The effect of women’s body mass index on pelvic organ prolapse: a systematic review and meta analysis

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Abstract

Background: Pelvic organ prolapse remains the public health challenge globally. Existing evidences report the effect of woman’s weight on the pelvic organ prolapse inconsistently and this urges the need of pooled body weight effect on the pelvic organ prolapse. Although there was a previous work on this regard, it included papers reported before June 18/2015. Thus, updated and comprehensive evidence in this aspect is essential to devise strategies for interventions.

Objective: This review aimed at synthesizing evidence regarding the pooled effect of body weight on the pelvic organ prolapsed.

Methods: For this review, we searched all available articles through databases including PubMed, Web of Sciences, CINAHL, JBI library, Cochran library, PsycINFO and EMBASE as well as grey literature including Mednar, worldwide science, PschEXTRA and Google scholar. We included cohort, case–control, cross-sectional and experimental studies which had been reported between March 30, 2005 to March 30, 2020. In the effect analysis, we utilized random model. The heterogeneity of the studies was determined by I2 statistic and the publication bias was checked by Egger’s regression test. Searching was limited to studies reported in the English language.

Results: A total of 14 articles with 53,797 study participants were included in this systematic review (SR) and meta analysis (MA). The pooled result of this Meta analyses depict that body mass index (BMI) doesn’t have statistical significant association with pelvic organ prolapse.

Conclusion: This review point out that women’s body mass index has no significant effect on the development of pelvic organ prolapse. However, the readers should interpret the result with cautions due to the presence of considerable limitations in this work.

Trial registration The protocol of this systematic review (SR) and meta analysis (MA) has been registered in PROSPERO databases with the Registration number of CRD42020186951

Keywords: Body mass index, Meta-analysis, Obesity, Pelvic organ prolapse

Introduction

Pelvic organ prolapse (POP) is an anatomic support defect of the pelvic viscera. It may be resulted from a series of long term failure of supporting and suspension mechanisms of the uterus and the vaginal wall. The defect in the supporting structures results in downward...
displacement of structures that are normally located adjacent to the vaginal vault [1, 2].

Pelvic organ prolapsed (POP) severely affects women's quality of life in several ways. Women with POP can feel different prolapse symptoms like "something coming down" and other urinary, bowel, and sexual symptoms [3–5]. It has socioeconomic and health consequences, affecting overall health and sexual function. It has been a major gynecologic problem in developed and developing nations [4, 6, 7].

Different risk factors such as increased maternal age and parity were identified to be linked to development of POP. However, most of those factors are non-modifiable. Similarly, maternal body mass index, which is a modifiable variable, also had been mentioned to be a determinant of POP although there are inconsistent reports across studies [8, 9].

As to the authors’ best knowledge, there is limited updated information on the pooled effect of maternal body mass index (BMI) on POP. In this regard, we obtained one systematic review (SR) and meta analyses (MA) regarding the effect of obesity on POP [10]. However, its search was limited on PubMed/MEDLINE and included only papers published before June 18, 2015. We also found one related protocol which is limited to studies done in low and middle income countries. In addition, there is one review which is focused only on qualitative aspect in this aspect [11].

Thus, the current work was intended to fill these gaps. Accordingly, we included all the available published studies located in all accessible databases which had been reported between March 30/2005 to March 30/2020. By doing so, the current SR and MA come up with the evidences generated from existing studies. Thus, this review article was aimed at synthesizing the pooled effect of maternal BMI on pelvic organ prolapse globally.

Method
Protocol registration
The protocol of this SR and MA has been registered in the International Prospective Register of Systematic Reviews (PROSPERO) with the Registration number of CRD42020186951.

Reporting
The Preferred Reporting Items for Systematic reviews and meta-analysis (PRISMA) guideline was utilized to report the results of this SR and MA.

Databases and searching strategies
We searched through all available articles from PubMed using ((((("Women"[Mesh]) OR "Female"[Mesh]) AND ("Body Weight"[Mesh] OR "Weight Gain"[Mesh]) OR "Weight Loss"[Mesh]) OR ("Obesity"[Mesh] OR "Obesity, Abdominal"[Mesh] OR "Obesity, Morbid"[Mesh] OR "Obesity, Maternal"[Mesh]) OR "Thinness"[Mesh])) AND ("Pelvic Organ Prolapse"[Mesh]). We also tried to search using Web of Sciences, CINAHL, JBI library, Cochran library, PsycINFO and EMBASE databases though some of which are inaccessible. Similarly, we searched for grey literature through Mednar, worldwide science, PschEXTRA and Google scholar. In addition, we searched articles from the different institutional online research repositories and Reference lists of included studies using the following searching terms: "Body weight", "Obesity", "Pelvic organ prolapse", "Body weight gain", "POP", "uterine prolapse", "genital prolapse", "enterocele", "cystocele", "anterior wall prolapse", "rectocele" and "posterior wall prolapse" as a combination and as a single term. We have conducted the search until March 30, 2020 and back to the previous recent 15 years.

Inclusion and exclusion criteria
Articles included met the following criteria: (1) observational studies including experimental, cohort, case–control and cross-sectional, (2) published and unpublished studies which had been reported between March 30/2005 to March 30/2020, (3) studies contained the OR, RR or HR of BMI with respect to POP, and (4) Studies on POP and BMI reported in English.

However, conference papers, editorials, trials, reviews, program evaluations, and only qualitative studies and all studies which had reported only the mean effect (OR, RR or HR) of BMI with respect to POP were excluded since such results may bring about difficulty in aggregated OR interpretation (as the aggregated OR is intended to be interpreted and compared with the reference group (i.e., normal BMI)).

Outcome measurement
The outcome variable for this protocol is POP (Yes, No). All forms of prolapses reported as POP, uterine prolapse, genital prolapse, enterocele, cystocele/ anterior wall prolapse or rectocele/posterior wall prolapse were counted as an outcome. Moreover, we included prolapses which had been either subjectively self-reported symptomatic prolapse or objectively measured prolapses as indicated by ICD codes, as well as prolapse measured through pelvic exams by trained professionals for all severities of prolapse. For the ease of data aggregation, reports of Baden–Walker Halfway grading system of grade 1 or more, or Pelvic Organ Prolapse Quantification (POP-Q) system stage I or more were considered comparable.
**Study selection and quality assessment**

Primarily, all retrieved studies have been imported to Endnote version 7 citation managers. Consequently, duplicated studies were carefully removed from Endnote. Then, two independent authors screened and assessed the titles and abstracts and review the full texts. Any disagreement had been solved through discussion and communication with the primary authors of the studies. After the full text review, two investigators assessed the quality of the studies independently using the Joanna Briggs Institute (JBI) quality appraisal criteria adapted for respective study. Accordingly, studies with low risk i.e. whenever fitted to 50% and/or above quality assessment checklist criteria were included in this SR and MA.

**Data extraction**

We extracted the first author of the study, year of publication, study area, design, study population, outcome variable measure, sample size, OR of BMI 30+, OR of BMI < 18.5 and OR of BMI (25.5–29.9).

We have focused on extracting of AOR as much as possible because of its importance for having adjusted and/or controlled possible confounders. For studies with no AOR, we have also searched for COR.

**Data analysis**

A Stata version 11 statistical software was used for all statistical analysis. We used a random model for MA to
estimate the pooled OR of BMI30+, OR of BMI <18.5 and OR of BMI 25.5–29.9. We assessed the percentages of total variations across studies using $I^2$ statistics. The values of 25, 50, and 75% was represented low, moderate, and high heterogeneity respectively. Publication bias across studies was checked using Egger’s regression test.

Results
Findings and selection process
We obtained a total of 21,319 papers from all searching strategies. From these, we found about 5241 literature while we limit a searching filter date from March 30/2005 till March 30/2020. Upon filtration for duplication ($n = 343$), we selected 4898 articles. Thereafter, irrelevant studies ($n = 4832$) were removed based on the review of titles and abstracts. Among 43 articles which passed for further full-text review, about 29 articles were excluded for different reasons [3, 7–9, 12–36]. Finally, 14 articles were found relevant to assess the effect of BMI on POP (Fig. 1).

Characteristics of the included studies
About 14 studies with 53,797 study participants were included in this SR and MA. Regarding the study area of the articles; two studies in Ethiopia [37, 38], one study in Tanzania [39], one study in United Arab Emirates [40], four studies in USA [41–44], three studies in Sweden [14, 45, 46], one study in UK [47], one study in New Zealand [48], and one study in Nepal [49] were included. As far as the study design of the included articles concerned, we included seven studies case control [37–39, 43, 45, 46, 49] and the remaining seven measured subjectively [14, 40–42] (Table 1).

The effect of BMI on POP
Two studies reported the statistical significant association between BMI <18.5 kg/m² and POP [37, 38]. Likewise, five studies [41–43, 45, 48] reported that BMI of 25–29.9 kg/m² had significant association with POP. Similarly, five studies [14, 41–43, 48] presented the finding exhibiting the significant association between BMI >30 kg/m² and POP. In the MA, however, no statistical significant association is observed between each category of BMI and POP for all included articles. Similarly, the MA results depict that the pooled (overall) effect of each category of BMI on POP is statistically insignificant (Figs. 2, 3 and 4).

### Table 1 Characteristics of the include articles and their study participants

| Code | Authors       | Year       | Setting                  | Design | N     | Study population                                                       | Measurement                                |
|------|---------------|------------|--------------------------|--------|-------|------------------------------------------------------------------------|--------------------------------------------|
| 1    | Asresie et al | 2016       | Bahir Dar, Ethiopia      | CC     | 370   | Gynecologic patients (age >18 years)                                   | Stage 3 + Vs free (OM)                     |
| 2    | Elbiss et al  | 2015       | United Arab Emirates     | CC     | 429   | All 30 + aged non-pregnant parous                                     | Symptomatic (SM)                          |
| 3    | Henok A       | 2017       | Southwest Ethiopia       | CC     | 422   | All >15 years worked on firewood sales                                | Symptomatic (SM)                          |
| 4    | Masenga et al | 2018       | Kilimanjaro, Tanzania    | CC     | 1047  | Non-pregnant 18–90-year-age women                                     | Stage 2 + Vs 0–1 (OM)                     |
| 5    | Kudish et al  | 2009       | WSU, USA                 | RCT    | 16,608| Postmenopausal women with uteri aged 50 to 79                        | Stage I + (OM)                             |
| 6    | Tegerstedt et al | 2005     | Stockholm, Sweden        | CC     | 859   | All aged ≥15 years women                                              | Symptomatic (SM)                          |
| 7    | Miedel et al  | 2009       | Stockholm, Sweden        | CC     | 859   | All aged ≥15 years women                                              | Symptomatic (SM)                          |
| 8w   | Kudish et al  | 2011       | Washington DC, USA       | RCT    | 11,185| Only white people                                                      | Stage ≥ II (OM)                           |
| 8b   | Kudish et al  | 2011       | Washington DC, USA       | RCT    | 800   | Only black people                                                      | Stage ≥ II (OM)                           |
| 8h   | Kudish et al  | 2011       | Washington DC, USA       | RCT    | 665   | Only Hispanic people                                                   | Stage ≥ II (OM)                           |
| 9O   | Whitecomb et al | 2009     | Kaiser, USA              | CC     | 1137  | Middle-aged and older women                                           | Stage ≥ II (OM)                           |
| 9S   | Whitecomb et al | 2009     | Kaiser, USA              | CC     | 2270  | Middle-aged and older women                                           | Symptomatic (SM)                          |
| 9Oh  | Whitecomb et al | 2009     | Kaiser, USA              | CC     | 1137  | Middle-aged and older women                                           | ≥0 cm (hymen and beyond)                  |
| 10   | Rortveit et al| 2007       | Northern California, USA | CS     | 2001  | Age 40–69 and members of the KPMCPNC                                   | Symptomatic (SM)                          |
| 11   | Dolan et al   | 2010       | UK                       | Cohort | 1782  | Women who gave birth to their first child                             | Symptomatic (SM)                          |
| 12S  | Glazener et al| 2012       | UK and New Zealand       | Cohort | 3763  | Women gave birth 12 years back                                        | Symptomatic (SM)                          |
| 12OJ | Glazener et al| 2012       | UK and New Zealand       | Cohort | 762   | Women gave birth 12 years back                                        | ≥0 cm (hymen and beyond)                  |
| 13   | Bohlin et al  | 2017       | Sweden                   | Cohort | 7209  | Women at 1 year after primary POP surgery                              | Symptomatic (SM)                          |
| 14   | Devkota et al | 2019       | Kaski district, Nepal    | CC     | 492   | Non-pregnant 18–60 aged, with no hysterectomy                          | Stage ≥ I                                |
Discussion

This SR and MA aimed at synthesizing the pooled effect of BMI on POP occurrences. The pooled MA results indicate that BMI index has no significant association with POP. This contradicts the result of previous similar work [10]. The previous SR and MA work was included papers published June 18, 2015. On the other hand, the current work included articles published between March 30/2005 and March 30/2020. Therefore, one possible justification for the discrepancy on the effect of BMI on POP could be publication time difference across included papers. In this regard, the former study is differed from the current study on two perspectives. First, the former study had included all eligible studies published from June 18/2015 backward unlike the current study which has not included articles published March 30/2005 back. Second, the previous MA and SR study had not considered the recent studies published since June 19/2015 onwards in contrast to the current study which included papers published till March 30/2020. Over time trend, the lifestyles of people are continually changing, and BMI is tremendously sensitive to changes in life styles.

The findings of this study should be interpreted with cautions as the study has a number of limitations. First of all, there is a high heterogeneity in definition of POP and categories of BMI across included studies. In this aspect, certain studies had measured POP subjectively (symptomatic based) [38, 45, 46] while others reported objectively [37, 48, 49]. There were also variations in cut-off points in POP definitions even within

Fig. 2 Forest plot showing the effect of BMI < 18.5 kg/m² on pelvic organ prolapse
studies reported objectively ranged from stage ≥ 1 [49] to stage ≥ 3 [37]. Second, some studies reported BMI’s category exhaustively (< 18.5 kg/m², 18.5–25.5 kg/m², 25.5–29.9 kg/m² and ≥ 30 kg/m²) while others reported it in a simple way (< 18.5 kg/m², 18.5–25.5 kg/m² and ≥ 25 kg/m²). Even other else reported a single figure of the mean value of BMI. Third, some of the studies presented only its crude odds ratio unlike the rests which had included the adjusted odds ratio too. Lastly, there was a quite disparity in study participants across included studies (Fig. 3). Therefore, a non-significant association between BMI and POP in the pooled result could be attributed to the aforesaid shortcomings of this study.

Conclusion
In this SR and MA, BMI has no pooled significant association with POP. However, the readers should interpret the result with cautions due to the presence of considerable limitations in this work.
Limitations

As the categories of BMI had been reported inconsistently across literature, we forced to report the findings of these variables with some sort of variation in categories aggregately. In addition, this SR and MA might miss important related articles as some important studies had reported the findings in different way which made the data extraction difficult and the data interpretation hard.

Abbreviations

AOR: Adjusted odds ratio; BMI: Body mass index; COR: Crude odds ratio; MA: Meta analyses; POP: Pelvic organ prolapse; PROSPERO: Prospective Register of Systematic Reviews; SR: Systematic reviews; UNFPA: United Nation.

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Authors’ contributions

CBZ, WFC and MSM: have contributed to the conception and design, acquisition of the data, analysis and interpretation of data, drafting the manuscript.
critical revision of the manuscript, revised the subsequent of drafts of manu-
script. All authors read and approved the final manuscript.
ABA & TMA: have contributed to analysis and interpretation of data, critical
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Availability of data and materials
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Not applicable.

Consent for publication
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Competing interests
The authors declare that there is no competing interests.

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