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Review Article

Global prevalence and reasons for case cancellation on the intended day of surgery: A systematic review and meta-analysis

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A B S T R A C T

Background: Cancellation of operation on the intended day of surgery affects the efficiency of Operation Room which incurs a significant financial loss for the patient, hospital, and health care cost of a country at large. This systematic and Meta-Analysis was intended to provide evidence on the global prevalence and determinants of case cancellation on the intended day of surgery.
Methods: A comprehensive search was conducted in PubMed/Medline; Science direct and LILACS from January 2010 to May 2020 without language restriction. The Heterogeneity among the included studies was checked with forest plot, $\chi 2$ test, I2 test, and the p-values. All observational studies reporting prevalence and determinants were included.
Results: A total of 1207 articles were identified from different databases with an initial search. Fort-eight articles were selected for evaluation after the successive screening. Thirty-three Articles with 306,635 participants were included. The Meta-Analysis revealed that the global prevalence of case cancellation on the intended day of surgery was 18% (95% CI: 16 to 20). The Meta-Analysis also showed that lack of operation theatre facility accounted for the major reason for cancellation followed by no attendant and change in medical condition.
Conclusion: The meta-analysis revealed that the prevalence of case cancellation was very high in low and middle-income countries and the majorities were avoidable which entails rigorous activities on operation theatre facilities, preoperative evaluation and preparation, patient and health care provider communications.
Registration: This Systematic Review and Meta-Analysis was registered in a research registry (**researchregistry5746**) available at https://www.researchregistry.com/browse-the-registry#home/

1. Introduction

The same day case cancellation refers to any surgical case that is scheduled into the operation theatre list on the day before surgery but is not operated on as per the schedule [1,2].

Operation Room (OR) is the financial centre of the Hospital [3–7] which can generate 40–50% of hospital and 60–70% of hospital revenue [8] with an average cost of 15–50 US Dollars per minute[3, 9–14].

Cancellation of operation on the intended day of surgery affects the efficiency of OR, reduces utilization of OR time and waste resources which incur a significant financial loss for the patient hospital and health care cost of a country at large [2–7,9–17].

Cancellation of operation is the leading cause that decreases OR efficiency which has a huge impact on patient, staff, hospital, and health care delivery [2,5,9–12,14–17]. The measure of OR efficiency is a controversial issue but studies reported that the surgical centre with a cancellation rate of less than 5% was considered efficient [2,8,18,19].

The incidence of cancellation is very high which varied with the hospital setting, culture, and socioeconomic status of the nation. The cancellation rate in the developed country ranged from 2 to 40% [2,9,12,20–22] while this rate is as high as 73% in low and middle-income countries[4, 7, 15, 22–26]. Studies reported that more than eighty Percent of cancellations were avoidable while only twenty Percent of cancellations were unavoidable [3,10,14–16,19,22,27–33].

Studies figured out many reasons for cancellation of operation on the intended day of surgery which themed in two broader

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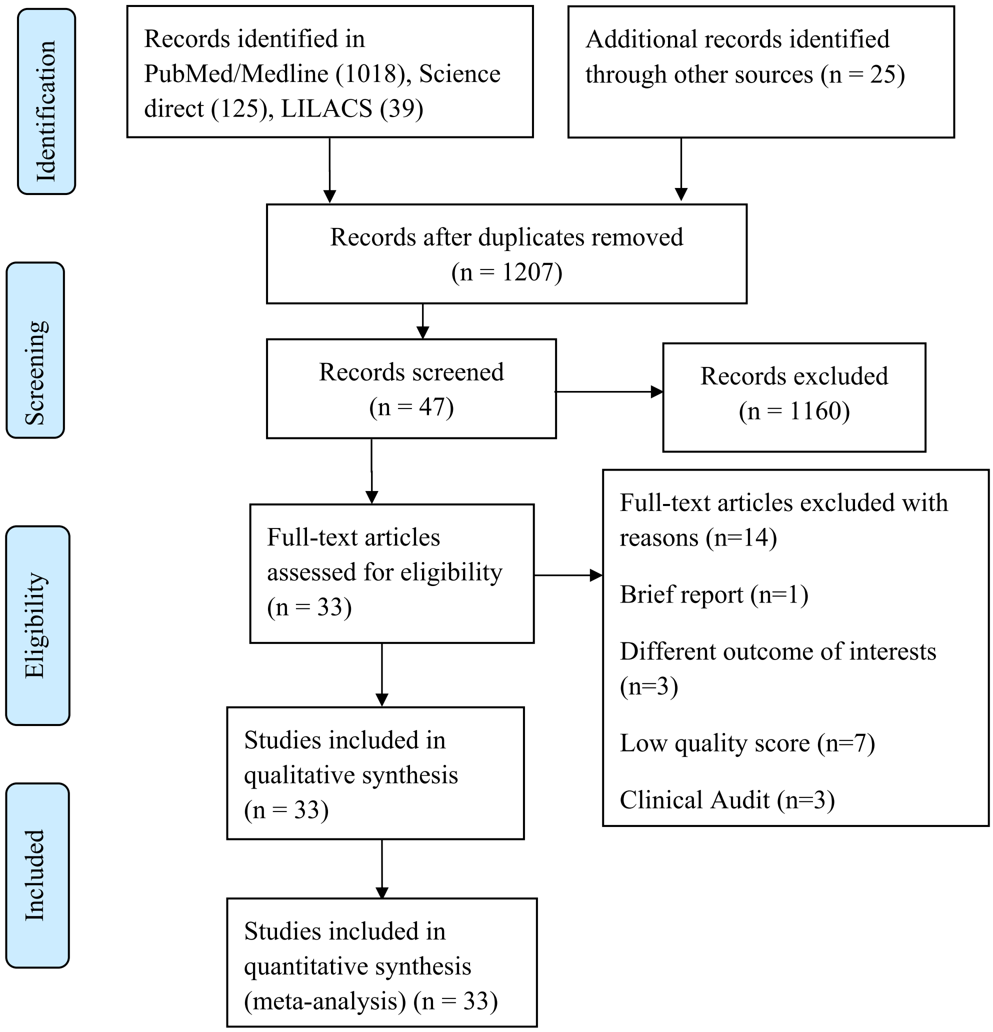

Fig. 1. Prisma flow chart.

categories as patient-related factors such as a change in medical condition, no show-up, no attendance, refuse to give informed consent and facility-related factors such as lack of a bed, operation time, equipment, inadequate workup, staff unavailability, and others [2,3,5,6,10,17,34–44].

A cohort study done by Wong et al. in the UK among 14,936 patients showed that 33.3% of patients were cancelled due to change in medical condition while 31% were cancelled because of insufficient bed capacity [18]. Another study conducted in the USA by Smith et al. also showed that 51% of patients were cancelled because they were unfit for anaesthesia [20].

A study conducted in Meddle east by Morris et al. among 760 patients found out that 67% of patients were cancelled due to patient-related factors [2]. A study from Brazil by Pinheiro et al. revealed that 61.2% of patients were cancelled because of facility-related factors [45].

A prospective cross-sectional study conducted in Ethiopia by Desta et al. showed that the majority of cases (35.8%) were cancelled because surgeons were not available [15]. A study done in Nigeria showed that 60.8% of cases were cancelled because they were not available (no-show) [46].

Body of evidence showed that patient cancellation on the intended day of surgery is associated with a significant psychosocial and economic impact on the patients and their families. Besides, it affects the health care delivery and revenue of the hospital which entails mitigating strategies to prevent avoidable surgical cancellations. Therefore, this systematic review and Meta-Analysis aimed to provide evidence on global prevalence and determinants of cancellation of cases on the intended day of surgery.

2. Objective and research questions

2.1. Objective

The objective of this systematic review and Meta-Analysis was to investigate the global prevalence, determinants, and outcomes of cancellation of cases on the intended day of surgery.

2.2. Research questions

- ➢ What is the global prevalence of case cancellation on the intended day of surgery?
- ➢ What is the prevalence of case cancellation on the intended day of surgery among the continents?
- ➢ What is the prevalence of case cancellation among Low and Middle-income countries
- ➢ What are the main reasons for case cancellation on the intended day of surgery?

Table 1
Description of included studies.

Author(s)	Year	Sample	Country	Types of Surgery	Major reason	Income	Quality Score	Prevalence (95% CI)
Ogwal et al[56]	2020	400	Uganda	All	Facility-related	Low	8	29(24, 33)
Ayele et al[33]	2019	369	Ethiopia	All	Unfit	Low	5	66(61, 71)
Boyapati et al[57]	2019	11,004	UK	All	Unfit	High	5	7(7, 8)
Desta et al[15]	2018	146	Ethiopia	All	Unfit	Low	6	32(27, 36)
Egbor et al[58]	2018	243	Nigeria	All	medical	Lower-middle	4	13(9, 18)
Khoda et al[41]	2018	5927	Finland	plastic	Unfit	High	6	69(5, 6)
Muñoz et al[59]	2018	848	Colombia	All	Unfit	Upper-middle	6	6(4, 8)
Wong et al[18]	2018	14,936	UK	All	Unfit	High	7	10(10, 11)
Kyei et al[1]	2017	884	Ghana	All	Lack of OR time	Lower-middle	5	21(18, 24)
Pinheiro et al[45]	2017	2828	Barzil	All	No attendant	Upper-middle	5	18(17, 20)
Yu et al[9]	2017	11,331	China	All	Medical	High	5	1(1, 2)
Fayed et al[17]	2016	54,419	Saudi Arabia	All	No show up	High	5	11(11, 11)
Gajida et al[46]	2016	200	Nigeria	All	patient Related	Lower-middle	5	49 (41,56)
Lankoande et al[14]	2016	103	Burkina Faso	All	No show up	Low	6	74(64, 82)
Santos et al[44]	2016	8443	Barzil	All	Unfit	Upper-middle	5	7(6, 7)
Cihoda et al[60]	2015	29,518	Barzil	All	Medical	Upper-middle	6	16(16, 17)
Hoffman et al[61]	2015	222	Germany	Outpatient	Unfit	High	7	13(12, 14)
Caesar et al[62]	2014	17,625	Sweden	Orthopedics	Transfer	High	6	39(38, 40)
Chang et al[11]	2014	417	China	All	Medical	High	6	59(54, 64)
Ebrahimipouret al[42]	2014	16,512	Iran	All	Unfit	Upper-middle	6	2(2, 2)
Kaddoum et al[38]	2016	5000	Lebanon	All	No show up	Upper-middle	5	4(4, 5)
Kajja[63]	2014	Uganda	854	all	lack of OR facility	Low	8	24(21, 27)
Smith et al [20]	2014	7081	USA	Cardiac	Unfit	High	6	2(2, 2)
Carvalho et al[64]	2013	1600	Barzil	All	No attendant	Upper-middle	4	19(18, 22)
Dimitriadis et al[37]	2013	19,368	UK	All	Unfit	High	5	5(5, 6)
Chiu et al[22]	2012	6234	Honk Kong	All	Lack of OR time	High	8	8(7, 8)
Kumar et al [31]	2012	7272	India	All	Lack of OR time	Lower-middle	4	18(17, 19)
Okonu[25]	2012	1547	Kenya	All	Lack of OR facility	Lower-middle	6	21(19,23)
Pohlman et al[13]	2012	854	USA	Urology	Unfit	High	8	13(11, 16)
Chalya et al[4]	2011	3064	Tanzania	All	Lack of OR facility	Low	5	21(20, 23)
Fantini et al[65]	2011	1768	Italy	Outpatient	Unfit	High	6	7(6, 8)
Mesmar et al[10]	2011	19,487	Jordan	All	No show up	Upper-middle	6	4(3, 4)
Sung et al[12]	2010	61,855	Taiwan	All	Unfit	High	8	0(0, 0)

3. Materials and methods

3.1. Protocol and registration

The systematic review and meta-analysis were conducted based on the Preferred Reporting Items for Systematic and Meta-analysis (PRISMA) protocols [47]. This Systematic Review and Meta-Analysis was registered in a research registry (researchregistry5746) on June 24/2020 and available at https://www.researchregistry.com/browse-the-registry#home/

3.2. Inclusion and exclusion criteria

3.2.1. Inclusion criteria

All observational (case series, cross-sectional, cohort, and case-control) studies reporting prevalence and determinants of cancellation at the intended day of surgery were included.

3.2.2. Exclusion criteria

Studies that didn't report the prevalence of cancellation on the intended day of surgery, studies conducted before 2010 were excluded. Besides, Randomized controlled trials, case-control studies, Systemic reviews, and Case reports were excluded.

3.3. Outcomes of interest

3.3.1. Primary outcomes

The primary outcome of interest was the prevalence of case cancellation on the intended day of surgery. Besides, the systematic review and Meta-Analysis identified the prevalence of the most common reasons for case cancellation on the intended day of surgery.

3.3.2. Secondary outcomes

The outcomes of case cancellation were not reported in the majority of included studies. However, systematic review and Meta-Analysis figured out the prevalence and determinants of outcomes of case cancellation on the intended day of surgery.

3.4. Search strategy

The search strategy was intended to explore all available published and unpublished studies among Coronaviruses infected patients admitted to ICU from December 2010 to May 2020 without language restrictions. A comprehensive initial search was employed in PubMed, Science direct, and LILACS followed by an analysis of the text words contained in Title/Abstract and indexed terms. A second search was undertaken by combining free text words and indexed terms with Boolean operators. The third search was conducted with the reference lists of all identified reports and articles for additional studies. Finally, an additional and grey literature search was conducted on Google scholars.

The PubMed/Medline database was searched with the following terms: ((((((((((((Operation[Text Word]) OR (surgery[Text Word])) OR (surgical procedure[Text Word])) AND (cancellation[Text Word])) OR (postponed[Text Word])) OR (delayed[Text Word])) AND (operation room[Text Word])) OR (operation theatre[Text Word])) OR (hospital[Text Word])) AND (prevalence[Text Word])) AND (risk factors[Text Word])) OR (reasons [Text Word]))))))))))))))

3.5. Data extraction

The data from each study were extracted with two independent authors with a customized format. The disagreements between the two independent authors were resolved by the other two authors.

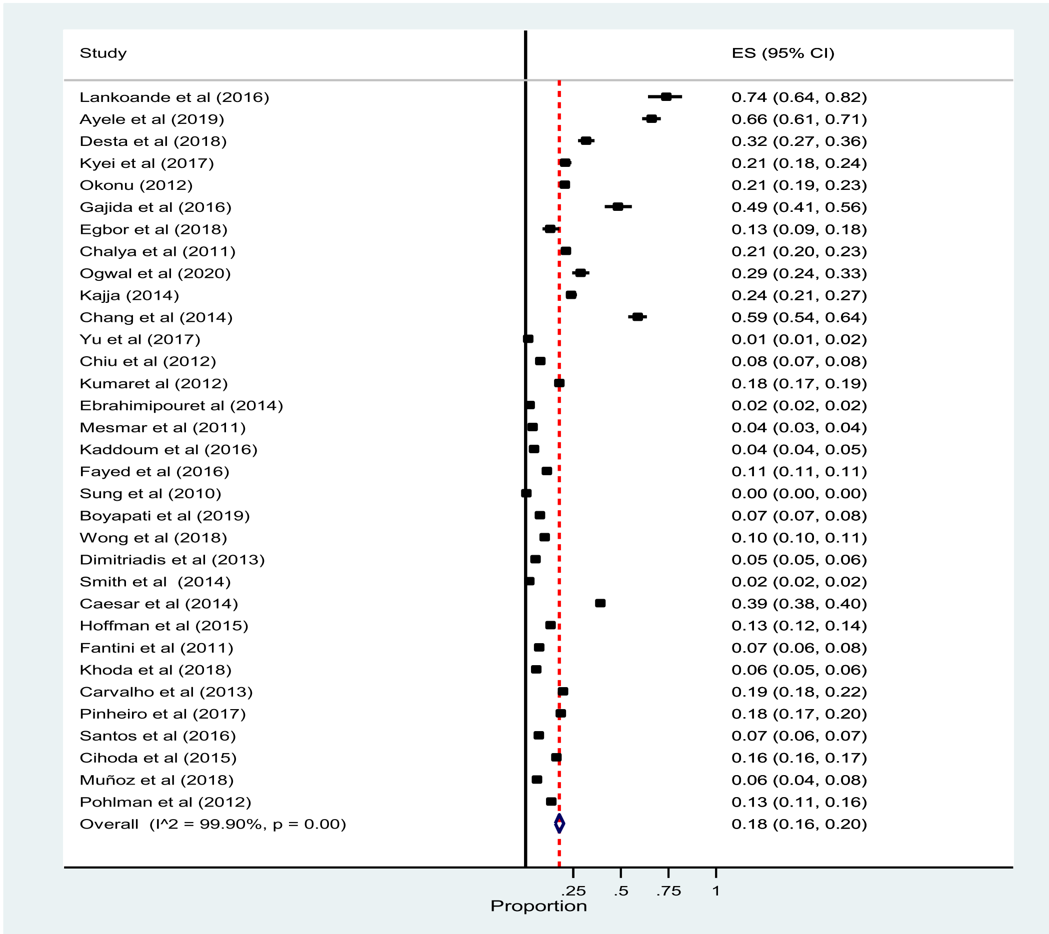

Fig. 2. Forest plot for the global prevalence of cancellation on the intended day of surgery by income level of countries: The midpoint of each line illustrates the prevalence; the horizontal line indicates the confidence interval, and the diamond shows the pooled prevalence.

The extracted data included: Author names, country, date of publication, sample size, the number of cancellation, reasons for cancellation, types of surgery, and determinants. Finally, the data were then imported for analysis in R software version 3.6.1 and STATA 14.

3.6. Assessment of methodological quality

Articles identified for retrieval were assessed by two independent Authors for methodological quality before inclusion in the review using a standardized critical appraisal Tool adapted from the Joanna Briggs Institute [48] (Supplemental Table 1). The disagreements between the Authors appraising the articles were resolved through discussion with the other Two Authors. Articles with average scores greater than fifty percent were included for data extraction.

3.7. Data analysis

Data analysis was carried out in R statistical software version 3.6.1 and STATA 14. The pooled prevalence of case cancellation on the intended day of surgery, the prevalence of main reasons of cancellation, subgroup analysis by country, continent, and types of surgery and level of income of countries of included studies were determined with a random effect model as there was substantial heterogeneity between the included studies. The Heterogeneity among the included studies was checked with forest plot, $\chi 2$ test, I^2 test, and the p-values. Subgroup analysis was conducted by Country, type of coronavirus, types of comorbidity, and complications. Publication bias was checked with a funnel plot and the objective diagnostic test was conducted with Egger's correlation, Begg's regression tests. The results were presented based on the Preferred Reporting Items for Systemic Reviews and Meta-Analysis (PRISMA).

4. Results

4.1. Selection of studies

A total of 1207 articles were identified from different databases with an initial search. Fort-eight articles were selected for evaluation after the successive screening. Thirty-three Articles with 306,635 participants were included in the systematic review and Meta-Analysis while fourteen studies were excluded with reasons [2,6,16,23,30,40,43,49–55] (Fig. 1).

4.2. Characteristics of included studies

Thirty-three studies with more than one-third of a million participants conducted to investigate prevalence and reasons for

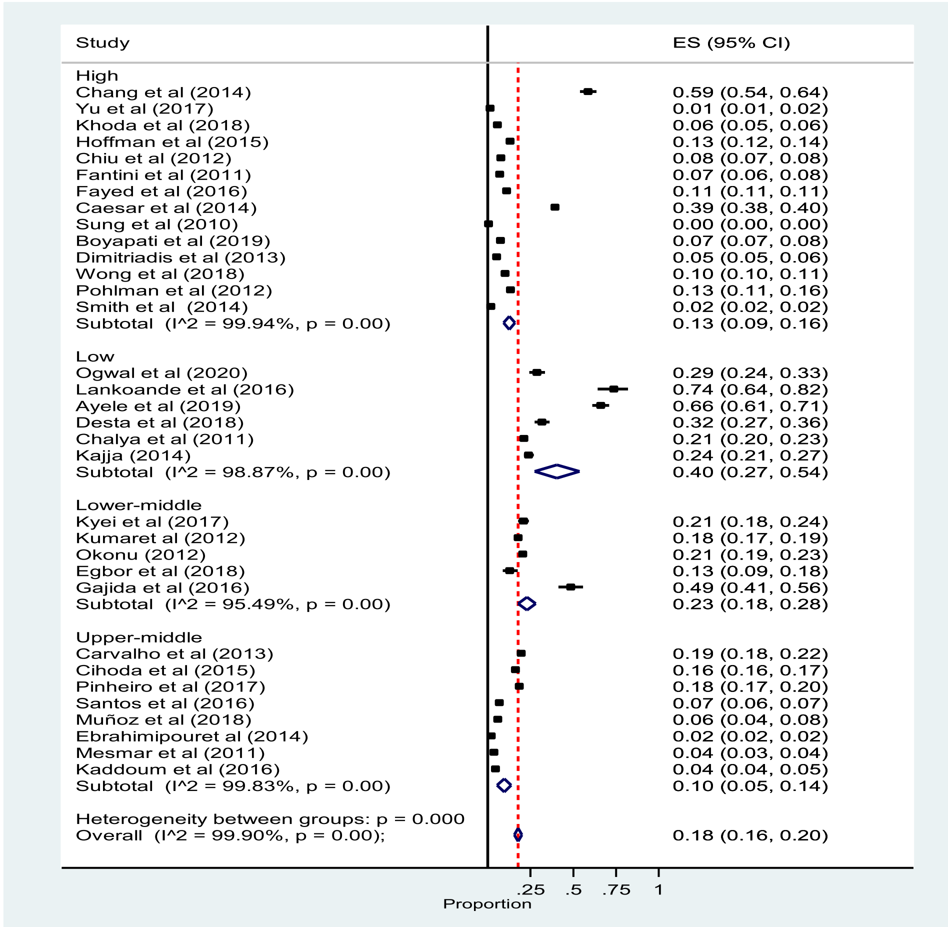

Fig. 3. Forest plot for subgroup analysis prevalence of cancellation on the intended day of surgery by income level of countries: The midpoint of each line illustrates the prevalence; the horizontal line indicates the confidence interval, and the diamond shows the pooled prevalence.

case cancellation on the intended day of surgery were included (Table 1) and fourteen studies were excluded with reasons. The methodological quality of included studies was moderate to high quality as depicted with the Joanna Briggs Appraisal tool for observational studies.

The included studies were published from 2010 to 2020 with sample size ranged from 103 to 61,815. Sixteen of the included studies were conducted in high-income countries while six, five, and eight of them were conducted in the low, lower-middle, and upper-middle-income countries.

The majority of included studies were conducted in Brazil (4 studies), United Kingdom (3 studies), and the United States of America, Ethiopia, Nigeria, and Uganda each accounted for two studies. The majority of included studies were conducted on different types of surgical specialities [27] while 2 studies were conducted on outpatient and the remaining four studies were on cardiac, orthopedics, plastic, and urological surgeries.

The majority of included studies (27 studies) were conducted in the English language while five and only one studies of the included studies were conducted in Spanish and Portuguese language respectively.

All most all of the included studies identified the possible reasons for cancellation of operation on the intended day of surgery which could be categorized as patient risk factors such as a change in medical condition(unfit for anaesthesia), patient unavailability(no-show), patient refusal to give informed consent, no attendant, financial constraint and facility-related factors which includes but not limited to insufficient bed, lack of operation time, staff unavailability, inadequate/lack of equipment and others (Fig. 2).

5. Meta-analysis

Thirty-three studies reporting prevalence and determinates of case cancellation on the intended day of surgery were incorporated in the Meta-Analysis. The Meta-Analysis was conducted with a random effect model as there was substantial heterogeneity between the included studies.

5.1. *Global prevalence of case cancellation*

The Meta-Analysis showed that the global prevalence of case cancellation on the intended day of surgery was 18% (95% CI: 16 to 20, 33 studies and 306,635 participants).

5.2. *Subgroup analysis*

5.2.1. *Level of income*

The income levels of countries were categorized based on the recent World Bank classification of countries by their economic level. The subgroup analysis showed that cancellation was the highest among low-income and lower-middle-income countries: 40% (95% CI: 27 to 54, 6 studies and 5252 participants) and 23% (95% CI: 5 to 14, 6 studies, 1547 participants) respectively (Fig. 3).

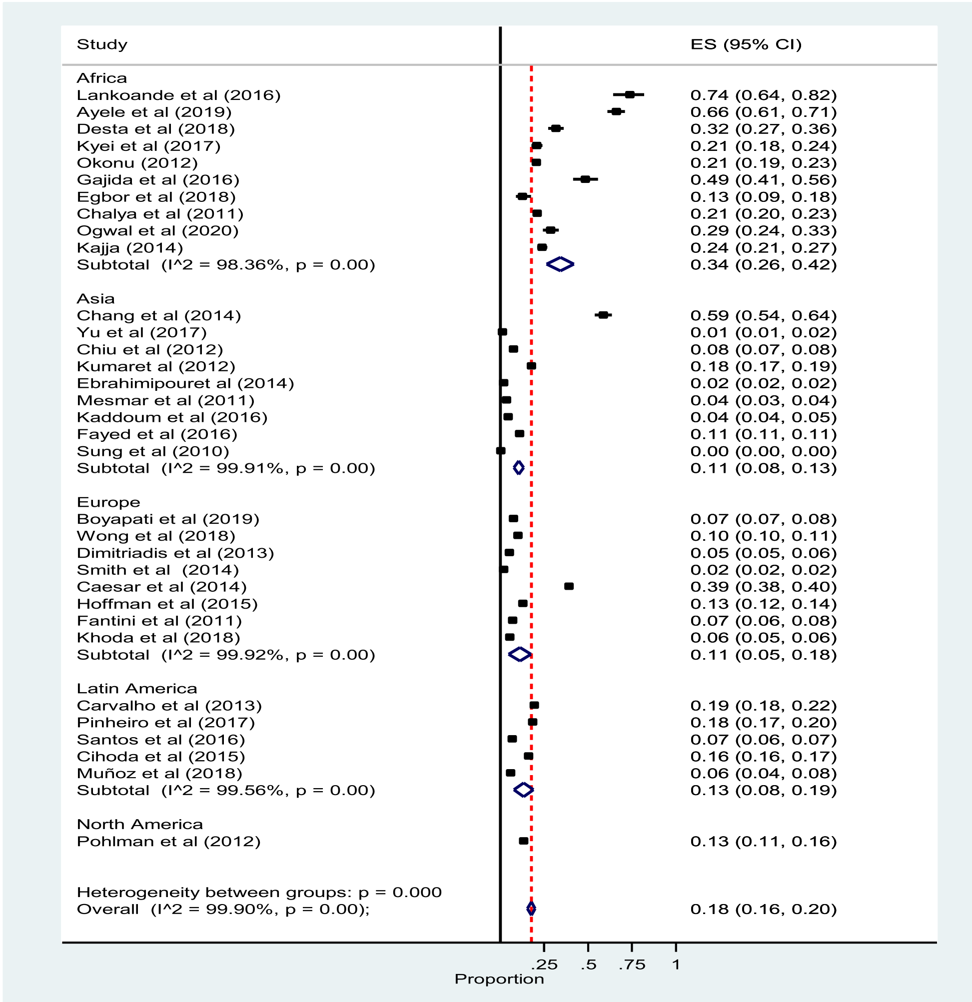

Fig. 4. Forest plot for subgroup analysis prevalence of cancellation on the intended day of surgery by income level of countries: The midpoint of each line illustrates the prevalence; the horizontal line indicates the confidence interval, and the diamond shows the pooled prevalence.

5.3. Region

The subgroup analysis revealed that the prevalence of cancellation was the highest in the African region, 34% (95% confidence interval (CI): 26 to 42, 10 studies, 7915 participants) followed by Latin America 13% (95% confidence interval (CI): 8 to 19, 5 studies, 43,237 participants) (Fig. 4). The Meta-Analysis also revealed that the prevalence of cancellation was the highest in Burkina Faso followed by Ethiopia, Uganda, Nigeria, Kenya and Brazil (Supplemental Fig. 1).

5.4. Determinants

This Meta-Analysis investigates the most common reasons from included studies to pool the independent risk factors of cancellation. The subgroup analysis revealed that lack of operation theatre facility accounted for the major cancellation, 23%(95% confidence interval(CI): 20 to 25) followed by no attendant 19% (95% confidence interval(CI): 18 to 22) and change in medical condition(unfit) 17% (95% confidence interval(CI): 12 to 23) (Fig. 5). The subgroup also showed that prevalence of cancellation was the highest among orthopaedic surgery 39% (95% confidence (CI): 38 to 40) and all general specialities 18%(95% confidence interval (CI): 16 to 20) (Supplemental Fig. 2).

5.5. Sensitivity analysis and publication bias

Sensitivity analysis was conducted to identify the most influential studies with metainf command in R and the influence of individual studies on effect estimate didn't show a significant difference.

Publication bias was investigated with funnel plot asymmetry and egger's regression, Begg's rank correlation test, and trim fill method. The trim fill showed that two large standard error studies were missed but the rank correlation test didn't show a significant difference (P-value < 0.1194) (Fig. 6).

6. Discussion

The Systematic review identified 28, 879 cancellations from a total of 306, 635 participants from 2010 up to 2020 which approximately correlates cancellation of one case on the intended day of surgery for every ten schedules globally.

The Meta-Analysis revealed that the global prevalence of case cancellation on the intended day of surgery was 18% (95% confidence interval (CI): 15 to 20). The subgroup analysis showed that the prevalence of case cancellation was the highest in low-income and upper lower-income countries and the lowest was in upper lower-income countries which are in line with individual included studies. This would be explained by limited operation theatre facilities, lack of human resources, low awareness and bad perception

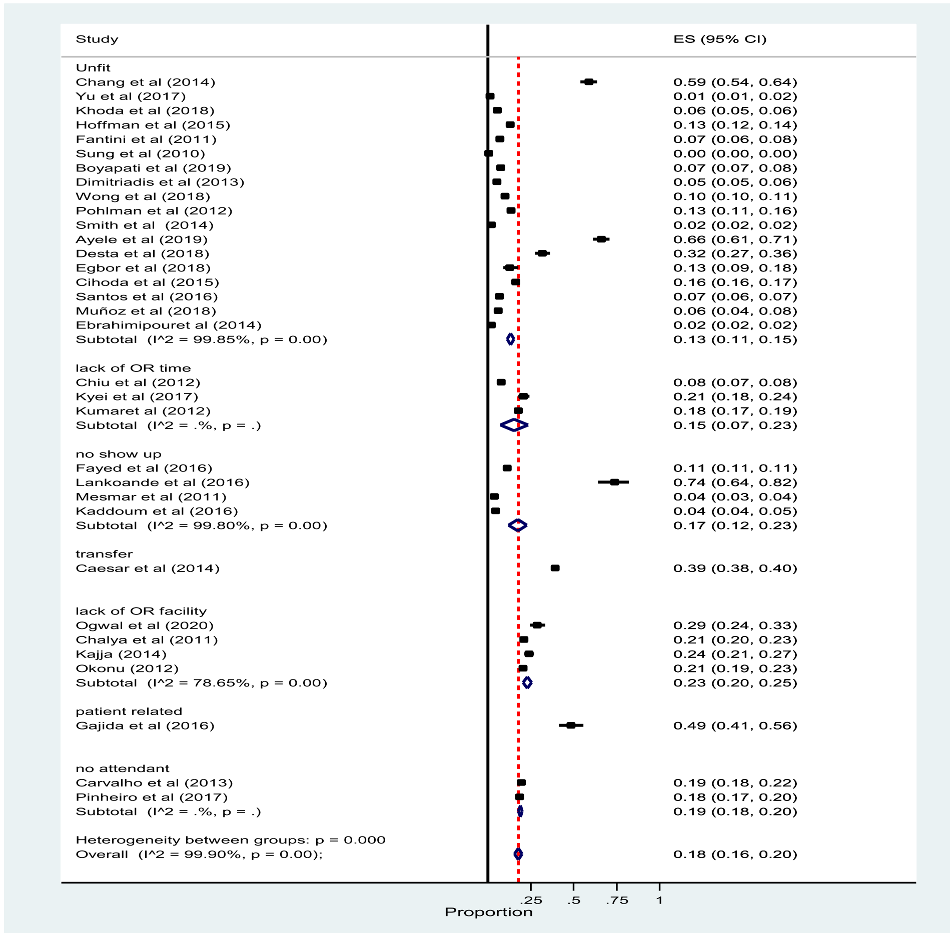

Fig. 5. Forest plot for subgroup analysis prevalence of cancellation on the intended day of surgery by income level of countries: The midpoint of each line illustrates the prevalence; the horizontal line indicates the confidence interval, and the diamond shows the pooled prevalence.

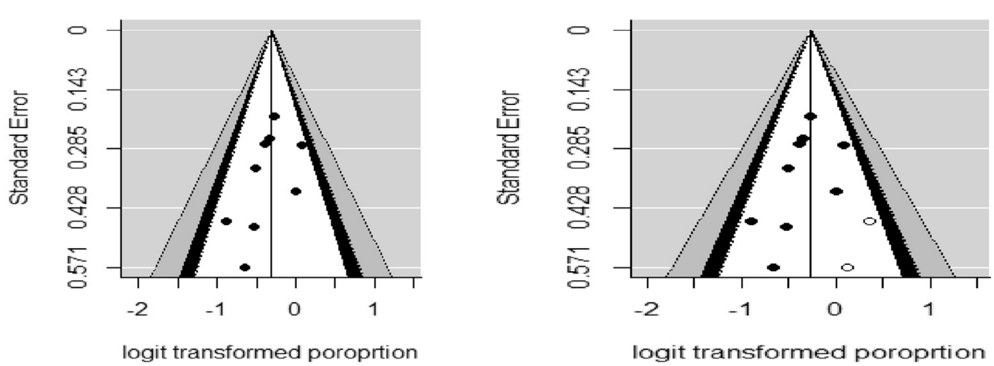

Fig. 6. Funnel and Trim Fill funnel plot showing publication bias. The vertical line indicates the effect size while the diagonal line indicates the precision of individual studies with a 95% confidence interval.

of patients towards anaesthesia and surgery, inadequate preoperative evaluation and preparation, lack of skilled professionals, lack of money for hospital charge, and others.

The subgroup analysis also showed that the prevalence of cancellation was the highest in Sub-Saharan African region [5,15,25,35,56,63] 34% (95% confidence interval (CI): 26 to 42) followed by Latin America [14,43,47,51,53,59,66] 13% (95% confidence interval (CI): 8 to 19) were Burkina Faso and Ethiopia accounted for more than fifty percent from African region [5,33].

This systematic review and Meta-Analysis revealed that the prevalence of cancellation was the highest among orthopaedic surgeries 39% (95% confidence (CI): 38 to 40). This might be due to the inclusion of a small number of studies, only one study in our case, orthopaedic surgeries demand adequate blood, fluoroscopies which is not affordable in low resources setting, takes long operation theatre time and patient refusal to amputations.

The Meta-Analysis identified the independent predictors of case cancellation. The majority of cases were cancelled because of facility-related factors including lack of equipment, insufficient bed capacity, lack of OR time, staff unavailability, and others. This finding is in line with studies conducted in Africa and Asia. The other reason for the cancellation was the change in the medical condition of the patient on the day of surgery accounted for 23% (95% confidence interval (CI): 20 to 25) which is in line with the majority of included studies.

6.1. Quality of evidence

The systematic review and meta-analysis incorporated sufficient studies with more than one-third of a million participants. The methodological quality of included studies was moderate to high quality as depicted with Joanna Briggs Institute assessment tool for meta-analysis of observational studies. However, substantial heterogeneity associated with differences in included studies in sample size, design, and location could affect the allover quality of evidence.

6.2. Limitation of the study

The review included sufficient studies with a large number of participants but the majority of studies included in this review didn't report data on risk factors to investigate the independent predictors. Besides, there were a limited number of studies in some countries and surgical specialities which would be difficult to provide conclusive evidence with results pooled from fewer studies.

6.3. Implication for practice

Body of evidence revealed that the prevalence of cancellation was very high particularly in low and middle-income countries. The major reasons for cancellations were avoidable and mainly related to financial and human resources, low awareness, and inadequate preoperative assessment and preparations. Therefore, an extenuating strategy is required by different stakeholders to avoid unnecessary cancellations through performing adequate patient evaluation and preparation, creation of awareness towards anaesthesia, mobilization of resources to the operation theatre, separation of operation room suits for each speciality, and provision of incentives to operation theatre staffs and others.

6.4. The implication for further research

The meta-analysis revealed that the prevalence case cancellation on the intended day of surgery is very high and the major reasons for case cancellation were identified. However, the included studies were too heterogeneous, and cross-sectional studies also don't show a temporal relationship between the outcome and its determinants. Therefore, further observational and multicenter studies are in demand for specific types of surgical specialities.

7. Conclusion

The meta-analysis revealed that the prevalence of case cancellation was very high particularly in low and middle-income countries. The majority of determinants of case cancellations were avoidable which entails rigorous activities on operation theatre facilities infrastructure, protocols on preoperative evaluation and preparation, patient and health care provider communications.

Ethical approval

Not applicable. The data were based on online published data.

Funding

No funding was granted for this research. The research was done by authors own resources.

Author contribution

AS and AC conceptualized, collect data, perform data analysis, interpret, writing the paper. BB and SY were acting the third Author to resolve the disagreement during appraisal and data extraction by other authors. AS, YC and BB involved in writing the manuscript, drafting the manuscript and reviewing the manuscript.

Conflict of interest statement

There is no any conflict of interest.

Guarantor

Semagn Mekonnen Abate(AS) who is the corresponding author is the guarantor.

Research registration number

The systematic review and meta-analysis was registered in submitted for registration in Prospero and they are working on it a research registry (**researchregistry5746**) and available at https://www.researchregistry.com/browse-the-registry#home/

Consent

Not applicable.

Availability of data and materials

Data and material can be available where appropriate.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijso.2020.08.006.

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