. Dieting and its effect on the gut microbiome: Bacterium associated with antibiotic-induced colitis plays a role in weight control [Internet]. *ScienceDaily*. 2021 [cited 2023 Feb 6]. Available from: <https://www.sciencedaily.com/releases/2021/06/210623141657.html>.
41. Castro F, de Souza HSP. Dietary Composition and Effects in Inflammatory Bowel Disease. *Nutrients*. 2019 Jun 21;11(6):1398.
42. Mackie RI, Sghir A, Gaskins HR. Developmental microbial ecology of the neonatal gastrointestinal tract. *The American Journal of Clinical Nutrition* [Internet]. 1999 May 1;69(5):1035s1045s. Available from: <https://academic.oup.com/ajcn/article/69/5/1035s/4714919>.
43. Bressa C, Bailén-Andrino M, Pérez-Santiago J, González-Soltero R, Pérez M, Montalvo-Lominchar MG, et al. Differences in gut microbiota profile between women with active lifestyle and sedentary women. Dasgupta S, editor. *PLOS ONE*. 2017 Feb 10;12(2):e0171352.
44. Khalifeh, M, Moore, N and Salameh, P. Public Knowledge and Attitude towards Antibiotic Use in Lebanon. 2017.
45. Hijazi, A R A, Jammoul, Z, Fares, S and Kassak, K M. Antibiotic Use: Knowledge, Attitude and Practices of a Southern Community in Lebanon. *European journal of environment and public health*. 2021; 5(2). doi: 10.21601/ejeph/11111.
46. Mouhieddine TH, Olleik Z, Itani MM, Kawtharani S, Nassar H, Hassoun R, et al. Assessing the Lebanese population for their knowledge, attitudes and practices of antibiotic usage. *Journal of Infection and Public Health*. 2015 Jan;8(1):20–31.

- 
47. Peters MDJ, Godfrey C, Mclnerney P, Munn Z, Tricco AC, Khalil, H. Chapter 11: Scoping Reviews (2020 version). Aromataris E, Munn Z, editors. JBI Manual for Evidence Synthesis. JBI; 2020. Available from <https://synthesismanual.jbi.global>. <https://doi.org/10.46658/JBIMES-20-12>.
48. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Annals of Internal Medicine* 2018; 169(7): 467-473.
49. Peters, M.D.J., Marnie, C., Tricco, A.C., Pollock, D., Munn, Z., Alexander, L., Mclnerney, P., Godfrey, C.M. and Khalil, H. (2020). Updated Methodological Guidance for the Conduct of Scoping Reviews. *JBI Evidence Synthesis*, 18(10), pp.2119–2126.
50. Pollock, D., Peters, M.D.J., Khalil, H., Mclnerney, P., Alexander, L., Tricco, A.C., Evans, C., de Moraes, É.B., Godfrey, C.M., Pieper, D., Saran, A., Stern, C. and Munn, Z. (2023). Recommendations for the extraction, analysis, and presentation of results in scoping reviews. *JBI Evidence Synthesis*, 21(3), pp.520–532. doi:<https://doi.org/10.11124/jbies-22-00123>.

Appendices

Appendix I: Search strategy

**Supplemental Table 1. Base and Database-Specific Search Strategy**

Database: Medline

Provider: Ovid

Date Searched: 15/06/2023

Limits: Advanced search, English, not animals

	Concept	Search Strategy
#1	Microbiome	'Gastrointestinal Microbiome'[MeSH Terms] OR 'gut microbiome'[MeSH Terms] OR 'microbiota'[MeSH Terms] OR 'gut microbio*'[Title/Abstract] OR 'gastrointestinal microbio*'[Title/Abstract] 'microbiota' [Title/Abstract] OR 'microbiome'[Title/Abstract]
#2	Knowledge	'knowledge' OR 'awareness' OR 'understanding' OR 'effects' OR 'interactions' OR 'citizen awareness' OR 'public health' OR 'attitudes'
#3	Health Beliefs	'health beliefs' OR 'lifestyle choices' OR 'lifestyle practices' OR 'healthy lifestyle' OR 'lifestyle determinants' OR 'practices of the community'
	Limits	#1, #2 AND #3  Filters: English  Publication type: All types  Not animals

Appendix II: Data extraction instrument

JBI template source of evidence details, characteristics and results extraction instrument

<b>Scoping Review Details</b>	
Scoping Review title:	
Review objective/s:	
Review question/s:	
<b>Inclusion/Exclusion Criteria</b>	
Population	
Concept	
Context	
Types of evidence source	
<b>Evidence source Details and Characteristics</b>	
Citation details (e.g. author/s, date, title, journal, volume, issue, pages)	
Country	
Context	
Participants (details e.g. age/sex and number)	
<b>Details/Results extracted from source of evidence</b> (in relation to the concept of the scoping review)	
E.g. Quality of Life Domains assessed	
E.g. Number of items in tool	
E.g. details of psychometric validation of tool	