

Impact of traditional bonesetters on contemporary fracture care in Low and Middle Income Countries (LMICs): a systematic review

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Abstract

Background: The review aimed at systematically examining the evidence in articles that assess the clinical effects and impact of traditional bonesetters on contemporary fracture care in Low and Middle Income Countries (LMICs).

Methods: A systematic review was conducted. Articles were identified by database searching ((PubMed, Embase, ScienceDirect, SCOPUS, and Web of Science). Searching, selecting and reporting were conducted according to the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) Statement. The key words that were used in search for literature were: "Bonesetter", "fracture healer" and "traditional bone setting". Publications included for review were original articles, set in an LMIC and directly talked about the role and/or impact of traditional bonesetters in providing fracture care. Papers that focused on Low and Middle Income (LMIC) settings were reviewed.

Results: A total of 176 papers were screened for eligibility and 15 studies were finally included. Nine were prospective studies, while 6 were retrospective studies. Most of the studies focused on clinical impacts of bone setter intervention. The evidence from the publications show that the main clinical effects of traditional bonesetters had been deleterious, but they had the potential to contribute positively when trained.

Conclusion: Few well designed studies are available that assessed the impact of traditional bonesetters. Reported cases and reviews indicate their impact to be deleterious. However, the potential exist that when trained, these deleterious impact can be reduced through training for traditional bonesetters who contribute to fracture care in many LMICs.

Introduction

In most Low and Middle Income countries (LMICs), traditional bonesetters (TBS) still play an integral role in trauma care [1]. The practice of traditional bone setting dates back to history and it has found root in many developing countries in Africa, South America and the Indian subcontinent where TBS still play a role in providing services [2]. In many developing countries, traditional care of injuries and diseases has remained popular despite the existence of modern health care services and advancement in various spheres of life [2,3]. Bone setting skills are usually passed down the family line without any documentation. TBS receive no formal training in modern orthopaedic care and their practice is kept a family secret and as part of an ancestral heritage [4].

Despite the presence and availability of modern orthopaedic services (MOS), TBS enjoy high patronage and wide acceptance across different social and educational strata as well as religions [5]. The high patronage of TBS is rooted in cultural belief and has no correlation with educational status, income or occupation [3]. Cultural beliefs, expectations of quicker healing, cheaper services and fear of amputation have been noted as reasons for TBS patronage in some studies [6,7,8]. The low coverage of health insurance and high out-of-pocket costs of healthcare in most developing countries also contribute to the poor utilization of MOS [9].

In Nigeria, TBS provide about 70%–90% of primary fracture care in certain areas [10] and this method of fracture care cannot be overlooked, as it has a huge impact on health outcomes. Many patients with fractures would preferentially present directly to the TBS or after initial resuscitation in a hospital.

The bone setting techniques adopted by the TBS lack a sound scientific basis which may lead to limb and life-threatening complications [11]. Various complications and failure rates of TBS treatment have been reported. Oginni [12] and OlaOlorun et al. [13] both in southwest Nigeria, have reported complication rates of 66.7% and 83% respectively, while Faheem et al. [14] in India reported 43%. Onuminya [9] also observed that 50–60% of limb gangrene in Nigeria were due to complications of TBS practice.

Some complications from TBS interventions include: non-union, mal-union, chronic osteomyelitis, limb gangrene, compartment syndrome and joint stiffness [9,11,15,16]. These complications constitute management challenges to orthopaedic surgeons in developing countries as they increase the case load and lead to orthopaedic surgeons treating complications of fractures [4,12].

This systematic review aims to provide a concise overview of current knowledge base of the impact of TBS on fracture care, identify gaps in knowledge and potential areas for future research to assess impact of well-designed interventions on outcome for patients who patronize TBS.

Methods

This systematic review was conducted based on the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) framework in order to assure quality of the search process and adequate reporting within this paper [17].

Search Strategy

Articles were identified by database searching (PubMed, Embase, ScienceDirect, SCOPUS, and Web of Science). A secondary search was conducted using three WHO indexes: Hinari Access to Research for Health program, Institutional Repository for Information Sharing (IRIS) and the Global Index Medicus (GIM). The time period used was from 1900 to May 2017. Titles, abstracts, key words and full texts were searched with the following search term: (“bonesetter” OR “fracture healer” OR “Traditional bone setting”). The search strategy used for the PubMed search was ‘bonesetter’ OR ‘traditional bone setting’ OR ‘fracture healer’ AND ‘Fractures’ OR ‘injuries’ OR ‘musculoskeletal injuries’ AND ‘fracture care’ Or ‘treatment’. The search strategy was adapted for each database as necessary. Furthermore, a manual search was conducted to identify relevant articles in the reference lists of the identified articles which meet the inclusion criteria.

Inclusion Criteria

Articles which were included in this systematic review had to meet the following criteria: 1) set in an LMIC; 2) published in English; 3) articles published in peer reviewed journals between 1900 and 2018; 4) directly mentioned the impact of traditional bonesetters’ treatment of fractures; 5) articles that evaluated the clinical complications of fractures resulting from traditional bonesetters’ treatment.

Exclusion Criteria

Articles were excluded if the paper: i) was a literature review, letter, comment or conference abstract ii) described a theoretical concept but did not directly address the role or impact of traditional bonesetters iii) had no abstract. Case reports, case studies and qualitative studies were excluded. Study eligibility for inclusion was assessed in duplicate by two authors, and in cases of discrepancy, a third author was consulted to reach a consensus.

Data Extraction and Synthesis

Titles and abstracts were initially screened for their fulfilment of inclusion criteria. Subsequently, the remaining potentially eligible articles were appraised in detail by reading the full-text papers.

All the retained papers were reviewed independently by two sets of two authors who examined the full texts using a data extraction pro-forma developed and pre-tested by the review team. The data extraction pro-forma was used to extract the following: the study setting, the study design, the study objectives, study population, sampling techniques, the treatment received, outcome of the TBS treatment, study limitations and conflicts of interest. Cases of non-concordance were resolved by another author. If there were any discrepancies between the two sets of authors, a fifth author adjudicated.

The outcome measures assessed included clinical impacts and how the work of TBS has affected the outcomes of fracture treatment. Relevant information was extracted into a narrative summary table designed for this review. The table contained fields for author information, country of study, study setting, study population and design, impact of TBS treatment and

summary of relevant results. The summary table was developed by two authors and validated by the review team. Impact was defined as 'the effect of bone- setters on how fractures are treated and the clinical outcomes as a result of intervention by bonesetters'.

Quality Assessment

We assessed the quality of the included studies using the National Heart, Lung, and Blood Institute (NHLBI) Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies, which is widely used and recommended by Cochrane for quality assessment of observational and cross-sectional studies [18]. The tool assessed the internal validity and risk of bias of the included studies using a checklist of 14 questions with responses, yes, no or others (cannot determine, CD; not applicable, NA; and not reported, NR). Two authors applied the tool and independently evaluated the items of the tool as "yes, " "no, " "not applicable, " "cannot determine, " or "not reported." This was used to guide the overall rating for the quality of each study as "good," "fair," or "poor." Where there was a disagreement, consensus was reached through discussion or by consulting a third author.

Results

Study selection

The database search yielded 192 results (Embase–41; PubMed- 28; Science Direct- 5; Cochrane–1; SCOPUS- 91; Web of Science- 26). Fifty four articles were identified through other sources. After the exclusion of duplicates, there were 176 articles eligible for further screening. Title and abstract screening according to the selection criteria led to the exclusion of 143 articles, leaving 33 articles for full-text assessment. After a careful review of these 33 articles, 15 were selected for inclusion in the current systematic review. The process of study selection is depicted in a flow diagram (Figure 1).

Study characteristics

Table 1 provides an overview of the main characteristics of the 15 studies included in our systematic review. Three of the articles were from Nigeria and about the impacts of traditional bone setting in Nigeria. Two articles each were from India, Sudan and Pakistan. One article each was from Ghana, Turkey, China, Indonesia, Ethiopia and Bangladesh. Altogether, seven studies (46.7%) were from the African continent while, eight studies (53.3%) were from Asia. The studies were published between 1986 and 2018. Ten out of the 15 studies were published between 2010 and 2018. All the studies were original articles from hospital-based, observational studies that investigated the outcomes of treatment of fractures by TBS. Nine of the studies were prospective while six were retrospective studies about patients who had previously been attended to by a traditional bonesetter after sustaining a musculoskeletal injury. None of the studies was a randomized controlled study or a systematic review. Further analysis of the studies showed that 1389 participants with 1470 complications of fracture treatment were studied. The age of the participants ranged from 6 weeks to 86 years with a mean age of 29.4 years. About 68.1% of the participants were males while 31.9% were females. The duration of studies ranges from 6 months to 5 years with a mean duration of 2.2 years.

Quality of included studies

We assessed the methodological quality of the studies according to the NHLBI assessment tool. Most of the studies were of intermediate quality (53.3%), 26.7% were of high quality and 20% of poor quality (table 2). Almost all the included studies had clearly stated research questions and objectives with clearly specified and defined study population. The most frequently unreported criteria were the loss to follow-up after baseline of 20% or less and the participation of eligible persons of at least 50%. In most of the included studies, the exposure and outcome measures were clearly defined, valid, reliable and implemented consistently across all the study participants. Other commons strengths included the clearly defined inclusion and exclusion

criteria for being included in the studies which were pre-specified and applied uniformly to all participants. Blinding of the outcome assessors to the exposure status of the participants was considered not to be applicable in the included studies. Only two of the studies reported that key potential confounding variables were measured and adjusted statistically for their impact on the relationship between exposures and outcomes.

Outcomes of selected articles

The outcome measures assessed were the presence of any musculoskeletal complications resulting from the treatment of a fracture by a traditional bonesetter. A range of indicators were employed for evaluation of outcomes. The most common complications that resulted from TBS treatment of fractures were: malunion, non-union, limb gangrene, compartment syndrome, joint stiffness, limb shortening and chronic osteomyelitis. Limb gangrene was a common complication amongst children [4, 22, 25]. Two studies examined the methods of treatment by TBS that resulted in complications. The local splints used by TBS in immobilizing limb fractures was noted to be a major cause of gangrene in children [15, 25]. One of the studies analyzed the cost effectiveness of TBS treatment. It was noted that the cost of treatment of the TBS ranged from USD 18–380, whereas the treatment of certain fractures at an orthopaedic hospital in Nigeria ranged from USD 34–98 [19]. The impact of TBS on treatment outcomes of fractures was generally found to be negative, reversing gains made by orthodox fracture care and leading to deleterious complications in many LMICs (Table 1).

Discussion

A total of 15 studies were fully reviewed in order to examine the impact of traditional bonesetters on fracture care in LMICs. Given the widespread influence and popularity of traditional bonesetters in many LMICs, this is surprisingly a low number. This revealed to us that the subject of bonesetters is an understudied one. Most of the articles included were set in Asia and Sub-Saharan Africa. This may be explained by the existence of TBS and their wide-spread patronage in these regions. Some of the papers which appeared with our search gave a historical account and examined factors that led to many people choosing TBS over orthodox medical practitioners, with few examining their impact on fracture care. Most of the articles included in this systematic review were set in English-speaking countries. This finding could be due to the inclusion criterion that required all articles to be in English or a greater familiarity with bone setters in English speaking countries than others.

It is worth observing that all the impacts of TBS interventions identified in the studies reviewed were of a clinical nature, with the most common impacts being Malunion, nonunion, limb gangrene, amputations, and compartment syndrome. These may be attributable to the non-scientific nature of their treatment methods which was highlighted by two studies [15, 25]. The studies reported that the local splints applied by TBS in immobilizing limb fractures were applied too tightly resulting in compartment syndrome, Volkmann's ischemic contracture and gangrene. The health and socioeconomic impact of these complications are enormous because young adults in the reproductive age are predominantly involved. These complications also pose a management challenge to orthopaedic surgeons in the developing countries resulting in poor outcomes of fracture treatment [4, 11, 12].

In spite of the generally poorer outcomes associated with traditional bone setters relative to orthodox medical treatment, large numbers of people in LMICs continue to patronize their services. This is due to the absence of orthodox medical services, perceived cheaper services, the perception that they are more competent at treating fractures, discomfort in cast, the fear of surgery, mistrust of doctors among others [1,9,33,34,35,36]. Dada et al [19] in their study also analyzed the differential cost of fracture treatment between the TBS and orthopaedic surgeons at an orthopaedic hospital in Nigeria. It was noted that the cost of fracture treatment by the TBS ranged from USD 18–380, while that in the orthodox hospital ranged from USD 34–98. This is contrary to a widely held opinion in many LMICs that TBS treatment of fractures is cheaper than orthodox treatment.

Another important impact of TBS intervention, as identified in several of the articles reviewed was that patients who sought initial help from TBS before visiting the hospital were more likely to have poorer outcomes than those who sought initial care

from orthodox hospitals [24, 33]. This is usually as a result of TBS gangrene that may follow treatment by a TBS which might lead to amputation, sepsis, or death in some cases [22].

Many experts have recommended that because of the widespread presence of TBS and the influence and respect they command among a lot of people in LMICs, efforts should be made to retrain them and possibly integrate them into the formal health system [34, 35]. Interviews with bone setters on this issue have elicited different responses; with some welcoming the idea and others rejecting it because they consider orthodox medical practitioners their competitors [36]. Onuminya [37] demonstrated that the training of a TBS resulted in a considerable decrease in the rate of gangrenous limbs, infection, non-union and malunion, when the operations of two bone setters were compared- one who had undergone training by orthodox medical practitioners and the other who had not.

Strengths and weaknesses

To the best of our knowledge, this systematic review is the first on the subject of traditional bonesetters and their impact on fracture outcomes and contemporary treatment of fractures. Taking into account the multifaceted nature of the subject of traditional bonesetters, we chose a search strategy which encompassed databases in biomedical as well as social sciences. The objective of this systematic review was clear-cut with a robust methodology to achieve it. The database search and study selection were performed in a systematic and documented manner, using the PRISMA Statement for conducting systematic reviews. The methodological quality of the included studies was appraised using the NHLBI assessment tool for internal validity and risk of bias.

There are however some limitations to this review. Our search strategy was limited to established scientific databases and grey literature in the WHO databases. This might have led to the exclusion of articles which are not found in these databases. Also, the fact that most of the articles which were eventually included were hospital-based studies may not be representative of the actual impact of TBS treatment of fractures since minor complications and fatalities may not have presented to the hospitals. Thus, all conclusions drawn in the present paper are limited to the 'established' databases and manual searching. It is difficult to tell how this search strategy may have affected the results of our review.

Conclusion

Our review identifies that currently, TBS provide huge services to individuals with trauma and bone fractures in many LMICs. Most of the reported outcomes have been deleterious. However, there is potential that when TBS are trained, they can contribute positively to fracture care and outcomes. Innovative interventions that can lead to improvement in the reported negative impact for individuals with fractures who patronize TBS should be tested in well-designed studies, and if proven to work should be adopted.

Abbreviations

LMIC: Low and Middle Income Countries

USA: United States of America

TBS: Traditional Bonesetters

MOS: Modern Orthopaedic Services

PRISMA: Preferred Reporting Items for Systematic reviews and Meta-Analyses

WHO: World Health Organization

Declarations

Ethics Approval and Consent to Participate: The research and ethics committee of University of Nigeria Teaching Hospital Ituku-Ozalla gave approval for the study.

Consent to publish: Not applicable

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interest: The authors declare no competing interests.

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Authors' contributions: EEE and FEN conceived the study. XG and SS designed the protocol for the systematic review. NOO, OEO, OEN and WNAM conducted the literature search. Titles and abstracts were initially screened for their fulfilment of selection criteria. Two of the authors (NOO and SS) conducted the screening procedure independently from each other. Cases of non-concordance were resolved by another author (WNAM). The corresponding data extraction was done by WNAM and NOO. NOO and WNAM drafted the manuscript. BCN, UNE, XG, EEE and FEN revised the manuscript. All the authors approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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Tables

Table 1: Characteristics of articles included in review

S/NO	AUTHOR (YEAR)	COUNTRY	TARGET GROUP (SETTING)	TYPE OF STUDY/DESIGN	OUTCOMES	SUMMARY OF RELEVANT RESULTS
1	Dada et al. (2009) ²¹	Nigeria	Patients with musculoskeletal injury treated strictly by a TBS	Prospective, non-interventional study; 121 patients with 155 musculoskeletal injuries	168 complications of treatment by TBS. Cost of treatment by TBS compared to orthodox surgery.	1. Mal-union and non-union which each accounted for 27 (16.1%) cases. 2. The cost of treatment of the TBS ranged from USD 18-380, whereas, at the Orthopedic Hospital, it ranged from USD 34-98.
2	Callistus et al. (2013)	Ghana	Patients with musculo-skeletal injuries treated by TBS with complications over 5 years in Northern Ghana	Prospective non-interventional study of 230 patients	Complications of TBS Treatment.	1. Non-Union (20.9%) 2. Malunion (31.3%) 3. Infection (17%) 4. Ankylosis (7.8%) 5. Paralysis (5.2%) 6. Gangrene (2.6%) 7. Osteonecrosis (5.7%)
3	Panigrahi et al. (2017)	India	120 patients who presented to the outpatient department of a University Teaching Hospital over a 2-year period with fracture complications from TBS treatment	Prospective, non-randomized study of 120 patients with fracture complications	Pattern of complications of traditional bonesetters' treatment.	1. Malunion (46%) 2. Non-union (20%) 3. Chronic osteomyelitis (6%) 4. Limb ischemia (28%)
4	Onuminya et al. (1999) ⁴	Nigeria	Patients in Northern Nigeria who suffered complications of limb fractures and managed by TBS	Retrospective study; 25 patients aged between 5-50 years	Complications of treatment by TBS	1. Gangrene (60%) 2. Cellulitis (20%) 3. Compartment syndrome (20%)
5	Nwankwo et al. (2005) ²⁴	Nigeria	15 patients presenting with limb gangrene; aged 1-83 years, who had presented to a TBS for treatment of musculoskeletal injuries	Prospective, non-controlled cohort study; 15 patients	Outcomes in patients who had been to a TBS after they had reported to hospital	1. Gangrene (100%) 2. Toxemia (93.3%) 3. Amputation (100%) 4. Death (26.6%)
6	Zehir et al. (2015) ³⁰	Turkey	Bonesetter-intervened patients with complications of fractures treatment	Retrospective analysis of hospital records	Complications of treatment by a TBS in 55 patients who presented	1. Joint stiffness (14.8%) 2. Degenerative arthritis (6.2%) 3. Permanent nerve injury (3.1%) 4. Skin necrosis (3.1%) 5. Deformity (2.5%) 6. Compartment syndrome (1.8%)

					with complications.	7. Amputation (1.2%) 8. Nonunion (0.6%) 9. Limb shortening (0.6%)
7	Huang (1986) ¹⁹	China	16 young adults, aged 16-43 years with neglected femoral neck fractures treated by a "Chinese bone setter"	Retrospective study of 16 cases of neglected femoral neck fractures	Outcomes of treatment of neglected femoral neck fractures initially seen by bone setters	1. Leg shortening 2. Upward displacement of the distal fragment 3. Variable degree of absorption of the femoral neck or head
8	Doumi et al. (2007) 2009	Sudan	46 patients who underwent upper limb amputations at a teaching hospital over 5 year period	Retrospective study of 46 patients who had upper limb amputations.	11 out of the 21 children had gangrene from TBS splintage as the cause of upper limb amputation.	TBS Splintage for limb injuries was a major cause of gangrene in children (40.7%)
9	MIAEL Hag et al. (2010)	Sudan	36 Patients with fractures treated by TBS presenting with complications over 6 months at a Teaching Hospital in Khartoum Sudan.	Retrospective review of hospital records.	Complications of patients treated for fractures by bonesetters	1. Malunion (25.7%) 2. Nonunion (20%) 3. Compartment syndrome (14.3%) 4. Joint stiffness (11.4%) 5. Gangrene (8.6%)
10	Warman et al. (2018)	Indonesia	86 Patients with 109 limb fractures presenting with complications from TBS treatment within one year.	A hospital-based retrospective analysis of medical records.	Early and late complications of fracture treatment by TBS	1. Malunion (54.7%) 2. Joint stiffness (9.4%) 3. Non-Union (18.7%) 4. Neurologic impairment (7.8%)
11	Zulfiqar et al. (2018)	Pakistan	77 Patients who presented to the outpatient clinic after being managed by TBS over 6 months period.	Cross-sectional, prospective, non-randomized study.	Pattern of complications among trauma patients treated by TBS	1. Joint stiffness (22%) 2. Volkmann's contracture (20.8%) 3. Skin necrosis (18.2%) 4. Non-union (3.9%)
12	Dastgir et al. (2012)	Pakistan	86 Patients with musculoskeletal injuries treated by TBS before presenting to a teaching hospital.	Prospective, non-randomized study.	Presence of complications after receiving TBS treatment.	1. Non-union (17.4%) 2. Malunion (24.4%) 3. Chronic osteomyelitis (17.4%) 4. Osteonecrosis (10.4%) 5. Gangrene (4.6%)
13	Prasad et al. (2015)	India	30 orthopaedic out-patients with TBS complications over 6 months period.	Prospective observational study.	Complications resulting from TBS fractures treatment	1. Malunion (36.7%) 2. Non-union (33.3%) 3. Myositis ossificans (16.7%) 4. Infections (6.7%)
14	Kumma et al. (2013)	Ethiopia	70 patients presenting to	Prospective, cross-sectional	Frequency of complications	Joint stiffness (52.8%) Infection (8.6%)

			the emergency unit of a hospital with history of fracture treatment by TBS.	survey.	arising from the TBS fracture treatment	Non-union (5.7%) Gangrene (4.3%) Volkmann's Contracture (5.7%)
15	Chowdhury et al. (2011)	Bangladesh	120 Patients with fractures previously treated by TBS before presenting to 2 hospitals over a 1 year period.	Prospective multi-center study.	Methods of treatment by TBS that resulted in complications	Malunion (83.9%) Non-union (14.7%) Joint stiffness (11%) Infections (22.1%) Gangrene 1.5%

Table 2 NHLBI Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies

/no	CRITERIA	Dada et al	Callistus et al	Panigrahi et al	Onuminya et al	Nwankwo et al	Zehir et al	Huang	Doumi et al
	Was the research question or objective in this paper clearly stated?	YES	YES	YES	YES	YES	YES	YES	YES
	Was the study population clearly specified and defined?	YES	YES	YES	YES	YES	YES	YES	YES
	Was the participation rate of eligible persons at least 50%?	CD	CD	NR	NR	NR	NR	NR	NR
	Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?	YES	NR	YES	NR	YES	YES	YES	NR
	Was a sample size justification, power description, or variance and effect estimates provided?	NO	NO	NO	NO	NO	NO	NO	NO
	For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	YES	YES	YES	YES	YES	YES	YES	YES
	Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?	YES	YES	YES	YES	YES	YES	YES	YES
	For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?	NO	NO	NR	YES	YES	NO	NO	NR
	Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	YES	YES	YES	YES	YES	YES	NO	YES
0	Was the exposure(s) assessed more than once over time?	NO	NO	NO	NO	NO	NO	NO	NO
1	Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	YES	NO	YES	YES	YES	YES	YES	YES
2	Were the outcome assessors blinded to the exposure status of participants?	NA	NA	NA	NA	NA	NA	NA	NA
3	Was loss to follow-up after baseline 20% or less?	NR	NR	NR	NR	NR	NR	NR	NR
4	Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?	NO	NO	NO	NO	NO	NO	NO	NO
	Rating	FAIR	POOR	FAIR	FAIR	GOOD	FAIR	FAIR	FAIR

Table 2 (contd.): NHLBI Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies

CRITERIA	MIAEL Hag et al	Warman et al	Zulfiqar et al	Dastgir et al	Prasad et al	Kumma et al	Chowdhury et al
Was the research question or objective in this paper clearly stated?	YES	YES	YES	YES	YES	YES	YES
Was the study population clearly specified and defined?	YES	YES	YES	YES	NR	YES	YES
Was the participation rate of eligible persons at least 50%?	NA	NR	NR	NR	NR	NO	NR
Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?	YES	YES	YES	YES	YES	YES	YES
Was a sample size justification, power description, or variance and effect estimates provided?	NO	NO	NO	NO	NO	NO	NO
For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	YES	YES	YES	YES	NO	YES	YES
Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?	YES	YES	NO	YES	NO	NO	YES
For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?	YES	YES	NO	NO	NO	YES	YES
Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	YES	YES	YES	YES	YES	YES	YES
0 Was the exposure(s) assessed more than once over time?	NO	NO	NO	NO	NO	NO	NO
1 Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	YES	YES	NO	YES	YES	YES	YES
2 Were the outcome assessors blinded to the exposure status of participants?	NA	NA	NA	NA	NA	NA	NA
3 Was loss to follow-up after baseline 20% or less?	NR	NR	NR	NR	NR	NR	NR
4 Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?	NO	YES	NO	NO	NO	NA	YES
Rating	GOOD	GOOD	POOR	FAIR	POOR	FAIR	GOOD

Figures

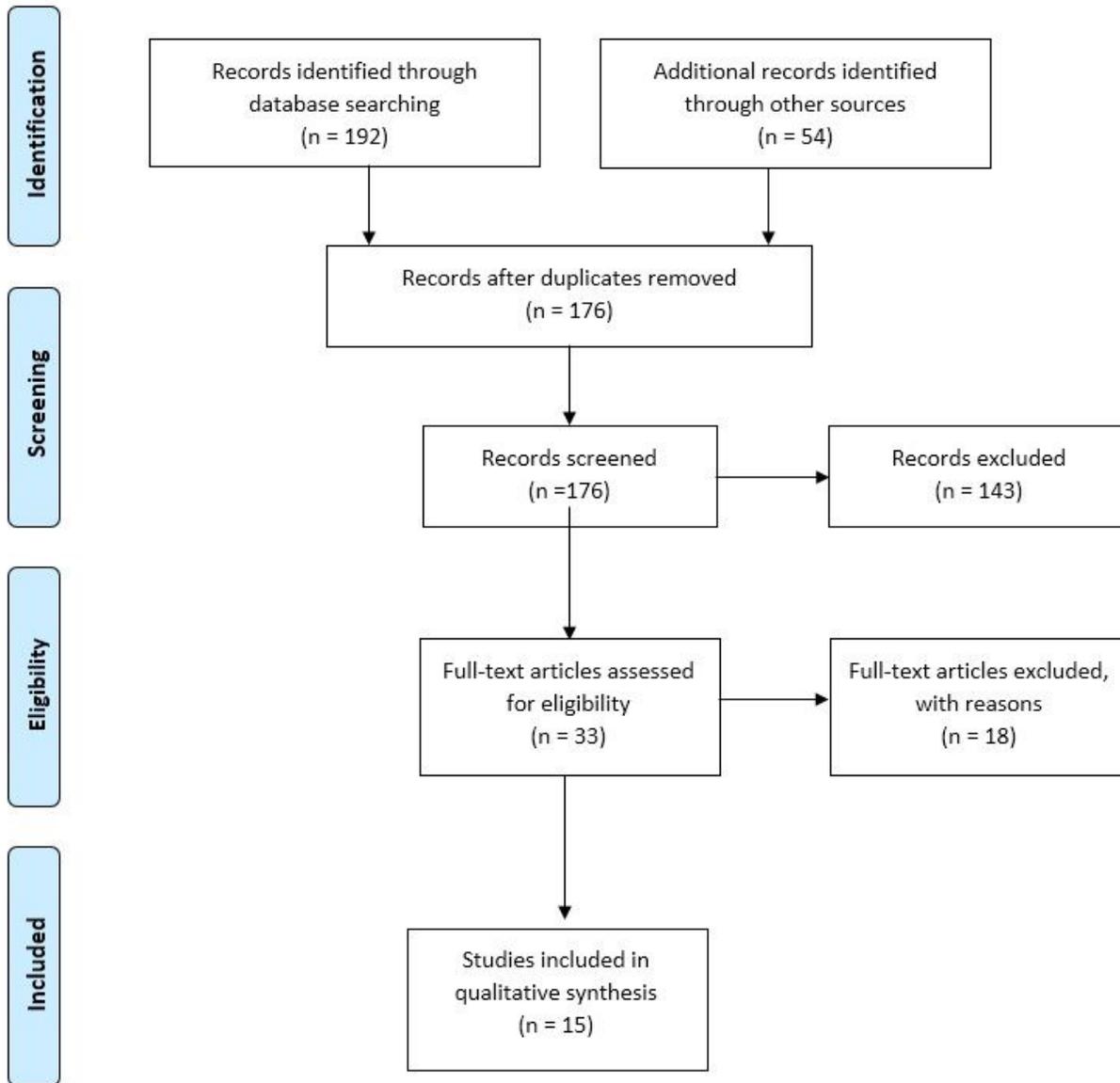


Figure 1

Flow chart of article selection process

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