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Epidemiology and Prevalence of Preterm Births: A Systematic Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Objective: The aim of this study was to explore dispersion of effect sizes regarding reported preterm births and to find out pooled prevalence estimate of preterm birth using meta-analysis.
Methods: For meta-analysis a total of 1106 published studies were initially found related to the preterm births, after careful screening 41methodologically sound studies were selected for meta analysis.
Results: In this study 41 published studies were taken with overall sample size of 6781976. Using meta-analysis the overall prevalence of preterm birth was found as 11.3% with significant erogenous results. Rosenthal method showed there exist significant publication bias in pre-term prevalence studies.
Conclusions: Based on meta-analysis results it can be evidently concluded that there exists enormous heterogeneity in pre-term prevalence reporting and the overall pooled prevalence is too high. The health care providers must focus on preventive measures and early screening of high-risk pregnancy.

Keywords: Pregnancy; gestational age; last menstrual period; dating scan; preterm birth; preterm babies.

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1. INTRODUCTION

All births within 21 days before and 14 days after 40 weeks are defined as “term” births and have the best short and long-term health outcomes and as opposed to term birth, preterm birth (PTB) defined as childbirth occurring at less than 37 completed weeks or 259 days of gestation [1]. Most preterm births are spontaneous that are related to preterm labor or preterm premature rupture of membranes (PROM). The remainder is iatrogenic that are performed because of medical or obstetrical complications that endanger the health of the mother or fetus or both.2 The prevalence of medically indicated or iatrogenic preterm birth is 25% [2]. Across 184 countries, the rate of preterm birth ranges from 5% to 18% of new born babies [3]. Almost 15 million infants are born preterm every year in all over the world. While more than 60% of preterm births occur in Sub-Saharan Africa and South Asia in some of the developed countries such as the United States of America [4]. The occurrence of preterm births rose steadily from 9.4% of all pregnancies in the developed countries in 1981 to 12.8% in 2006, before declining to 12.7% in 2007 and 12.3% in 2008 [5]. Despite of much work done in past and also being done currently, no consistency can yet be established regarding prevalence of preterm birth worldwide, as the range of the preterm birth prevalence has been reported to be as low as 1.52% [6] to as high as 41.5% [7].

We planned this to find prevalence of preterm birth in Pakistan and to determine pooled prevalence of preterm birth using meta-analysis.

2. METHODOLOGY

For systematic review and meta-analysis literature was searched out with key words “preterm birth, prematurity, prevalence and mortality in preterm birth” through Web of Science, PubMed, *e*Medicine, and Higher Education Commission of Pakistan’s digital library. Only recent, peer reviewed and methodologically sound studies were short listedfor meta-analysis. Studies with copyright or permission issues were excluded. The detailed information is presented in PRISMA flow diagram [Fig. 1]. A total of 1106 published studies were found initially that were related to the pre-term births, after careful screening 46 studies were found most relevant. Data was entered and analyzed usingMetaXL and R Language to find pooled prevalence estimate using restricted maximum likelihoodrandom effect model. I-squared statistics and Cochran's Q was also used. I^2> 75% was considered as high heterogeneity [8]. So to test the null hypothesis for all studies Cochran's *Q* (based on Chi-square distribution) was used and *p-value<0.05* was considered significant.

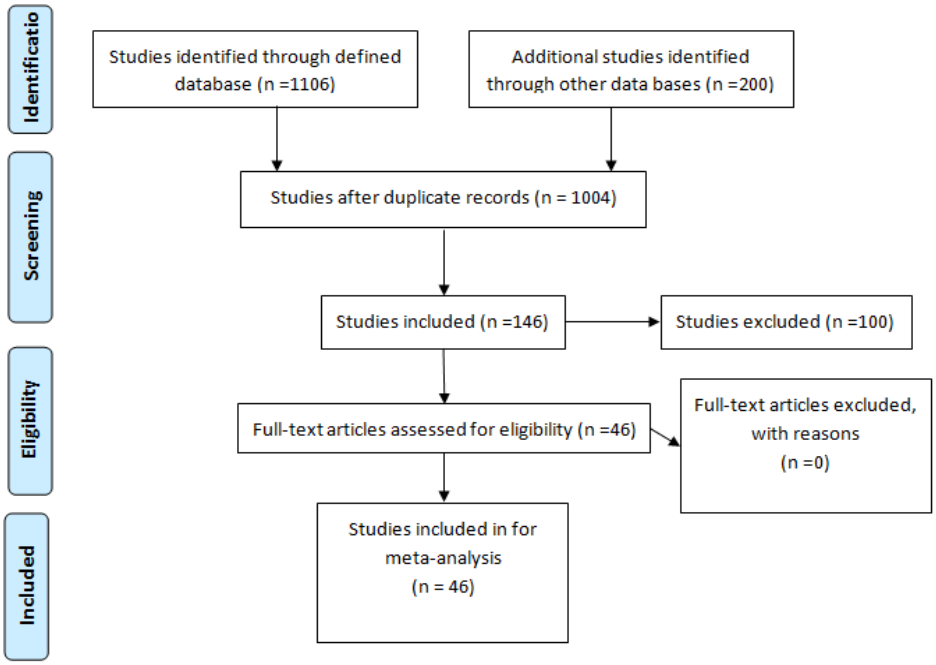

Fig. 1. PRISMA flow diagram showing flow of information through the different phases

3. RESULTS

Forty one articles were taken with overall sample of size 6781976. Using meta-analysis the overall prevalence of preterm birth was found as 12.5%.Enormous heterogeneity is observed in prevalence rates based on I-squared statistics (that was > 75%) and Cochran's Q (that was also too high). Chi-square heterogeneity test was significant P-value < 0.001. The detailed graphical description prevalence of preterm birth is given in Forest plot Fig. 2.Both Fail-safe N method and Kendall's test of funnel plot asymmetry showed significant publication bias. Publication bias is also evident from funnel plot Fig. 3.It is evident that the chance that a statistically significant result is published is higher than a statistically non-significant result. Hence, the combined prevalence might be larger than it is in reality.

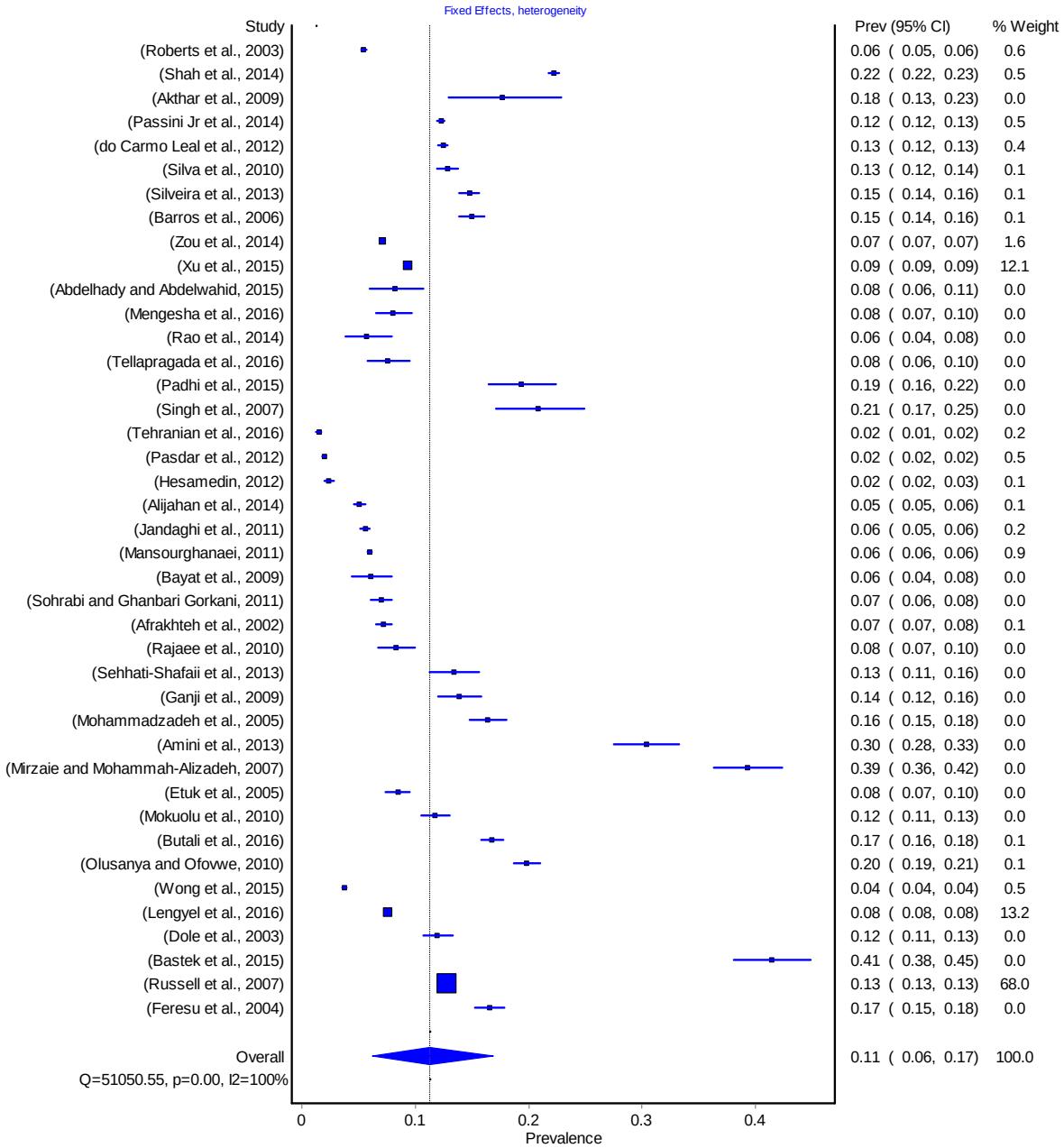

Fig. 2. Forest plot depicting prevalence of preterm birth in different studies using fixed effect heterogeneity technique

Table-1. Random-Effects Model (k = 41 studies)

	Estimate	se	Z			CI Lower Bound	CI Upper Bound
Intercept	0.125	0.0137	9.14	P< .001		0.098	0.152
Heterogeneity Statistics							
Tau	**Tau²**		**I²**	**H²**	**df**	**Q**	
0.087	0.0076	0.0017	99.99%	8592.621	40.000	70069.749	P< .001
Publication Bias Assessment							
Fail-safe N		2134687.000	P< .001	Kendall's Tau = 0.359		P< .001	

Note: Tau² Estimator: Restricted Maximum-Likelihood, Fail-safe N Calculation Using the Rosenthal Approach

Table 2. Prevalence of preterm birth in different studies

Studies	Countries	Sample Size (n)	Prevalence (%)	Weights
(Pasdar et al. 2012) [9]	Iran	32450	2	0.025
(Barros et al. 2006) [11]	Brazil	4231	15	0.025
(Shah et al. 2014) [13]	Bangladesh	32126	22.3	0.025
(Mohammadzadeh et al., 2005) [15]	Iran	1979	16.4	0.024
(Feresu et al. 2004) [17]	Zimbabwe	3103	16.6	0.024
(Zou et al. 2014) [19]	China	107905	7.1	0.025
(Amini et al., 2013) [21]	Iran	990	30.4	0.024
(Butali et al., 2016) [23]	Nigeria	5561	16.8	0.025
(Passini Jr et al. 2014) [25]	Brazil	33740	12.3	0.025
(Tehranian et al. 2016) [6]	Iran	13281	1.52	0.025
(Sohrabi and Ghanbari Gorkani, 2011) [28]	Iran	3102	7	0.025
(Tellapragada et al. 2016) [30]	India	790	7.6	0.024
(do Carmo Leal et al. 2012) [32]	Brazil	23940	12.5	0.025
(Xu et al. 2015) [33]	China	818481	9.40	0.025
(Bayat et al. 2009) [35]	Iran	720	6.1	0.024
(Silveira et al. 2013) [37]	Brazil	6109	14.8	0.025
(Hesamedin, 2012) [39]	Iran	5400	2.4	0.025
(Rao et al. 2014) [41]	India	488	5.8	0.024
(Mirzaie and Mohammah-Alizadeh, 2007) [43]	Iran	988	39.4	0.024
(Russell et al. 2007) [45]	USA	4611400	12.8	0.025
(Mengesha et al.2016) [47]	Ethiopia	1152	8.1	0.024
(Akthar et al. 2009) [10]	Bangladesh	226	17.69	0.023
(Dole et al. 2003) [12]	USA	2444	12	0.025
(Olusanya and Ofovwe, 2010) [14]	Nigeria	4314	19.9	0.025
(Padhi et al. 2015) [16]	India	670	19.4	0.024
(Lengyel et al. 2016) [18]	USA	892733	7.6	0.025
(Silva et al. 2010) [20]	Brazil	5149	12.9	0.025
(Roberts et al. 2003) [22]	Australia	37500	5.5	0.025
(Sehhati-Shafaii et al., 2013) [24]	Iran	960	13.4	0.024
(Etuk et al. 2005) [26]	Nigeria	2640	8.48	0.025
(Singh et al. 2007) [27]	India	416	20.9	0.023
(Alijahan et al. 2014) [29]	Iran	6705	5.1	0.025
(Mansourghanaei, 2011) [31]	Iran	62841	5.99	0.025
(Bastek et al. 2015) [7]	USA	817	41.5	0.024
(Jandaghi et al. 2011) [34]	Iran	10913	5.6	0.025
(Mokuolu et al. 2010) [36]	Nigeria	2589	11.8	0.025
(Rajaee et al. 2010) [38]	Iran	1117	8.3	0.024
(Ganji et al. 2009) [40]	Iran	1237	13.9	0.024
(Wong et al. 2015) [42]	USA	34630	3.80	0.025
(Abdelhady and Abdelwahid, 2015) [44]	Egypt	511	8.2	0.024
(Afrakhteh et al. 2002) [46]	Iran	5628	7.23	0.025

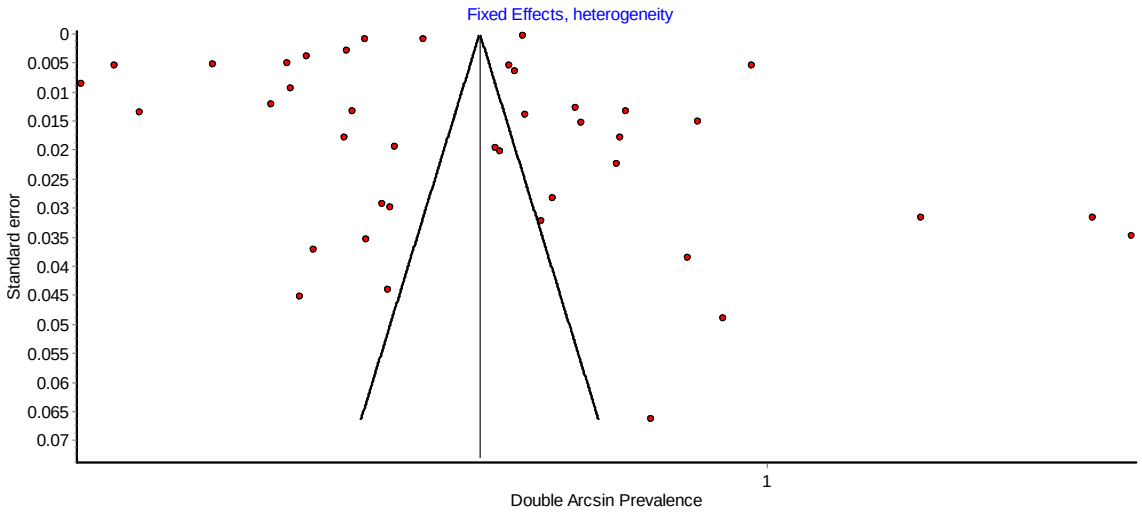

Fig. 3. Funnel plot depicting high variation in different studies using random effect heterogeneity technique

4. DISCUSSION

The prevalence is raising in all over the world because of increased frequency of multiple births due to assisted reproductive techniques (ART), more working mothers, increasing psychological stress and medically induced prematurity [48]. According to given prevalence in different studies we observe no consistency in reported prevalence of preterm birth worldwide, as the lowest and highest prevalence of PTB in recent literature is reported as 1.52% [6] and 41.5% [7] respectively. Thigh prevalence in different regions is may be due to various risk factors during pregnancy and definition of PTB. Published data from global studies are also recorded and meta-analysis for all 41 studies including the prevalence of current study was done. The overall prevalence of preterm birth across the world tends to 11.3%. This pooled statistics is greater than 5% and less than 18% that is reported among 184 countries across the world [3].

The reason of increasing prevalence of PTB may be the assessment methods of gestational age using latest techniques like ultrasonography [49]. Especial attentions must be given to minimize the risk preterm birth as there are various complications in these children. It is also measured as a major cause of neonatal death / mortality and disability / morbidity [50,51]. Of all early neonatal deaths (deaths within the first 7 days of life) that are not related to congenital malformations, 28% are due to preterm birth [52]. Infants born preterm are more likely than infants born full term to die during the neonatal period (first 28 days) and infancy (first year), and mortality rates increase proportionally with decreasing gestational age or birth weight. [53-55]. The morbidity associated with preterm birth often extends to later life, resulting in enormous physical, psychological and economic costs [56,57]. Lungs (being last organ to be developed in utero) are the most common affected organ of the baby after preterm birth. The other consequences of preterm birth are cerebral palsy, blindness (impaired vision), and developmental difficulties, including cognitive, sensory, learning and language deficits [51].

Children born preterm are more likely to have white matter brain abnormalities early on causing higher risks of cognitive dysfunction. White matter connectivity between the frontal and posterior brain regions is critical in learning to identify patterns in language. Preterm children are at a greater risk for having poor connectivity between these areas leading to learning disabilities [58]. Another most serious gastrointestinal complication affecting preterm infants is necrotizing Enterocolitis (NEC). Mortality rates for infants who develop NEC range from 15% to 30% [59,60]. Retinopathy of prematurity (ROP) is a major cause of severe visual impairment or blindness in infants born prematurely, with approximately 50,000 infants affected worldwide each year. The disease is characterized by abnormal vascular proliferation in the immature retina, likely due to the presence

of increased local reactive oxygen species and angiogenic growth factors [61]. In sum, preterm infants, particularly those who experience one or more of the complications, are at risk for neurodevelopmental disabilities such as CP, developmental delay, and mental retardation [62,63].

5. CONCLUSION

On the basis of our study we conclude that PTB is reported with huge variability but the pooled prevalence is too high. The health care providers must focus on preventive measures and early screening of high risk pregnancy. Reducing preterm birth can result in improvement of overall neonatal health and significantly reduce neonatal mortality in future.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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