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World J Surg (2023) 47:3060–3069
https://doi.org/10.1007/s00268-023-07183-2

SCIENTIFIC REVIEW

Factors Contributing to Delays to Accessing Appendectomy in Low- and Middle-Income Countries: A Scoping Review

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Accepted: 29 August 2023 / Published online: 25 September 2023
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Abstract

Background Appendicitis is one of the most common emergency surgical conditions worldwide. Delays in accessing appendectomy can lead to complications. Evidence on these delays in low- and middle-income countries (LMICs) is lacking. The aim of this review was to identify and synthesise the available evidence on delays to accessing appendectomy in LMICs.

Methods This scoping review followed the Preferred Reporting Items for Systematic Reviews and Meta-analysis Extension for Scoping Reviews framework. The delays and their interconnectivity in LMICs were synthesised and interpreted using the Three Delays framework. We reviewed Africa Wide EBSCOhost, PubMed–Medline, Scopus, Web of Science, African Journals Online (AJOL), and Bioline databases.

Results Our search identified 21 893 studies, of which 78 were included in the final analysis. All of the studies were quantitative. Fifty per cent of the studies included all three types of delays. Delays in seeking care were influenced by a lack of awareness of appendicitis symptoms, and the use of self and alternative medication, which could be linked to delays in receiving care, and the barrier refusal of medical treatment due to fear. Financial concerns were a barrier observed throughout the care pathway.

Conclusion This review highlighted the need for additional studies on delays to accessing appendectomy in additional LMICs. Our review demonstrates that in LMICs, persons seeking appendectomy present late to health-care facilities due to several patient-related factors. After reaching a health-care facility, accessing appendectomy can further be delayed owing to a lack of adequate hospital resources.

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Background

A third of the global burden of disease can be treated through surgical care [1]. Yet access is inequitable in and between low- and middle-income countries (LMICs), where 90% of people lack access to timely surgical care [1, 2]. Appendicitis, the most common surgical emergency worldwide, is a time-sensitive disease and can lead to high rates of morbidity and mortality if left untreated [1, 3, 4]. Although males and females of any age and all races can be affected, the disease is more prevalent in children and young adults [5, 6]. Africa and South-East Asia have the highest unmet surgical need for appendectomy [1]. Appendectomies are more commonly used to manage appendicitis in LMICs rather than antibiotics as patients tend to present late [7]. There are several reasons for this delay in presentation.

Delays to appendectomy care have been described in the context of different frameworks [8]. Our review will use the Three Delays framework [8], which includes seeking (Delay 1), reaching (Delay 2), and receiving care (Delay 3) [8–10]. The Lancet Commission on Global Surgery recommended this framework to quantify delays in emergency surgical care [9]. This comprehensive framework allows all factors associated with delays to care, including social, economic, health system, and environmental factors, to be examined and was therefore chosen.

There is a need to synthesise the available evidence at all points in the appendectomy care pathway to enable the design of targeted interventions. To this end, the aim of this study was to identify and synthesise the available evidence on delays to accessing appendectomy in LMICs, in the context of the Three Delays framework.

Methodology

Study design

This scoping review used the Preferred Reporting Items for Systematic Reviews and Meta-analysis Extension for Scoping Reviews (PRISMA-ScR) [11] and the Arksey & O'Malley framework [12, 13]. The search strategy was designed using the PEO (Population/Exposure/Outcome) framework. The elements were defined as: P (people who had appendectomy in LMICs), E (factors associated with a delay to appendectomy in LMICs), and O (delays to appendectomy experienced in LMICs).

Eligibility criteria

The search period was January 1990–January 2022. Studies published before the year 1990 were excluded due to their temporal irrelevance. To be eligible for inclusion, studies had to either note that there was a delay to, and, or list factors that led to a delay in accessing appendectomy within a LMIC. Included studies could be cross-sectional, case–control, case series, cohort, interventional, qualitative, or mixed methods.

Studies were excluded if it focussed on the diagnosis, pathophysiology or aetiology of appendicitis, post-operative or non-operative management of appendicitis, duplicate studies, or high-income countries (HICs). We excluded case reports, editorials, commentaries, books, reviews, and study protocols. Studies not published in English, and that could not be translated using Google Translate, as well as those where the full-text versions were unavailable, were excluded.

Searching electronic databases

Databases searched were Africa-Wide EBSCOhost, PubMed–Medline, Scopus, Web of Science, African Journals Online (AJOL), and Bioline. The search strategy comprised of the World Bank list of LMICs combined with the Medical Search Headings (MeSH) for appendicitis and appendectomy, and the truncated elements appendi* and appendec*. Synonyms and different spellings of appendectomy were included in the search string. Keywords for similar concepts were combined using the Boolean operator "OR", and different concepts were combined with "AND". An example of our search strategy used for one of the databases can be seen in Supplementary Table 1.

Searching other sources

Reference lists of relevant studies, reviews, and grey literature were hand searched for additional studies that fit the PEO framework.

Screening and study selection

Studies were imported into Covidence review software (Veritas Health Innovation, Melbourne, Australia), which was used to perform our review. All studies were reviewed in duplicate, and all reviewers discussed results at weekly conflict resolution meetings. Discordant results were discussed by the primary review team (JL, JD, JJ, CF), and the eligibility criteria were re-reviewed for individual conflicts. Senior authors (MM, KC) resolved any final conflicts.

Data extraction, chartering, and analysis

The extraction of the included studies was done in duplicate using a standard template [12] which was edited to ensure alignment with the study objectives. In the end, the primary author reviewed and collated the captured information.

Data were captured into Microsoft Excel. Variables collected included author name(s), study title, publication year, country, aim, design, timeframe, and the type of delay and any associated factors. Data were analysed and summarised using STATA Statistical software, version 15 (Stata Corp LP, College Station, Texas, USA). No inferential or hypothesis testing was conducted. Delays to appendectomy and the associated factors were categorised using the Three Delays framework. Our review captured factors that affected health-seeking behaviour (Delay 1), factors that influenced reaching a facility (Delay 2), and factors that influenced receiving care at a health-care facility (Delay 3). There was no limit to the number of delays and associated factors that could be extracted from each study. Factors linked to each delay were mapped. Additionally, factors that linked to more than one delay were considered "interconnected" and were also mapped.

Results

Search results

Our search yielded 21 893 studies of which 5 811 were removed as duplicates, leaving 16 082 for title and abstract screening. Based on the eligibility criteria, 885 full-text studies were excluded. The most common reasons for full-text exclusion were a lack of description of appendectomy delay factors (n = 660) and the type of study design (n = 121) which comprised of 64 reviews, 26 editorials, 13 case reports, 11 conference abstracts for which no full-text article was available, 3 study protocols, 2 books, 1 dissertation, and 1 retracted article (Fig. 1). In the end, 78 studies were included in our review. Detailed descriptions of these studies can be found in Supplementary Table 2.

Study characteristics

The three LMICs with the highest number of publications were South Africa (n = 12), Nigeria (n = 12), and Turkey (n = 8) (Fig. 2). All the studies were quantitative. The most common study designs were cross-sectional 38 (48.7%) [14–52] and cohort 32 (41.0%) [26, 52–83] (Table 1). Study periods ranged from two months to twenty-five years. There were 27 097 patients across the seventy-eight studies with a median of 166 (IQR: 10–3717) [14–28, 30, 32–42, 44–61, 63, 64, 66–82, 84–92].

Study outcomes measured

Fifty-nine of the studies [15, 17, 18, 20, 22, 24, 25, 27, 28, 30–37, 39–41, 44, 45, 47, 49–56, 58–60, 63–72, 74–76, 78–81, 83, 86, 88–90] reported perforation rates in 3603 (25.9%) patients, fifteen studies [14, 16, 19, 26, 29, 42, 46, 48, 57, 61, 62, 84, 85, 87, 92] reported the complication rate for 2071 (41.2%) patients, and four of the studies [23, 38, 43, 77] did not report either. In addition, fifty-five studies reported mortality rates. Of these studies, 141 (0.8%) appendicitis patients died [14–16, 18, 21, 22, 24–27, 29–34, 36, 37, 39–41, 44–46, 48, 51, 52, 59–67, 69–72, 74, 77, 78, 82, 85–89].

Delays to accessing appendectomy

Thirty-nine (50%) studies reported on all three delays, twenty-four reported at least two delays, and fifteen reported on only one delay (Fig. 3).

Factors associated with delay 1 (seeking care)

Lack of knowledge of appendicitis symptoms and alternative forms of health-care

Thirty-five studies reported that a lack of knowledge of appendicitis symptoms led to a delay in seeking appendectomy [14, 16, 17, 19–23, 30–32, 39–42, 44, 45, 48, 49, 52, 53, 55, 56, 59, 65, 70, 71, 73–75, 77–79, 83, 89] (Table 2). The inability of vulnerable populations to communicate their symptoms to their parents or caregivers can lead to a delay in seeking care [22, 49]. Elderly appendicitis patients may have initially related their acute symptoms to existing co-morbidities, while pregnant women related their symptoms to pregnancy [48, 86]. Moreover, twenty-one studies reported that appendicitis patients first considered alternative forms of health-care such as self-medication [14, 17, 19, 21, 22, 25, 42, 45, 56, 71, 74, 75, 77, 83], visiting a traditional healer [23, 32, 38, 39, 75, 78], or allied health professionals [16], prior to seeking care in the formal health sector (Table 2).

Financial concerns and personal factors

Fourteen studies reported that financial concerns influenced the decision to seek care (Table 2) [19, 21, 30, 35, 39, 50, 53, 55, 59, 71, 73, 77, 87, 88]. In two studies, farmers and daily wage earners in rural communities only sought care for appendicitis when they were severely ill [19, 87]. Nine studies [19, 21, 42, 55, 59, 65, 70, 74, 87] reported personal

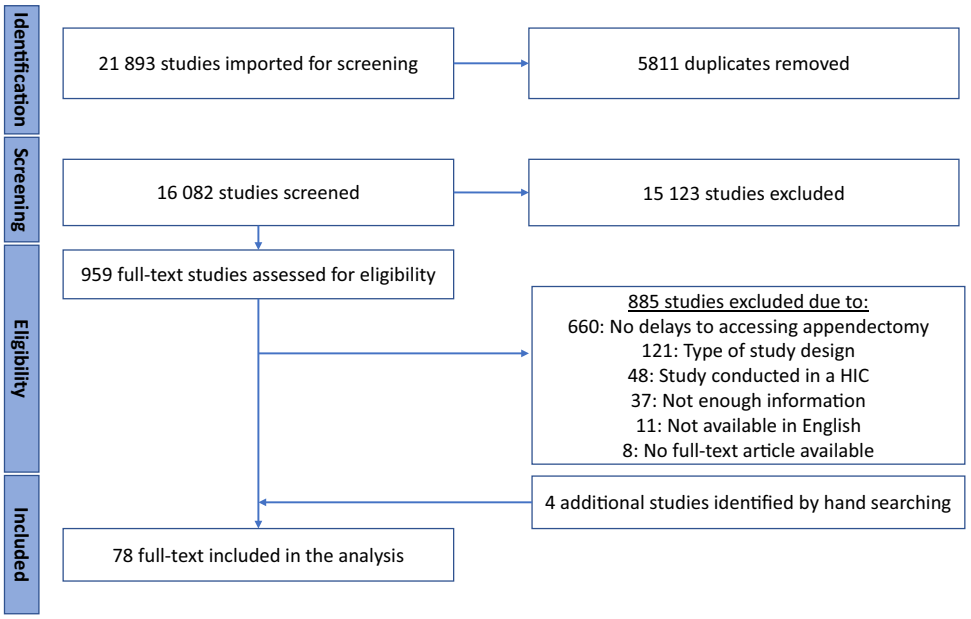


Fig. 1 The PRISMA-ScR flowchart

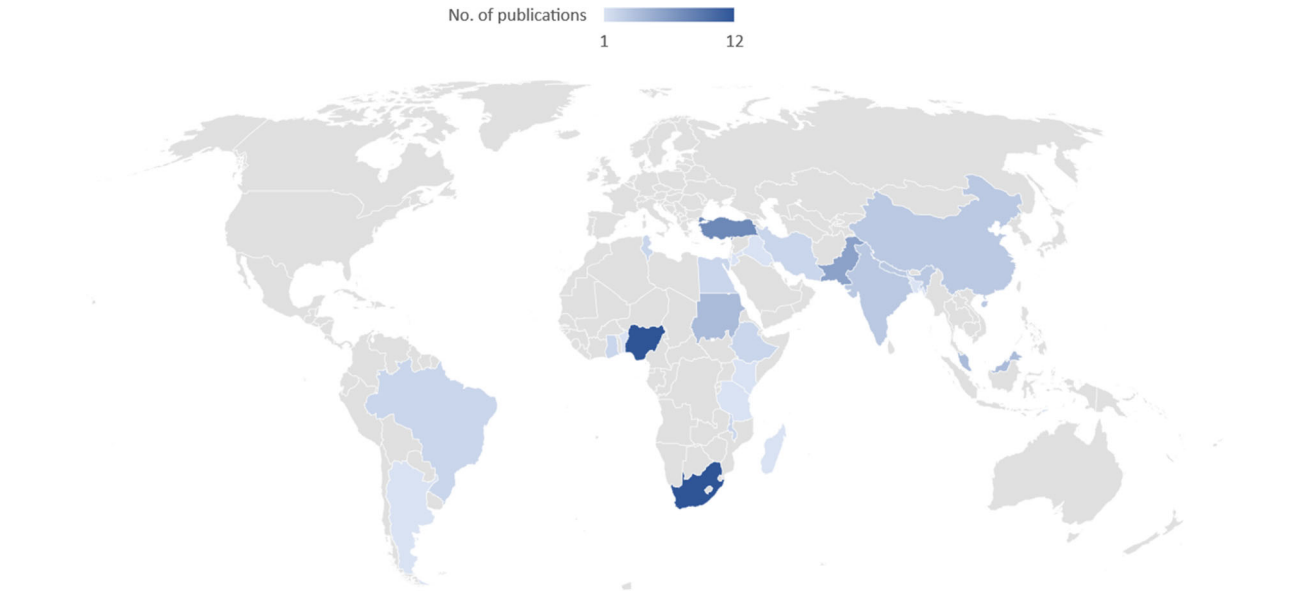


Fig. 2 The study distribution according to WHO region and country

factors leading to a delay in seeking care such as the fear of hospitalisation or undergoing surgery [21, 32, 35, 65, 74]. During the COVID-19 pandemic, seeking care was delayed due to the fear of contracting the virus or compliance with government regulations (Table 2) [29, 31, 81].

Gender and cultural disparities

Six studies noted that gender and cultural disparities influenced the decision to seek care for appendectomy (Table 2) [17, 20, 36, 50, 54, 77]. Two studies reported that females seek care for abdominal complaints sooner than men [17, 54]. However, often women have to consult their husbands prior to seeking care and can then only do so with their husband's permission [20, 77]. In eastern Turkey, one of the studies reported that boys were a higher priority than girls, and that girls living in these rural regions hid their appendicitis symptoms from their parents [20].

Table 1 Types of studies

Study design	Prospective (n, %)	Retrospective (n, %)
Interventional–non-randomised control trial	1 (3.7)	0 (0)
Case series	2 (7.4)	4 (7.8)
Cross-sectional	15 (55.6)	23 (45.1)
Case-control	0 (0.0)	1 (2.0)
Cohort	9 (33.3)	23 (45.1)
Total	27 (100)	51 (100)

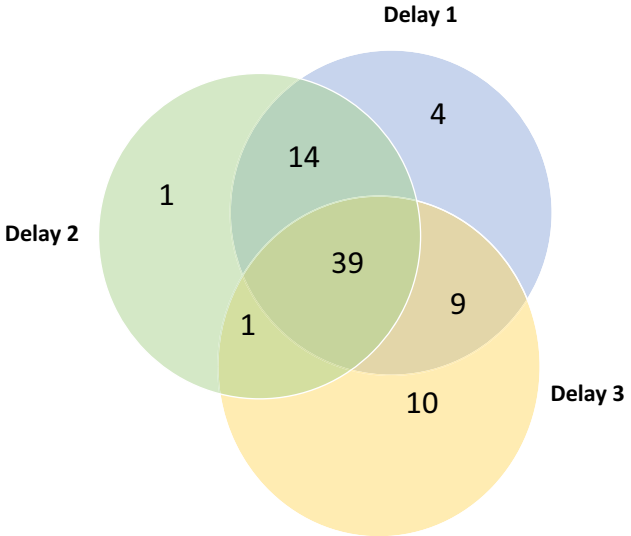


Fig. 3 The overall number of studies (n) reporting Delay 1 (seeking care), Delay 2 (reaching care), and/or Delay 3 (receiving care)

Table 2 Factors leading to delays to appendectomy

Factor leading to delays	Number of studies (n)
Delays in seeking health-care	
Lack of knowledge of appendicitis-like symptoms and alternative forms of health-care	35
Financial concerns and personal factors	20
Gender and cultural disparities	7
Delays in reaching care	
Distance to health-care facilities	15
Lack of adequate transport and infrastructure including financial challenges	14
Delays in receiving care	
Delay in diagnosing and managing appendicitis	48
Lack of infrastructure	18
Lack or shortage of hospital resources	16
Cultural and financial factors that affect receiving care	6

Factors associated with delay 2 (reaching care)

Distance to health-care facilities

Eight studies reported that distance can affect individuals' ability to reach a health-care facility (Table 2) [23, 26, 37, 53, 59, 65, 77, 82]. Overall, rural dwellers presented later to health-care facilities than urban dwellers, thus increasing their risk of complications [37, 59, 61, 65].

Lack of adequate transport and transport infrastructure

Poor roads, difficult terrain, underdeveloped ambulance systems, and a lack of other transport options, delayed reaching care [19, 30, 35, 37, 53, 59, 63, 65, 77, 79, 90]. One of the studies reported that transportation fees further contribute to delays in reaching care (Table 2) [78].

Factors associated with delay 3 (receiving care)

Delays in diagnosing and managing appendicitis

Forty-eight studies reported that diagnosing and managing appendicitis can be challenging (Table 2) [16, 18–26, 28, 32–35, 37–40, 44, 45, 47, 49, 50, 58, 59, 61, 65–68, 71–74, 76–80, 83–86, 88–90, 93]. Children with appendicitis may not be able to provide a detailed account of their symptoms [71, 90, 94], which along with an inadequate examination, and the irritability of children, may delay their diagnosis and management. Females with appendicitis may exhibit similar symptoms to several gynaecological diseases, leading to appendicitis being low on the index of suspicion [37, 38, 67]. One study reported that pregnant women preferred to consult their obstetrician first rather than a surgeon [86], and another found that both the obstetrician and surgeon were hesitant to operate on pregnant woman presenting with a query appendicitis [28]. HIV-positive patients also experience a delay in diagnosis and management when presenting with appendicitis [33].

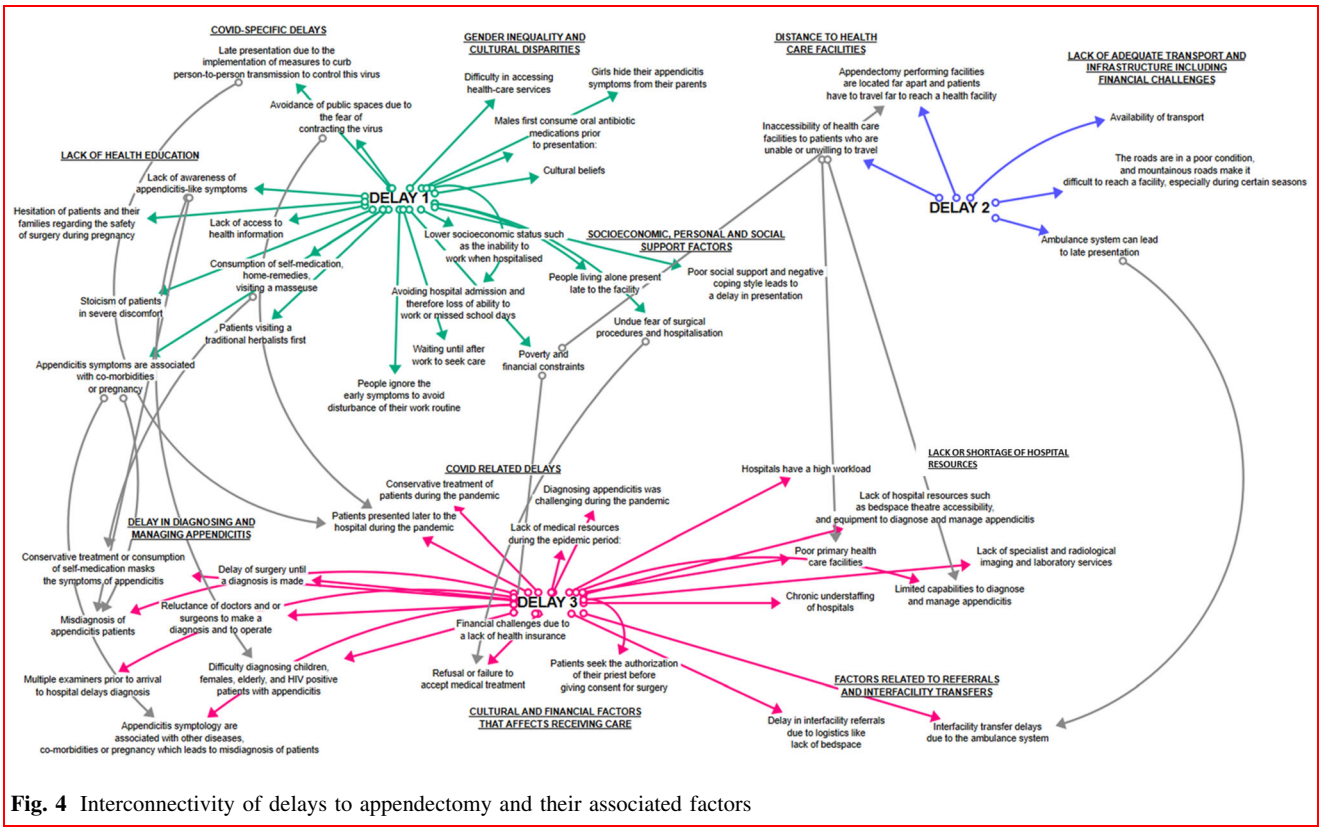


Fig. 4 Interconnectivity of delays to appendectomy and their associated factors

Lack or shortage of human resources

Some of the studies cited a lack or shortage of experienced health-care staff as contributing to the delay in appendectomy [37, 39, 77]. High patient to staff ratios delayed prompt diagnosis [58]. Non-surgeon specialists working in smaller hospitals or emergency departments waited until symptoms worsened before referring patients [26, 38, 55, 58, 71].

Lack of infrastructure

There is a lack of equipment and minimal funds to maintain the available equipment [22, 37, 47, 59, 72, 77, 88]. Limited theatre space at health-care facilities can also delay the administration of appendectomy [23, 55, 58]. Interfacility transfers can be delayed due to logistical issues such as insufficient bedspace at the referral hospital [69, 78], and transportation issues due to limited ambulance resources [35, 37, 65]. During COVID-19, delays to accessing appendectomy occurred due to a lack of surgical resources [31].

Cultural and financial factors that affect receiving care

Seven studies reported that persons undergoing appendectomy may refuse to access care for reasons such as financial concerns [16, 18, 35, 37, 39, 55, 67], and obtaining permission from religious leaders prior to allowing the surgeon to proceed with the appendectomy.

Visualising the delays to accessing appendectomy

Interconnectivities between factors and the associated delays that affected access to appendectomy were mapped (Fig. 4). For delays in seeking care, gender inequality was only associated with this delay. However, most of the factors grouped under a lack of health education (Delay 1—seeking care) could be linked to a delay in diagnosing and managing appendicitis (Delay 3—receiving care).

Discussion

Our review identified and synthesised evidence from 78 studies on delays to appendectomy in LMICs [8]. All of the studies were quantitative [18, 20–28, 30–32, 34, 37, 39–42, 45, 46, 49–51, 57–60, 65–87, 89, 90]. Our review showed

an uneven geographic distribution of studies from LMICs, with most publications emerging from South Africa, Nigeria, and Turkey [14, 15, 23, 24, 28, 29, 33, 35, 46, 50, 51, 53, 54, 60, 70, 81, 82, 84, 85, 90]. While findings from these countries may highlight important themes that can be extrapolated to other LMICs, they may not represent delays to appendectomy in all settings. More mixed methods and qualitative studies in LMICs, could add a richer dimension to understanding factors associated with delays in the appendectomy care pathway [95].

Overall, we acknowledge that there will be heterogeneity amongst countries in their social determinants of health, as well as their health systems, thus making any generalisations challenging. Nonetheless, our review included studies that reported morbidity and mortality rates among patients undergoing appendectomy. Patients may delay seeking care due to a lack of knowledge including the lack of perceived severity or urgency of appendicitis symptoms [96], and concerns relating to the perceived cost of health-care. Public awareness messaging should be targeted to specific populations with the greatest need for health education. Provision should also be made within the health system to enable access to free or affordable health-care [96].

The measured distance to a health-care facility and the cost of transportation both could be potential contributors to delays to care, although this was outside of the scope of the review. One determinant of equitable access to health-care is the ability to reach a facility that provides surgical care within two hours [1]. Few studies in our review documented that reaching appropriate surgical care was challenging, especially for rural communities. Similarly, a Pakistani study found that rural community dwellers were up to two times less likely to undergo an abdominal operation relative to urban dwellers [97]. Geographical access to health-care facilities and its effect on the administration of timely appendectomy needs to be addressed given the observed association between limited access to a health-care facility and high perforation rates [98, 99].

Barriers to receiving care in LMICs for appendectomy can be related to a lack of human and infrastructure resources. In sub-Saharan Africa there is a shortage in health-care workers [100, 101]. Trained health-care professionals are located within the city, leaving very few doctors available to help at district hospitals [97] which then forces individuals to travel to urban areas to obtain health-care [102]. Addressing the shortage of staff and trained providers could have a significant impact on the appendectomy care pathway if prioritised [103, 104]. Educational and ongoing training at lower-level facilities such as district hospitals are required. In some countries, decentralisation of certain procedures to alleviate the burden at higher-level facilities, and accessibility of affordable transport could aid in improving access to appendectomy.

For many individuals, multiple delays occur throughout the care pathway, such as financial barriers. Rural dwellers, especially, will delay seeking care owing to financial concerns, job insecurity, and a lack of access to a health-care facility [59]. Hence owing to the interconnectivity of barriers and delays, a health systems approach is needed to address these inequities. Engagement with policymakers and health system managers may be required to ensure that issues such as access due to socioeconomic factors, financial concerns, and geographical factors are considered when treatment protocols are being developed and implemented. This can be achieved by setting up stakeholder workshops, comprising of different role players, across countries. In the end these findings should be used to influence policy for appendectomy patients specifically.

This scoping review had limitations. Studies that were not in English and could not be translated using Google Translate, or no full-text article was available were excluded. Therefore, we may have underreported delays to accessing appendectomy. As distance and cost of care could not be studied because it was outside the scope of the review, its effect on time to accessing appendectomy could not be considered. The results are also limited in its generalisability due to the heterogeneity amongst countries in their social determinants of health and their health systems. However, to the best of our knowledge, this is the first study to synthesise evidence on delays to appendectomy in LMICs, using the Three Delays framework.

Conclusion

This review has highlighted the need for additional studies on delays to accessing appendectomy in additional LMICs. While each health system is unique, there are some common themes. This review shows that in LMICs, persons seeking appendectomy present late to health-care facilities due to socioeconomic, cultural, and financial factors. After reaching a health-care facility, accessing appendectomy can further be delayed owing to a lack of resources that are required to provide the necessary care. Addressing these factors could improve patient outcomes. Future studies should also consider the heterogeneity of the health system within the relevant countries when interpreting these findings. Moreover, this work could inform a systematic review and meta-analysis that quantifies the impact of each of the delays so that it in turn better informs decision-making and budget allocation, improving access to appendectomy care.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00268-023-07183-2.

Funding Open access funding provided by Stellenbosch University. This research was funded by the National Research Foundation.

Declarations

Conflict of interest None.

Ethical approval The study made use of publicly available data; therefore, ethical approval was not required.

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References

1. Meara JG, Leather AJM, Hagander L et al (2015) Global Surgery 2030: Evidence and solutions for achieving health, welfare, and economic development. The Lancet 386(9993):569–624
2. Reuter A, Rogge L, Monahan M et al (2022) Global economic burden of unmet surgical need for appendicitis. Br J Surg 109(10):995–1003
3. Chamisa I (2009) A clinicopathological review of 324 appendices removed for acute appendicitis in Durban, South Africa: a retrospective analysis. Ann R Coll Surg Engl 91(8):688–692
4. Busch M, Gutzwiller FS, Aellig S et al (2011) In-hospital delay increases the risk of perforation in adults with appendicitis. World J Surg 35(7):1626–1633
5. Walker ARP, Segal I (1995) Appendicitis: an African perspective. J R Soc Med 88(11):616–619
6. Carr NJ (2000) The pathology of acute appendicitis. Ann Diagn Pathol 4(1):46–58
7. Salminen P, Paajanen H, Rautio T et al (2015) Antibiotic therapy vs appendectomy for treatment of uncomplicated acute appendicitis: the APPAC randomized clinical trial. JAMA 313(23):2340–2348
8. Thaddeus S, Maine D (1994) Too far to walk: maternal mortality in context. Soc Sci Med 38(8):1091–1110
9. Calvello EJ, Skog AP, Tenner AG et al (2015) Applying the lessons of maternal mortality reduction to global emergency health. Bull World Health Organ 93(6):417–423
10. Anto-Ocrah M, Cushman J, Sanders M et al (2020) A woman's worth: An access framework for integrating emergency medicine with maternal health to reduce the burden of maternal mortality in sub-Saharan Africa. BMC Emerg Med 20(1):1–8
11. Tricco AC, Lillie E, Zarin W et al (2018) PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med 169:467–473
12. Arksey H, O'Malley L (2005) Scoping studies: Towards a methodological framework. Int J Soc Res Methodol 8(1):19–32
13. Tricco AC, Lillie E, Zarin W et al (2016) A scoping review on the conduct and reporting of scoping reviews. BMC Med Res Methodol 16(1):1–10
14. Abantanga FA, Nimako B, Amoah M (2009) The range of abdominal surgical emergencies in children older than 1 year at the Komfo Anokye Teaching Hospital, Kumasi. Ghana Ann Afr Med 8(4):236–242
15. Afenigus AD, Bayieh AM, Kassahun B (2020) Treatment outcomes of acute appendicitis and associated factors among admitted patients with a diagnosis of acute abdomen in Debre Markos Referral Hospital, Amhara Region. North West Ethiopia J Perioper Pract 32(5):123–130
16. Agholor K, Omo-Aghoja L, Okonofua F (2011) Rate of negative appendectomy in pregnant women in Benin City. Nigeria J Obstet Gynaecol Res 37(11):1540–1548
17. Ahmad KA, Ideris N, Abd Aziz SHS (2019) A cross-sectional study of neutrophilto- lymphocyte ratio in diagnosing acute appendicitis in hospital Melaka. Malays J Med Sci 26(6):55–66
18. Akhator A (2012) Appendicitis in the elderly-experience from Nigeria. Biosci Biotechnol Res Asia 9(2):717–719
19. Asad S, Ahmed A, Ahmad S et al (2015) Causes of delayed presentation of acute appendicitis and its impact on morbidity and mortality. J Ayub Med Coll Abbottabad 27(3):620–623
20. Avci V, Ayengin K (2019) Why is the rate of perforated appendicitis higher in girls in eastern Turkey, unlike the literature? Turk Pediatri Arsivi 54(1):40–43
21. Ayoade AB, Olawoye OA, Salami BA et al (2006) Acute appendicitis in Olabisi Onabajo University teaching Hospital Sagamu, A three year review. Niger J Clin Pract 9(1):52–56
22. Azoz M, Elhaj M (2009) Appendicitis in children: audit of outcome in kosti-teaching hospital. SJMS 4(4)
23. Bagguley D, Fordyce A, Guterres J et al (2019) Access delays to essential surgical care using the Three Delays Framework and Bellwether procedures at Timor Leste's national referral hospital. BMJ Open 9(8):1–5
24. Bekele A, Mekasha A (2006) Clinical profile and risk factors for perforation of acute appendicitis in children. East Afr Med J 83(8):434–439
25. Doumi EA, Abdelrahman IH (2007) Acute appendicitis: still a missed diagnosis in El Obeid. Western Sudan SJMS 2(1):7–8
26. Doumi EA, Manofali OE (2014) Appendicular mass at El Obeid Hospital. Western Sudan SJMS 9(3):183–186
27. Duduyemi BM (2015) Clinicopathological review of surgically removed appendix in Central Nigeria, Alexandria. J Med 51(3):207–211
28. Duqoum W (2001) Appendicitis in pregnancy. East Mediterr Health J 7(4–5):642–645
29. Kumaira Fonseca M, Trindade EN, Costa Filho OP et al (2020) Impact of COVID-19 outbreak on the emergency presentation of acute appendicitis. Am Surg 86(11):1508–1512
30. Fulton J, Lazarus C (1995) Acute appendicitis among black South Africans. S Afr J Surg 33(4):165–166
31. Gao Z, Li M, Zhou H et al (2020) Complicated appendicitis are common during the epidemic period of 2019 novel coronavirus (2019-nCoV). Asian J Surg 43(10):1002–1005
32. Ghumro AA, Khaskheli NM, Memon AA et al (1996) Perforated versus non perforated appendicitis: a comparative study. JCPSP 6(4):214–216
33. Giiti GC, Mazigo HD, Heukelbach J et al (2010) HIV, appendectomy and postoperative complications at a reference hospital in Northwest Tanzania: cross-sectional study. AIDS Res Ther 7(47):1–6

34. Gürleyik G, Gürleyik E (2003) Age-related clinical features in older patients with acute appendicitis. Eur J Emerg Med 10(3):200–203
35. Kanumba ES, Mabula JB, Rambau P et al (2011) Modified alvarado scoring system as a diagnostic tool for acute appendicitis at Bugando Medical Centre, Mwanza, Tanzania. BMC Surg 11:1–5
36. Kong VY, Bulajic B, Allorto NL et al (2012) Acute appendicitis in a developing country. World J Surg 36(9):2068–2073
37. Kong VY, Sartorius B, Clarke DL (2015) Acute appendicitis in the developing world is a morbid disease. Ann R Coll Surg Engl 97(5):390–395
38. Kong VY, Aldous C, Clarke DL (2014) Understanding the reasons for delay to definitive surgical care of patients with acute appendicitis in rural South Africa. S Afr J Surg 52(1):2–5
39. Kunle AE, Yinka OT, Oluyomi TA et al (2011) Surgical pathologic review of appendectomy at a sub- urban tropical tertiary hospital in Africa. JMMS 2(6):932–938
40. Lee HY, Jayalakshmi P, Syed Noori SH (1990) Acute appendicitis ∼ the university hospital experience. Med J Malays 48(1):17–27
41. Levy RD, Degiannis E, Kantarovsky A et al (1997) Audit of acute appendicitis in a black South African population. S Afr J Surg 35(4):198–202
42. Li J, Xu R, Hu DM et al (2019) Effect of delay to operation on outcomes in patients with acute appendicitis: a systematic review and meta-analysis. J Gastrointest Surg 23(1):210–223
43. Moustakis J, Piperidis AA, Ogunrombi AB (2020) The effect of COVID-19 on essential surgical admissions in South Africa: a retrospective observational analysis of admissions before and during lockdown at a tertiary healthcare complex. S Afr Med J 110(9):910–915
44. Ngim CF, Quek KF, Dhanoa A et al (2014) Pediatric appendicitis in a developing country: What are the clinical predictors and outcome of perforation? J Trop Pediatr 60(6):409–414
45. Nshuti R, Kruger D, Luvhengo TE (2014) Clinical presentation of acute appendicitis in adults at the Chris Hani Baragwanath academic hospital. Int J Emerg Med 7(1):1–6
46. Ohene-Yeboah M, Togbe B (2006) An audit of appendicitis and appendicectomy in Kumasi. Ghana West Afr J Med 25(2):138–143
47. Paydar S, Javidi Parsijani P, Akbarzadeh A et al (2013) Short-term outcome of open appendectomy in Southern Iran: a single center experience. Bull Emerg Trauma 1(3):123–126
48. Shambe I, Dikkol N, Ozoilo K (2016) Pregnancy outcome following non-obstetric abdominal surgery in Jos University Teaching Hospital: a 5-year retrospective study. Niger J Clin Pract 19(5):591–594
49. Singh M, Kadian Y, Rattan K et al (2014) Complicated appendicitis: Analysis of risk factors in children. Afr J Paediatr Surg 11(2):109–113
50. Steinman M, Rogeri PS, Lenci LL et al (2013) Appendicitis: What does really make the difference between private and public hospitals? BMC Emerg Med 13(15):1–5
51. Williams BM, Purcell LN, Varela C et al (2021) Appendicitis mortality in a resource-limited setting: issues of access and failure to rescue. J Surg Res 259:320–325
52. Doumi EAMM (2009) Acute Abdomen at El Obeid hospital, Western Sudan. SJMS 4(2)
53. Seqsaqa M, Rozeik AE, Khalifa M, et al (2021) Geographic influence on postoperative complications in children with complicated appendicitis: a single center study. Ann of Pediatric Surg 17(1)
54. Langenscheidt P, Lang C, Püschel W et al (1999) High rates of appendicectomy in a developing country: an attempt to contribute to a more rational use of surgical resources. Eur J Surg 165(3):248–252
55. Maroju NK, Smile SR, Sistla SC et al (2004) Delay in surgery for acute appendicitis. ANZ J Surg 74(9):773–776
56. Adisa AO, Alatise OI, Arowolo OA et al (2012) Laparoscopic appendectomy in a Nigerian teaching hospital. JSLS 16(4):576–580
57. Ahmed A, Dauda M, Garba S et al (2010) Emergency abdominal surgery in Zaria. Nigeria S Afr J Surg 48(2):59–62
58. Fahim F, Shirjeel S (2005) A comparison between presentation time and delay in surgery in simple and advanced appendicitis. J Ayub Med Coll Abbottabad 17(2):37–39
59. Kong VY, van de Linde S, Aldous C et al (2013) Quantifying the disparity in outcome between urban and rural patients with acute appendicitis in South Africa. S Afr Med J 103(10):742–745
60. Mohammed IF, AlBayati BA (2020) Acute appendicitis in pregnancy: the presentation and the outcome. Eur J Mol Clin Med 7(6):450–455
61. Hernandez MC, Finnesgaard E, Aho JM et al (2018) Appendicitis: rural patient status is associated with increased duration of prehospital symptoms and worse outcomes in high- and low-middle-income countries. World J Surg 42(6):1573–1580
62. Hernandez MC, Kong VY, Bruce JL et al (2018) Pediatric appendicitis severity in KwaZulu-Natal, South Africa: a retrospective cohort analysis. World J Surg 42(11):3785–3791
63. Sobnach S, Ede C, Van Der Linde G et al (2019) A study comparing outcomes of appendectomy between HIV-infected and HIV-negative patients. Chirurgia (Bucur) 114(4):467–474
64. Ademola TO, Oludayo SA, Samuel OA et al (2015) Clinicopathological review of 156 appendicectomies for acute appendicitis in children in Ile-Ife, Nigeria: a retrospective analysis. BMC Emerg Med 15:7
65. Bhandari TR, Shahi S, Acharya S (2017) Acute appendicitis in pregnancy and the developing world. Int Sch Res Notices 2017:1–5
66. Calis H (2018) Morbidity and mortality in appendicitis in the elderly. J Coll Physicians Surg Pak 28(11):875–878
67. Edino ST, Mohammed AZ, Ochicha O et al (2004) Appendicitis in Kano, Nigeria: A 5-year review of pattern, morbidity and mortality. Ann Afr Med 3(1):38–41
68. Gupta A, Regmi S, Hazra NK et al (2010) Clinically monitored delay-a valid option in cases with doubtful diagnosis of acute appendicitis. Indian J Surg 72(3):215–219
69. Ibis C, Albayrak D, Hatipoglu AR et al (2010) The amount of comorbidities as a single parameter has no effect in predicting the outcome in appendicitis patients older than 60 years. South Med J 103(3):202–206
70. Njoku TA, Okobia MN (2006) Perforated appendicitis: Risk factors and outcomes of management. Niger J Surg Sci 16(2):76–79
71. Osifo OD, Ogiemwonyi SO (2009) Appendicitis in children: an increasing health scourge in a developing country. Pak J Med Sci 25(3):490–495
72. Osuigwe AN, Ekwunife CN, Anyanwu SNC (2004) Childhood acute appendicitis In Nnewi Nigeria. Niger J Clin Pract 7(1):11–14
73. Ozguner IF, Buyukyavuz BI, Savas MC (2004) The influence of delay on perforation in childhood appendicitis. A retrospective analysis of 58 cases. Saudi Med J 25(9):1232–1236
74. Pokharel N, Sapkota P, Kc B et al (2011) Acute appendicitis in elderly patients: a challenge for surgeons. Nepal Med Coll J 13(4):285–288
75. Rahman GA, Debrah SA (2017) Complicated appendicitis: experience from central region of Ghana. Int Surg J 5(1):277–277

76. Rana MUI, Amna A, Fawad M (2018) Prevalance of appendicitis in children in a developing countries: a research study on painful and swollen appendix is increasing in the countries. Indo Am J Pharm Sci 5(10):10256–10261
77. Reiter AJ, Schlottmann F, Kajombo C et al (2019) Surgical outcomes of acute appendicitis in high-middle- and low-income countries. Am Surg 85(2):E97–E99
78. Rogers AD, Hampton MI, Bunting M et al (2008) Audit of appendicectomies at Frere Hospital. Eastern Cape S Afr J Surg 46(3):74–77
79. Sulu B, Günerhan Y, Palanci Y et al (2010) Epidemiological and demographic features of appendicitis and influences of several environmental factors. Ulus Travma Acil Cerrahi Derg 16(1):38–42
80. Tan PH, Teng XX, Gan ZY et al (2020) A study on the clinical factors associated with acute appendicitis and perforated appendicitis among children in a secondary medical Centre in Malaysia. Malays J Med Sci 27(4):139–146
81. Turanli S, Kiziltan G (2021) Did the COVID-19 pandemic cause a delay in the diagnosis of acute appendicitis? World J Surg 45(1):18–22
82. Willmore WS, Hill AG (2001) Acute appendicitis in a Kenyan rural hospital. East Afr Med J 78(7):355–357
83. Zhou Y, Cen LS (2020) Managing acute appendicitis during the COVID-19 pandemic in Jiaxing. China World J Clin Cases 8(19):4349–4359
84. Miloudi N, Brahem M, Ben Abid S et al (2012) Acute appendicitis in pregnancy: specific features of diagnosis and treatment. Journal de Chirurgie Viscerale 149(4):309–314
85. Ghali MAE, Kaabia O, Mefteh ZB et al (2018) Acute appendicitis complicating pregnancy: a 33 case series, diagnosis and management, features, maternal and neonatal outcomes. Pan Afr Med J 30:212
86. Terzi A, Yildiz F, Vural M et al (2010) A case series of 46 appendectomies during pregnancy. Wien Klin Wochenschr 122(23):686–690
87. De U, Ghosh S (2002) Acute appendicectomy for appendicular mass: a study of 87 patients. Ceylon Med J 47(4):117–118
88. Ahmad N, Ali AA (2020) Acute appendicitis is still a morbid disease in the developing world. Pak J Med Health Sci 14(3):537–539
89. Sayyahfar S, Nasiri J, Dehghan KT et al (2019) Pitfalls in the diagnosis of acute appendicitis in tehran children's hospital. Arch Pediatr Infect Dis 7(3):3–7
90. Magaam S (2011) Acute appendicitis in patients with different ages at Hodeidah City. Yemen World J Med Sci 6(3):136–141
91. Hernandez MC, Kong VY, Aho JM et al (2017) Increased anatomic severity in appendicitis is associated with outcomes in a South African population. J Trauma Acute Care Surg 83(1):175–181
92. Khan MS, Siddiqui MTH, Shahzad N et al (2019) Factors associated with complicated appendicitis: view from a low-middle income country. Cureus 11:1–7
93. Rahman MAM, Chowdhury TK, Chowdhury MZ et al (2020) Early appendectomy for appendicular mass: operative findings and outcome in 220 children - a developing country perspective. Ann Pediatric Surg 16(39):1–5
94. Singh N (2009) A new global malaria eradication strategy: implications for malaria research from an Indian perspective. Trans R Soc Trop Med Hyg 103(12):1202–1203
95. Renjith V, Yesodharan R, Noronha JA, et al (2021) Qualitative methods in health care research. Int J Prev Med 12(20)
96. Lee SL, Shekherdimian S, Chiu VY (2011) Effect of race and socioeconomic status in the treatment of appendicitis in patients with equal health care access. Arch Surg 146(2):156–161
97. Zafar SN, Fatmi Z, Iqbal A et al (2013) Disparities in access to surgical care within a lower income country: an alarming inequity. World J Surg 37(7):1470–1477
98. Paquette IM, Zuckerman R, Finlayson SRG (2011) Perforated appendicitis among rural and urban patients: Implications of access to care. Ann Surg 253(3):534–538
99. Lassi ZS, Middleton P, Bhutta ZA, et al (2019) Health care seeking for maternal and newborn illnesses in low- and middle-income countries: a systematic review of observational and qualitative studies. F1000Res 8:200
100. Kempthorne P, Morriss WW, Mellin-Olsen J et al (2017) The WFSA global anesthesia workforce survey. Anesth Analg 125(3):981–990
101. O'Flynn E, Andrew J, Hutch A et al (2016) The specialist surgeon workforce in East, Central and Southern Africa: a situation analysis. World J Surg 40(11):2620–2627
102. Siddiqi S, Kielmann AA, Khan MS et al (2001) The effectiveness of patient referral in Pakistan. Health Policy Plan 16(2):193–198
103. Odland ML, Whitaker J, Nepogodiev D et al (2020) Identifying, prioritizing and visually mapping barriers to Injury Care in Rwanda: a multi-disciplinary stakeholder exercise. World J Surg 44(9):2903–2918
104. Swart O, Esterhuizen TM, Voss M (2021) The role of treatment delays in surgical site infection after appendicectomy in a South African rural regional hospital. S Afr Med J 111(3):271–275

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