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**Abbreviations:** BPD, Bronchopulmonary dysplasia; CoE, Certainty of evidence; ELBW, Extremely low birth weight; ELGANs, Extremely low gestational **RESEARCH ARTICLE** 

# ELBW and ELGAN outcomes in developing nations–Systematic review and meta-analysis

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# Abstract

# Context

Morbidity and mortality amongst extremely low birth weight (ELBW) and extremely low gestational age neonates (ELGANs) in developing nations has not been well studied.

# Objectives

Evaluate survival until discharge, short- and long-term morbidities of ELBW and ELGANs in LMICs.

# **Data sources**

CENTRAL, EMBASE, MEDLINE and Web of Science.

# **Study selection**

Prospective and retrospective observational studies were included.

# Data extraction and synthesis

Four authors extracted data independently. Random-effects meta-analysis of proportions was used to synthesize data, modified QUIPS scale to evaluate quality of studies and GRADE approach to ascertain the certainty of evidence (CoE).

# **Results**

192 studies enrolling 22,278 ELBW and 18,338 ELGANs were included. Survival was 34% (95% CI: 31% - 37%) (CoE–low) for ELBW and 39% (34% - 44%) (CoE–moderate) for

age neonates; EUGR, Extrauterine growth retardation; HICs, High income countries; IVH, Intraventricular hemorrhage; LMICs, Low- and middle-income countries; MA, Meta-analysis; NEC, Necrotising enterocolitis; NDI, Neurodevelopmental impairment; NMR, Neonatal mortality rate; PDA, Patent ductus arteriosus; PMA, Post-menstrual age; PVL, Periventricular leukomalacia; ROB, Risk of bias; ROP, Retinopathy of prematurity; SR, Systematic review; SDG, Sustainable Development Goals; VLBW, Very low birth weight. ELGANs. For ELBW neonates, the survival for low-income (LI), lower middle-income (LMI) and upper middle income (UMI) countries was 18% (11% - 28%), 28% (21% - 35%) and 39% (36% - 42%), respectively. For ELGANs, it was 13% (8% - 20%) for LI, 28% (21% - 36%) for LMI and 48% (42% - 53%) for UMI countries. There was no difference in survival between two epochs: 2000–2009 and 2010–2020. Except for necrotising enterocolitis [ELBW and ELGANs—8% (7% - 10%)] and periventricular leukomalacia [ELBW—7% (4% - 11%); ELGANs—6% (5%-7%)], rates of all other morbidities were higher compared to developed nations. Rates of neurodevelopmental impairment was 17% (7% - 34%) in ELBW neonates and 29% (23% - 37%) in ELGANs.

# Limitations

CoE was very low to low for all secondary outcomes.

#### Conclusions

Mortality and morbidity amongst ELBW and ELGANs is still a significant burden in LMICs. CoE was very low to low for all the secondary outcomes, emphasizing the need for high quality prospective cohort studies.

# **Trial registration**

PROSPERO (CRD42020222873).

# Introduction

Prematurity is one of the leading causes of childhood mortality, rates of which are on the rise across the globe [1–4]. Available data indicate that about 80% of the preterm births happen in the geographical regions of Africa and South Asia [2, 3]. When countries are grouped by their World Bank income categories, it is found that approximately 90% of all preterm births occurs in low- and middle-income countries (LMICs). The average preterm birth rate for LMICs is close to 9–12%, compared to approximately 9% for most of high-income countries (HICs) [4].

The quantum of impact on decreasing the neonatal mortality rate (NMR) is more pronounced when community based interventions targeting the late preterm and term neonates are implemented successfully across LMICs [1]. It is estimated that about 80% of neonatal deaths can be thwarted in LMICs by achieving a 95% coverage rate of simple neonatal interventions such as neonatal resuscitation, avoiding hypothermia, clean cord practices, kangaroo mother care as well as supporting breast feeding, clubbed with antenatal practices [1]. Henceforth, higher level NICU care targeting extremely low birth weight (ELBW) neonates with a birth weight of less than 1000 grams and extremely low gestational age neonates (ELGANs) born at less than 28 weeks' gestation might not be a priority as of now in many LMICs.

Every Newborn action plan by WHO envisages reducing national NMR to 12 per 1000 live births by the year 2030 [5]. Historical trends of NMR from developed nations reveal that once a NMR of 15 per 1000 live births is attained, augmenting community based health programmes with facility based neonatal care through establishment of higher level NICUs would facilitate achieving single digit NMR in LMICs [6]. Improved survival rates amongst ELBW and ELGANs in LMICs with such an approach might also be associated with increased rates of typical morbidities of prematurity, including bronchopulmonary dysplasia (BPD), retinopathy of prematurity (ROP) and long term neurodevelopmental impairment (NDI) [7–10]. While previous systematic reviews have tried to quantify the burden of mortality and morbidity in high risk neonates including preterm infants from LMICs, none have been published till date with exclusive focus on the particularly vulnerable group of ELBW neonates and ELGANs [11–13]. Assessing the burden of mortality and morbidity in these infants is vital in developing future newborn targeted health interventions and policies, especially for those LMICs that are transitioning from community based care to a facility based one. Hence, this systematic review and meta-analysis was conducted to study the survival, short- and long-term outcomes of ELGANs and ELBW neonates from LMICs.

# Methods

The protocol for the systematic review was registered with PROSPERO (CRD42020222873) [14]. The reporting of the review is in accordance with PRISMA guidelines [15].

#### Literature search

Electronic databases: MEDLINE, EMBASE, Web of Science and Cochrane CENTRAL were searched from 1<sup>st</sup> January 2000 till 21<sup>st</sup> November 2020. There were no language restrictions. Google translate (California, USA) was used for translating non-English literature. Studies published in Urdu and Persian were translated with the help of a translator as there were some limitations in Google translate for these languages. Studies published as abstracts were also eligible for inclusion. Only published data was used in this systematic review. Four authors (TA, NBS and PB, DN) conducted the literature search independently in pairs of two using Rayyan-QCRI software [16]. The search strategy for the different databases is provided in S1 Table in S1 File.

#### **Inclusion criteria**

Retrospective as well as prospective observational studies that had reported on outcomes of ELGANs (born at less than 28 weeks' of gestation) and / or ELBW neonates (birth weight of less than 1000 grams) from a LMIC as per the World Bank country classifications by income levels (2020) were eligible for inclusion [17]. Randomized controlled trials were excluded as certain ELGANs and ELBW neonates who would otherwise have been eligible for inclusion might have been excluded due to a variety of reasons such as stringent inclusion criteria, refusal of consent and presence of co-morbid conditions among others.

#### Outcomes

The primary outcome of the review was proportion of neonates who had survived until discharge. Secondary outcomes included prevalence of intraventricular hemorrhage (IVH) (> grade II) [18], periventricular leukomalacia (PVL) (any severity), necrotizing enterocolitis (NEC) (stage II or more) [19], PDA requiring surgical or medical treatment, BPD [oxygen requirement at 36 weeks' postmenstrual age (PMA)], sepsis (early onset and late onset sepsis) diagnosed based on blood culture as well as on other blood markers, ROP (any ROP, ROP stage  $\geq 2$  as per ICROP classification [20], ROP requiring laser therapy or intravitreal bevacizumab), extrauterine growth retardation (EUGR) (defined as weight less than 10<sup>th</sup> centile at 36 weeks' PMA), any NDI (as defined by authors) and cerebral palsy of any severity, both assessed at 18–24 months' corrected age.

#### Risk of bias (ROB) assessment

The risk of bias assessment was done using a modified QUIPS scale [21]. Four parameters namely, representativeness of the sample, definition and assessment of the outcomes, evaluation of baseline characteristics of the enrolled subjects known to affect the outcomes and method of data collection were evaluated. Studies that had satisfied all the four criteria were classified as having a low risk of bias. Those fulfilling two or three criteria were adjudged as having an intermediate risk of bias and those satisfying one or none were classified as high risk of bias studies. Two authors (TA, NBS) evaluated the risk of bias independently. Disagreements were resolved by consulting a third author (VVR).

#### Data collection and synthesis

The data for relevant outcomes were extracted using a pre-specified proforma by two authors independently (PB, DN). Statistical analysis was done using the R-Software. Meta-analysis of proportions was used for synthesis of data. Raw data was used if the proportions were between 0.20 to 0.80. Otherwise, data was logit transformed. Freeman-Tukey Double arcsine transformation of data was preferred over logit transformation when there were many proportions with 0 or 1 values. 'Metaprop' package in R-software was used for meta-analysis of proportions. 'Metaprop' can analysis meta-analysis of raw data based on proportions as well as convert raw data to logit transformation or Freeman-Tukey Double arcsine transformation and re-transform to proportions by default for meaningful interpretation. A random effects model was chosen as significant heterogeneity was anticipated as reported in prior studies on newborn survival [22]. An inverse variance method was chosen with DerSimonian Liard estimator being used for assessing between study variance [23]. The final estimates were expressed as proportions with 95% confidence interval.

#### Certainty of evidence (CoE) assessment

CoE was assessed using a modified GRADE approach [24]. Outcomes from prospective studies started as high quality evidence and other type of studies as low. The parameters of risk of bias, inconsistency, imprecision, indirectness and publication bias were evaluated for downgrading the evidence further. I<sup>2</sup> value was used to adjudge significant heterogeneity. Imprecision was evaluated based on the point estimate and the 95% confidence interval. If these were to cross a decision threshold to intervene, the CoE was downgraded by one level for imprecision. Though publication bias assessment in meta-analysis of prognosis studies is a contentious topic, we assessed publication bias using funnel plots and Begg's rank test based on GRADE working group guidelines [24, 25].

#### Sensitivity analyses

The following sensitivity analyses were performed for the primary outcome

- Categorizing studies from countries based on three income levels-low income (LI), lower middle-income (LMI) and upper middle-income (UMI).
- Categorizing studies based on geographical regions where they are situated.
- Excluding studies with low sample size (less than 50 subjects).
- Comparison of survival between two time periods—epoch 1: 2000–2009 and epoch 2: 2010–2019.
- Analyzing studies which had evaluated neonates with varying baseline sickness.



#### Fig 1. PRISMA flow.

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#### Results

A total of 21,535 studies were identified from the literature search, of which 2157 full texts were assessed for eligibility after removal of duplicates as well as title, abstract screening and 192 studies (ELBW neonates– 22,278; ELGANs– 18,338) were included in the final synthesis (S1 File references 1–192). The PRISMA flow is given in Fig 1. Ninety-two studies with 13,667 ELBW and sixty studies enrolling 8,412 ELGANs had reported on the primary outcome measure of survival until discharge. The included studies were predominantly from middle-income countries. Studies from twenty-four countries situated in six geographical regions namely, Asia, Africa, Europe, Middle East, North America and South America had reported on survival for ELGANs. Similarly, studies from thirty-one countries located in seven different geographical regions (aforementioned regions along with Caribbean) had reported on survival

for ELBW neonates. There was a preponderance of studies published from Brazil, China, India, Iran and South Africa. The denominator of the primary outcome measure (live births versus NICU admissions) and level of NICU care were inconsistently reported. Only five studies with 273 ELGANs and ELBW neonates had assessed the long-term neurodevelopmental outcomes at 24 months' corrected age. The characteristics of included studies is given in Table 1.

# **Risk of bias**

52 studies had a high risk of bias, 131 studies had an intermediate risk of bias and only 7 studies had a low risk of bias. Risk of bias was unclear in two studies. Only 31 studies had described the baseline characteristics of the neonates known to affect the survival and other morbidities such as receipt of antenatal corticosteroids, gender, small for gestational age (SGA) Status, Apgar scores and Level of NICU care. 83 studies had a prospective study design. The risk of bias of included studies is given in S2 Table in S1 File.

#### **Primary outcome**

**1a. Survival until discharge for ELBW neonates.** The overall survival was 34% (95% CI: 31% - 37%). There was significant heterogeneity in the survival rates between studies. Subgroup analysis to address the heterogeneity was done by analyzing studies based on the income status, region and country of origin. While there were widely varying survival rates between countries of similar economic status as well as region of origin, it was much lesser when studies were analyzed according to the country of origin.

For ELBW neonates, the survival for LI, LMI and UMI countries was 18% (11% - 28%), 28% (21% - 35%) and 39% (36% - 42%), respectively (S1 and S2 Figs in S1 File). While most of the countries from the African subcontinent had a survival rate of less than 20%, single center studies from Benin, Eritrea, South Africa and Tanzania reported better survival rates of more than 40% for ELBW neonates. While single center studies from China and India had reported survival rates of more than 60%, it was much lesser from the other Asian countries. While the countries from South America had a reported survival of 39% - 48%, the only middle-income country from North America, Mexico had a survival rate of 43% (37% - 49%). Amongst the countries from the Middle East, Turkey had the highest survival rate of 43% (31% - 57%). Country-wise survival outcomes for ELBW neonates is given in Fig 2. Publication bias was detected for this outcome (S3 Fig in S1 File)

**1b. Survival until discharge for ELGANs.** Survival until discharge was 39% (34% - 44%). It was 13% (8% - 20%) for LI, 28% (21% - 36%) for LMI and 48% (42% - 53%) for UMI countries. Similar to ELBW survival, there was considerable variation between countries of similar economic classification and geographic region (S4-S6 Figs in S1 File) Single-center outlier studies from Benin, China, South Africa, Thailand and Turkey had reported relatively higher survival of more than 60% when compared to other countries (Fig 3). The survival as assessed by synthesizing data from multiple studies was highest in China [61% (53% - 68%)].

#### Secondary outcomes

**Short-term and long-term neurological outcomes.** *2a. Severe IVH and PVL.* The rate of severe IVH and PVL in ELBW neonates was 14% (9% - 20%) and 7% (4% - 11%), respectively. For ELGANs, while the overall rate of severe IVH was 14% (11% - 19%). it was 6% (5% - 7%) for PVL (S7-S11 Figs in S1 File).

2b. CP and NDI assessed at 24 months' corrected age. Only one study had reported NDI outcome for ELBW neonates which was 17% (7% - 34%). Meta-analysis of five studies revealed a

#### Table 1. Characteristics of included studies.

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AladendNameRandelNameFuelFuelSectionSectionAladachar)Midde atIradUIBidN205-2010SiGAN-3.2.E.W.17Alamamiral OriginaMide atIradUISiGANSiGAN-3.2.E.W.17Anadar)AricaNigrinaInfantSiGANSiGANSiGAN-3.2.E.W.17AnadariginaAricaNigrinaInfantSiGANSiGAN-3.2.E.W.17SiGAN-3.2.E.W.17AnadariginaMide atTraceInfantSiGANSiGAN-3.2.E.W.17SiGAN-3.2.E.W.17AnadariginaMide atTraceVIVISiGANSiGAN-3.2.E.W.17AnadariginaMide atTraceVISiGANSiGAN-3.2.E.W.17SiGAN-3.2.E.W.17AnadariginaMide atTraceVIVISiGAN-3.2.E.W.17SiGAN-3.2.E.W.17AnadariginaMide atTraceVIVISiGAN-3.2.E.W.17SiGAN-3.2.E.W.17AnadariginaMide atTraceVIVIVISiGAN-3.2.E.W.17AnadariginaMide atNiVIVISiGAN-3.2.E.W.17SiGAN-3.2.E.W.17AnadariginaMide atNiVIVIVISiGAN-3.2.E.W.17BalarotaAricaSiGAN-3.2.E.W.17VIVISiGAN-3.2.E.W.17BalarotaAricaSiGAN-3.2.E.W.17VISiGAN-3.2.E.W.17SiGAN-3.2.E.W.17BalarotaAricaSiGAN-3.2.E.W.17VISiGAN-3.2.E.W.17SiGAN-3.2.E.W.17BalarotaMide at	Ali 2019	Asia	Pakistan	LMI	ELBW	2016-2017	200
Alizade 2015Midde EastInqnUMIBoh2008-2010EIGAN-32, ELBW-17Altamemi2019Mide EastInqUATELBW203-200832Amadi 2019AfricaNigeriaLATELBW201-20142Andegiorgia AccoAfricaNigeriaLATELBW201-20142AnadezonaAfricaFarkenUATELBW2016-002Araz-Ersan 2014Midde EastTarkenUMIELBW1992-199516.GAN-32, ELBW-10AnadezonaMidde EastTarkenUMIELBW1992-199516.GAN-32, ELBW-10Anady 2014Midde EastTarkenUMIELBW2002-20060516.GAN-37, ELBW-31Anasy2003Midde EastIndiaUMIELBW2002-20060516.GAN-37, ELBW-31Assey2003AsiaIndiaUMIELBW2002-20060516.GAN-37, ELBW-31Balo 2012AsiaIndiaUMIELBW2002-20060516.GAN-37, ELBW-31Balo 2012AsiaIndiaUMIELBW2002-20060516.GAN-37, ELBW-31Balo 2012AsiaIndiaUMIELBW2002-20060516.GAN-37, ELBW-31Balo 2012AsiaIndiaUMIELBW2002-20060516.GAN-37, ELBW-31Balo 2012AsiaIndiaUMIELBW2002-200616.GAN-37, ELBW-31Balo 2012AsiaSouth AriaUMIELBW2012-201616.GAN-	Ali 2016	Asia	Bangladesh	LMI	ELBW	2013-2014	113
Altanemi2019Midde EastInqUMIELBW2003-00932Amad2015AfricaNigeriaLAIELGANNA15Amad2015AfricaNigeriaLAIELGAN201-0142Andejorgish2020AfricaFireaJDentoPale-010ELGAN-38,LBW-410Araz-Ens2013Midde EastTurkyUMIELBW1990-2000ELGAN-32,LBW-410Analy2014Midde EastTurkyUMIELBW1997-000ELGAN-37,LBW-13Alasy2030Midde EastTurkyUMIELBW2002-007143-00-007Baljo200AriaIndiaLMIELBW2002-007143-00-007Baljo201AfricaSouth AfricaUMIELBW2003-00756-00-007Ballo2017AfricaSouth AfricaUMIELBW2013-00156-00-007Ballo2017AfricaSouth AfricaUMIELBW2013-00156-00-007Ballo2017AfricaSouth AfricaUMIELBW2013-001ELGAN-53,LEBW-10-00-00-00Ballo2017AfricaSouth AfricaUMIELBW2013-001ELGAN-54,LEBW-50-00-00Ballo2017AfricaSouth AfricaUMIELBW201-2013ELGAN-54,LEBW-50-00-00-00Ballo2017Midde EastTurkyUMIELBW201-2014ELGAN-54,LEBW-50-00-00-00Ballo2017Midde EastTurkyUMIELBW201-2014ELGAN-54,LEBW-50-00-00-00Ballo2017Midde East	Alizadeh 2015	Middle East	Iran	UMI	Both	2005-2010	ELGAN-32, ELBW-17
Amal2019AfricaNigeriaIATIFIGANNA15Amal2015AfriaNigriaIAIELBW201-201422AnadgiorgiA202AfridTurkeyUMIBoth1996-2010ELGAN-283, ELBW-410Arachersan2013Midde EatTurkeyUMIELBW1992-1995ELGAN-283, ELBW-410Arady 2010Midde EatTurkeyUMIELBW1992-1995ELBW-3Alaby 2013Midde EatTurkeyUMIELBW2002-000ELBW-3Alaby 2014South AmeriaBallUMIELBW2002-200305Baji 2020South AmeriaUMIELBW2002-2003536Baji 2021AfricaSouth AfriaUMIELBW2006-200755Ballo 2017AfricaSouth AfriaUMIELBW2006-200755Ballo 2017AfricaSouth AfriaUMIELBW2006-200755Ballo 2017AfricaSouth AfriaUMIELBW2012-201ELGAN-153, ELBW-160Ballo 2017AfrideSouth AfriaUMIBoth2012-201ELGAN-163, ELGAN-153, ELBW-160Ballo 2017AfrideSouth AfriaUMIBoth2012-201ELGAN-163, ELGAN-163, ELGAN-163, ELGAN-163, ELGAN-163, ELGAN-164, ELG	Altamemmi 2019	Middle East	Iraq	UMI	ELBW	2003-2008	32
Amad2015AfricaNigeriaLMIELBW201-201422Andegrogh 2020AfricaFirreaUMELBW216A2Arac-rsan 2014AfricaSouth AfricaUMELBW1992-100ELGAN-283,ELBW-101Aracl-san 2014Middle SatTurkyUMELBW1992-100ELGAN-283,ELBW-101Arady 2013Middle SatTurkyUMELBW2010ELGAN-37,ELBW-310Arasy 2003Middle SatGrafuUMELBW2002-2006363Arasy 2004South ArricaSuffaUMELBW2002-2007376.ELGAN-37,ELBW-310Arasy 2005AfricaSouth AfricaUMELBW2002-2007376.ELGAN-37,ELBW-310Ballo 2012AfricaSouth AfricaUMELBW2002-2007376.ELGAN-37,ELBW-320Ballo 2012AfricaSouth AfricaUMELBW201-2013ELGAN-37,ELBW-320Ballo 2012AfricaSouth AfricaUMELBW201-2014ELGAN-37,ELBW-320Ballo 2014AfricaSouth AfricaUMELBW201-2014ELGAN-37,ELBW-320Ballo 2014AfricaSouth AfricaUMELBW201-2014ELGAN-36,ELBW-30Ballo 2014AfricaSouth AfricaUMBoth201-2014ELGAN-36,ELBW-30Ballo 2014AfricaSouth AfricaIAGMIAGMIAGMIAGM-46,ELBW-30Ballo 2014AfricaIAGMIAGMIAGMIAGM-46,ELBW-30IAGM-46,ELBW-30 <td>Amadi 2019</td> <td>Africa</td> <td>Nigeria</td> <td>LMI</td> <td>ELGAN</td> <td>NA</td> <td>15</td>	Amadi 2019	Africa	Nigeria	LMI	ELGAN	NA	15
Andegiophi 2020AfricaErimeII of andELBW20162 (2 c A)Araci-San 2013Midule atVarkyUM1Boh1992-199518Arady 2013Midule AtVarkyUM1ELBW1902-109518/10-10Ataly 2013Midule AtVarkyUM1Boh1997-200416/10-10-10Atasy 2034Midule AtVarkyUM1BuhW2002-200605/2-10-10Azerelo Cardoso 2013South AfricaMalIM1ELBW2002-200605/2-10-10Balja 202AfricaSouth AfricaUM1ELBW2002-200605/2-10-10Baldo 2017AfricaSouth AfricaUM1ELBW2006-200705/2-10-10Baldo 2017AfricaSouth AfricaUM1ELBW2013-201636/2-0-10-10Baldo 2017AfricaSouth AfricaUM1Both2012-201336/2-0-10-10Baldo 2017AfricaSouth AfricaUM1Both2012-01ELGAN-357, ELBW-30-10-10Baldo 2017AfridaSouth AfricaUM1Both2012-01ELGAN-359, ELBW-30-10-10Basi 2015Midde EatInfaUM1Both2012-01ELGAN-45, ELBW-30-10-10Basi 2015AfridaInfaUM1Both2012-01ELGAN-45, ELBW-30-10-10Basi 2015AfridaInfaUM1Both2012-01ELGAN-45, ELBW-30-10-10Basi 2015AfridaInfaUM1ELBW2012-01ELGAN-45, ELBW-30-10-10 <t< td=""><td>Amadi2015</td><td>Africa</td><td>Nigeria</td><td>LMI</td><td>ELBW</td><td>2011-2014</td><td>22</td></t<>	Amadi2015	Africa	Nigeria	LMI	ELBW	2011-2014	22
Arac-Ersan 2013Middle EastTurkeyUMIBoth1996-2010ELGAN-283, ELBW-410Arnalo 2010AfricaSouth AfricaUMIELBW1902-10918Atalay 2013Middle EastTurkyuUMIBufh1997-2000ELGAN-37, ELBW-31Atasy 2003South ArneraBrafuUMIBLBW2010-2005365Baja 2020AiraSouth AfricaUMIELBW2002-2007143Ballo 2012AricaSouth AfricaUMIELBW2006-2007143Ballo 2012AfricaSouth AfricaUMIELBW2006-2007143Ballo 2017AfricaSouth AfricaUMIELBW2006-2007143Ballo 2017AfricaSouth AfricaUMIELBW2013-201656Ballo 2017AfricaSouth AfricaUMIBufh2016-2017ELGAN-373, ELBW-301Ballo 2018Middle EastTurkyuUMIBoth2016-2017ELGAN-453, ELBW-401Ballo 2013Middle EastIrakyuUMIBoth2012-2018ELGAN-46, ELBW-51Basz 2008AfridaIrakyuUMIBoth2012-2018ELGAN-46, ELBW-51Basz 2015Middle EastIrakyuUMIBoth2012-2014ELGAN-46, ELBW-51Basz 2016AfridaIrakyuUMIBoth2012-2014ELGAN-46, ELBW-51Basz 2018AfridaIrakyuUMIBoth2012-2014ELGAN-46, ELBW-51Basz 2015Sout	Andegiorgish 2020	Africa	Eritrea	LI	ELBW	2016	22
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Atalay 2013Middle EastTurkeyUMIELBW2010ELBW-20Atasy 2003Middle EastTurkeyUMIFLBW1997-2010ELGAN-37, ELBW-31Azeredo Cardoso 2013South AmeraIndiaIMIELBW2002-2006305Bajaj 2020AáraNataUMIELBW2007-201997Ballo 2010AfricaSouth AfricaUMIELBW2006-200795Ballo 2012AfricaSouth AfricaUMIELBW2013-2016346Ballo 2013AfricaSouth AfricaUMIELBW2013-201634Ballo 2014AfricaSouth AfricaUMIBoth2014-2017ELGAN-373, ELBW-310Ballo 2015Middle EastTurkeyUMIBoth2015-2017ELGAN-45, ELBW-410Bas 2015Middle EastTurkeyUMIBoth2016-2017ELGAN-45, ELBW-410Bas 2016Middle EastIndiaIMIBoth2012-2014ELGAN-45, ELBW-310Bas 2015Middle EastIndiaIMIBoth2012-2014ELGAN-46, ELBW-310Bas 2016AfricaIndiaIMIBoth2012-2014ELGAN-46, ELBW-310Bas 2015AfricaIndiaIMIELBW2012-2014ELGAN-45, ELBW-310Bothard2016South AmeraBraziUMIELBW2012-2014ELGAN-46, ELBW-31Bothard2015AfricaIndiaIMIILGANILGAN-32, ELBW-310ILGAN-32, ELBW-31Bothard2016<	Arnold 2010	Africa	South Africa	UMI	ELBW	1992-1995	18
Atasay2004Middle EastTurkeyUMIBoth1997-2000ELGAN-3F, ELBW-31Azeredo Cardoso 2013South ArricoMIGELBW2002-2006305Bajaj 2020AfricaIonaUMIELBW2002-2006143Ballor 2010AfricaSouth ArricoUMIELBW2006-2007143Ballor 2010AfricaSouth ArricoUMIELBW2008-2007153Ballor 2017AfricaSouth ArricoUMIELBW2018-2016164Ballor 2017Middle EastSouth ArricoUMIBoth2011-2013164Bas 2015Middle EastTurkeyUMIBoth2012-2013ELGAN-373, ELBW-64Bas 2015Middle EastTurkeyUMIBoth2012-2013ELGAN-48, ELBW-64Bas 2015Middle EastIndexUMIBoth2012-2013ELGAN-48, ELBW-64Bas 2015Middle EastIndexUMIBoth2012-2014ELGAN-48, ELBW-64Bas 2015Middle EastIndexUMIBoth2012-2014ELGAN-48, ELBW-64Bas 2015Middle EastIndexUMIBoth2012-2014ELGAN-48, ELBW-64Bas 2015Middle EastIndexIndexIndexIndexIndex-18, ELGAN-48, ELBW-64Bas 2015Middle EastIndexIndexIndexIndexIndex-18, ELGAN-48, ELBW-64Bas 2015Middle EastIndexIndexIndexIndexIndex-18, ELGAN-48, ELBW-64<	Atalay 2013	Middle East	Turkey	UMI	ELBW	2010	ELBW-20
Azerdo Cardoso 2013South AmeriaBrailUMIELBW2002-2006305Baja 2020AsiaIndiaIAIGAELBW2017-01997Balto 2010AfricaSouth AfricaUMIELBW2006-2007143Balto 2017AfricaSouth AfricaUMIELBW2013-01654Balto 2017AfricaSouth AfricaUMIELBW2013-01654Balto 2017AfricaSouth AfricaUMIELBW2013-01654Balto 2017AfricaSouth AfricaUMIButh2012-017ELGAN-373, ELBW-64Basi 2015Midde EasTurkeyUMIBoth2012-013ELGAN-373, ELBW-64Basi 2015Midde EasInauUMIBoth2012-013ELGAN-373, ELBW-64Basi 2016Midde EasInauUMIBoth2012-013ELGAN-153, ELBW-164Basi 2015Midde EasIndiaLMIBoth2012-013ELGAN-164, ELBW-36Basi 2015AisaIndiaLMIBoth2012-013ELGAN-164, ELBW-36Bohad 2016Midde EasIndiaIMIELBW2012-01359Bothou 2017South ArricaIndiaMIELBW2012-013ELGAN-26, ELBW-36Bohad 2017South ArricaIndiaIMIELBW2012-013ELGAN-26, ELBW-36Bothou 2017South ArricaIndiaIMIELBW2012-013ELGAN-26, ELBW-36Bothou 2017South ArricaIndia <td>Atasay2003</td> <td>Middle East</td> <td>Turkey</td> <td>UMI</td> <td>Both</td> <td>1997-2000</td> <td>ELGAN-37, ELBW-31</td>	Atasay2003	Middle East	Turkey	UMI	Both	1997-2000	ELGAN-37, ELBW-31
Baja 2020AsiaIndiaIMIEMPEMP2017-201997Ballo 2010AfricaSudnáriaUMELBW206-207014.3Ballo 2012AfricaSudnáriaUMELBW206-20709Ballo 2014AfricaSudnáriaUMELBW206-207054Ballo 2017AfricaSudnáriaUMELBW2012-01054Balo 2017MidlesaTarkyUMBulo211-013ELGN-375,ELBW-64Bas 2015MidlesaInaUMBoh216-2017ELGN-375,ELBW-64Bas 2015MidlesaInaUMBoh216-2018ELGN-452,ELBW-64Bas 2015MidlesaInaUMBoh212-2013ELGN-452,ELBW-64Bas 2016MidlesaInaMidlesaInaBoh212-2013ELGN-452,ELBW-64Bas 2015MidlesaInaMidlesaInaMidlesaELGN212-2013ELGN-452,ELBW-64Bas 2016MidlesaInaMidlesaInaMidlesaELGN212-2013ELGN-452,ELBW-64Bas 2017Sub AfricaInaMidlesaInaMidlesaELGN212-2013ELGN-452,ELBW-64Bas 2017Sub AfricaMidlesaInaMidlesaInaMidlesaInaELGN212-2014ELGN-452,ELBW-64Bas 2017Sub AfricaMidlesaMidlesaMidlesaMidlesaInaMidlesaInaInaBas 2017Sub AfricaMidl	Azeredo Cardoso 2013	South America	Brazil	UMI	ELBW	2002-2006	305
Balor 2010AfricaSouth AfricaUMIELBW2006-2007143Balor 2012AfricaSouth AfricaUMIELBW2005-200795Balor 2017AfricaSouth AfricaUMIELBW2013-00054GBalor 2017Midle EasTurkyUMIBalor2013-000ELGN-375, ELBW-36Bas 2015Midle EasTurkyUMIBoh2012-010ELGN-375, ELBW-36Bas 2015Midle EasTurkyUMIBoh2012-010ELGN-46, ELBW-46Bas 2015Midle EasInfanUMIBoh2012-010ELGN-46, ELBW-46Bas 2015Midle EasInfanUMIBoh2012-010ELGN-46, ELBW-46Bas 2015Midle EasInfanUMIBoh2012-010ELGN-46, ELBW-46Bas 2015Midle EasInfanUMIELBW2012-013ELGN-46, ELBW-46Bas 2015Midle EasInfanUMIELBW2012-013ELGN-46, ELBW-46Bas 2015Midle EasInfanUMIELGN2012-013ELGN-46, ELBW-46Bas 2015Saude EasMidle EasInfanELGN-46, ELBW-46ELGN-46, ELBW-46Bas 2015Midle EasInfanUMIELGN2012-013ELGN-46, ELBW-46Bas 2015Saude EasMidle EasInfanELGN-46, ELBW-46ELGN-46, ELBW-46Bas 2015Saude EasMidle EasInfanELGN-46, ELBW-46ELGN-46, ELBW-46Bas 2015Saude EasMidle Eas <td>Bajaj 2020</td> <td>Asia</td> <td>India</td> <td>LMI</td> <td>ELBW</td> <td>2017-2019</td> <td>97</td>	Bajaj 2020	Asia	India	LMI	ELBW	2017-2019	97
Ballot 2012AfricaSouth AfricaUMIELBW2006-200795Ballot 2017AfricaSouth AfricaUMIELBW2013-2016546Ballot 2017aAfricaSouth AfricaUMIELBW2013-2016546Bas 2015Middle EatTurkyUMIBoth2011-2013ELGAN-1339, ELBW-109Bas 2016Middle EatTurkyUMIBoth2012-2013ELGAN-1639, ELBW-109Bas 2018Middle EatIranUMIBoth2012-2013ELGAN-1639, ELBW-109Bas 2028AsiaIndiaLMIBoth2012-2013ELGAN-1639, ELBW-149Bohanval 2018AsiaIndiaLMIBoth2012-2013ELGAN-1639, ELBW-149Bohanval 2018AsiaIndiaLMIBoth2012-2013ELGAN-1639, ELBW-149Bohanval 2018AsiaIndiaLMIELBW2012-2013ELGAN-1639, ELBW-149Bohanval 2018South ArricaIndiaLMIELBW2012-2013ELGAN-1639, ELBW-149Bohanval 2017South ArricaBrainUMIELGAN2012-2014ELGAN-124, ELBW-129Bohanval 2017South ArricaIndiaLMIBoth2018-2014ELGAN-124, ELBW-129Bohanval 2018South ArricaIndiaUMIELBW2018-2014ELGAN-124, ELBW-129Bohanval 2014South ArricaIndiaUMIELBW2012-2014IndiaBohanval 2014South ArricaIndiaUMIELBW2012-201	Ballot 2010	Africa	South Africa	UMI	ELBW	2006-2007	143
Ballot 2017AfricaSouth AfricaUMIELBW2013-2016546Ballot 2017aAfricaSouth AfricaUMIELBW201334Bas 2015Middle EastTurkyUMIBoth2016-2017ELGAN-3737, ELBW-204Bas 2018Middle EastTarkyUMIBoth2016-2017ELGAN-1539, ELBW-164Basir 2015Middle EastIarkyUMIBoth2012-001ELGAN-68, ELBW-64Basir 2016AsiaIndiaIMIBoth2012-001ELGAN-68, ELBW-64Basir 2018AsiaIndiaIMIBoth2012-001ELGAN-68, ELBW-64Bohade 2018AsiaIndiaIMIBoth2012-00147Bohade 2018AsiaIndiaIMIELBW2016-201747Bohade 2018AsiaIndiaIMIELBW2019-01912Bohade 2018AsiaIndiaIMIELBW2019-01912Bohade 2017AsiaBrailUMIBoth201747Bohade 2017AsiaManyIMIBoth2019-01012Bohade 2017AsiaIndiaUMIBoth2019-01057Bohade 2017South ArrierJarentUMIBoth2019-01057Bohade 2017South ArrierIndiaUMIELBW2019-01021Bohade 2017South ArrierJarentUMIELBW2002-01023Bohand 2017South ArrierIn	Ballot 2012	Africa	South Africa	UMI	ELBW	2006-2007	95
Ballot 2017aAfricaSouh AfricaUMIELBW201334Bas 2015Midd EastTurkeyUMIBoth201-2013ELGAN-3737, ELBW-304Bas 2018Middle EastTurkeyUMIBoth2016-2017ELGAN-1539, ELBW-109Bair 2015Middle EastIranUMIBoth2016-2017ELGAN-64, ELBW-64Bas 208AsiaIndiaIMIBoth2012-2013ELGAN-164, ELBW-45Bhunwa 2018AsiaIndiaIMIBoth2012-2013EJGAN-16, ELBW-45Bokad 2018AsiaIndiaIMIELBW2016-20174Bota 2012AsiaIrakyUMIELGAN2009-20115Bontot 2007South ArriesBrailUMIBoth2007-001ELGAN-1246, ELBW-101Brimah 2020AriaMalaysiaUMIBoth2017-001ELGAN-1246, ELBW-102Bontot 2007South ArriesBrailUMIBoth2007-001ELGAN-1246, ELBW-102Brimah 2020South ArriesArgentinaUMIBoth2007-001ELGAN-1246, ELBW-102Brimah 2020South ArriesBrailUMIBoth2007-001ELGAN-1246, ELBW-102Brimah 2020South ArriesBrailUMIBoth2007-001ELGAN-1246, ELBW-102Brimah 2020South ArriesBrailUMIELBW2007-001201-001Carchoro 2020South ArriesIrakyUMIELBW201-2013EJGAN-8, ELBW-5 <t< td=""><td>Ballot 2017</td><td>Africa</td><td>South Africa</td><td>UMI</td><td>ELBW</td><td>2013-2016</td><td>546</td></t<>	Ballot 2017	Africa	South Africa	UMI	ELBW	2013-2016	546
Bas 2015Middle EastTurkeyUMIBoth2011-2013ELGAN-3737, ELBW-26494Bas 2018Middle EastTurkeyUMIBoth2016-2017ELGAN-1539, ELBW-1109Basiri 2015Middle EastIranUMIBoth2012ELGAN-68, ELBW-64Basu 2008AsiaIndiaLMIBoth2012-0013ELGAN-46, ELBW-64Bhunwal 2018AsiaIndiaLMIBoth2012-013ELGAN-46, ELBW-64Bokade 2018AsiaIndiaLMIELBW2016-201747Botal 2012South AmeriaBrainUMIELBW2009-201159Bonotto 2007South AmeriaBrainUMIBoth2018-201912Bonotto 2007South AmeriaBrainUMIBoth2018-2019ELGAN-426, ELBW-101Brainah 2020AfricaGhanaLMIBoth2018-2019ELGAN-426, ELBW-201Brainah 2020South AmeriaBrainUMIBoth2018-2019ELGAN-426, ELBW-201Brainah 2020South AmeriaBrainUMIELBW2012-2003270-2014Carnoro 2012South AmeriaBrainUMIELBW2012-2013201-2014Carnoro 2014South AmeriaBrainUMIELBW2012-2013201-2014Carnoro 2014South AmeriaBrainUMIELBW201-2013201-2014Carnoro 2014MidestTurkeyUMIELBW201-2013315Carnoro 2014Mides	Ballot 2017a	Africa	South Africa	UMI	ELBW	2013	34
Bas 2018Middle EastTurkeyUMIBoth2016-2017ELGAN-1539, ELBW-109Basiri 2015Middle EastIranUMIBoth2012ELGAN-68, ELBW-64Basu 2008AsiaIndiaLMIBothNAELGAN-46, ELBW-45Bhunwal 2018AsiaIndiaLMIBoth2012-2013ELGAN-16, ELBW-34Boka 2018AsiaIndiaLMIELBW2016-201747Bolat 2012Middle EastTurkeyUMIELGAN2009-201159Bonot 2007South AmeriaBrailUMIBoth2018-201912Boo 2012AsiaMalaysiaUMIBoth2018-2019ELGAN-1246, ELBW-30Bonot 2007AsiaGhanaLMIBoth2018-2019ELGAN-1246, ELBW-104Bound 2012AsiaGhanaLMIBoth2018-2019ELGAN-1246, ELBW-20Bound 2012South AmeriaPareinaUMIBoth2018-2019ELGAN-1246, ELBW-30Bound 2012South AmeriaMaisoiUMIELBW2018-201920Carnero 2012South AmeriaBrailUMIELBW2002-201327Carnero 2017North AmeriaMaicoUMIELBW2002-201420Carnero 2017South AmeriaMaicoUMIELBW2010-201325Carnero 2017North AmeriaMaicoUMIELBW2001-201325Carnero 2014MideatTurkeyUMIELBW	Bas 2015	Middle East	Turkey	UMI	Both	2011-2013	ELGAN-3737, ELBW-2694
Basiri 2015Middle EastIranUMIBoth2012ELGAN-68, ELBW-64Basu 2008AsiaIndiaLMIBothNAELGAN-46, ELBW-45Bhunwal 2018AsiaIndiaLMIBoth2012-2013ELGAN-16, ELBW-34Bokade 2018AsiaIndiaLMIELBW2016-201747Bolat 2012Middle EastTurkeyUMIELGAN1992-199012Bonoto 2007South AmericaBrailUMIBoth2007ELGAN-1246, ELBW-101Bonath 2020AsiaMalaysiaUMIBoth2007ELGAN-28, ELBW-20Braimah 2020AfricaGhanaLMIBoth2008-2010ELGAN-28, ELBW-20Buenos Aires 2012South AmericaArgentinaUMIBoth2008-2010ELGAN-28, ELBW-20Buenos Aires 2012South AmericaArgentinaUMIBoth2008-2010ELGAN-26, ELBW-451Carnicro 2012South AmericaBrailUMIELBW2007-201057Castro 2007South AmericaBrailUMIELBW2002-200320Carnicro 2017North AmericaMaxicoUMIELGAN2002-2003235Castro 2007South AmericaMaxicoUMIELBW2010-2016140Castro 2007North AmericaMaxicoUMIELBW2010-2013255Castro 2014MidaestTurkeyUMIELBW2010-2013140Chandari 2009AsiaInia </td <td>Bas 2018</td> <td>Middle East</td> <td>Turkey</td> <td>UMI</td> <td>Both</td> <td>2016-2017</td> <td>ELGAN-1539, ELBW-1109</td>	Bas 2018	Middle East	Turkey	UMI	Both	2016-2017	ELGAN-1539, ELBW-1109
Basu 2008AsiaIndiaIMIBothNAELGAN-46, ELBW-45Bhunwal 2018AsiaIndiaIMIBoth2012-2013ELGAN-16, ELBW-34Bokade 2018AsiaIndiaIMIELBW2016-201747Bolat 2012Middle EastTurkeyUMIELBW2009-201159Bonotto 2007South AmeriaBrazilUMIBoth192-199912Boo 2012AsiaMalaysiaUMIBoth2007-2010ELGAN-1246, ELBW-101Braimah 2020AfricaGhanaIMIBoth2018-2019ELGAN-28, ELBW-20Buenos Aires 2012South AmeriaArgentinaUMIBoth2008-2010ELGAN-426, ELBW-451Garneiro 2012South AmeriaBrazilUMIBoth2008-201057Carneiro 2012South AmeriaBrazilUMIELBW2007-201057Carneiro 2012South AmeriaBrazilUMIELBW2002-200320Carneiro 2017North AmeriaMexicoUMIELBW2010-2013235Caticharagon 2017North AmeriaMexicoUMIELBW2010-201335Caticharago 2014MideastTurkeyUMIELBW2011-2013197Chandar 2014MideastTurkeyUMIELBW2010-201324Chandar 2019AsiaIndiaLMIELBW2016-201824Chanduri 2019AsiaChinaUMIELBW2016-2018 </td <td>Basiri 2015</td> <td>Middle East</td> <td>Iran</td> <td>UMI</td> <td>Both</td> <td>2012</td> <td>ELGAN-68, ELBW-64</td>	Basiri 2015	Middle East	Iran	UMI	Both	2012	ELGAN-68, ELBW-64
Bhunwal 2018AsiaIndiaLMIBoth2012-2013ELGAN-16, ELBW-34Bokade 2018AsiaIndiaLMIELBW2016-201747Bolat 2012Middle EastTurkeyUMIELBW2009-201159Bonoto 2007South AmeriaBrazilUMIBoth1992-199912Boo 2012AsiaMalaysiaUMIBoth2017ELGAN-1246, ELBW-101Brainah 2020AfricaGhanaLMIBoth2018-2019ELGAN-28, ELBW-201Brainah 2020South AmeriaArgentinaUMIBoth2018-2019ELGAN-426, ELBW-451Brainah 2020South AmeriaArgentinaUMIBoth2018-2010ELGAN-426, ELBW-451Brainah 2020South AmeriaArgentinaUMIELBW2007-201057Carneiro 2012South AmeriaBraziUMIELBW2007-201057Catro 2007South AmeriaBraziUMIELBW2002-20332002-2033Catro 2017North AmeriaMexicoUMIELBW2010-2014205Cathaga 2014MideatTurkeyUMIELBW2011-2013197Chendahari 2009AsiaIndiaLMIBoth2002-2064ELGAN-58, ELBW-58Chendahari 2009AsiaIndiaUMIELBW201-2013197Chendahari 2009AsiaIndiaUMIELBW2016-201824Chen 2015AsiaChinaUMIELGAN<	Basu 2008	Asia	India	LMI	Both	NA	ELGAN-46, ELBW-45
Bokade 2018AsiaIndiaLMIELBW2016-201747Bolat 2012Midle EastTurkeyUMIELBW2009-201159Bonoto 2007South AmeriaBrailUMIELGAN1992-199912Boo 2012AsiaMalaysiaUMIBoth2007ELGAN-1246, ELBW-101Brainah 2020AfricaGhanaLMIBoth2018-2019ELGAN-28, ELBW-201Buenos Aires 2012South AmeriaArgentiaUMIBoth208-2010ELGAN-28, ELBW-201Garneiro 2012South AmeriaBrailUMIELBW2007-201057Carneiro 2012South AmeriaBrailUMIELBW2007-201057Cardero 2017South AmeriaBrailUMIELBW2007-2010207Cardero 2017North AmeriaMarciaUMIELBW2007-2014207Cardero 2017North AmeriaMarciaUMIELBW201-2013205Cardero 2014MideastTurkeyUMIELBW201-2013205Cardero 2014MideastInfainLMIELBW201-2013205Chardani 2009AsiaInfainUMIELBW201-2014204Chardoro 2014AsiaInfainUMIELBW201-2014204Chardoro 2015AsiaInfainUMIELBW201-2012214Chardoro 2014AsiaInfainUMIELBW201-2012214Chardoro	Bhunwal 2018	Asia	India	LMI	Both	2012-2013	ELGAN-16, ELBW-34
Bolat 2012Middle EastTurkeyUMIELBW2009-201159Bonotto 2007South AmericaBrazilUMIELGAN1992-199912Boo 2012AsiaMalaysiaUMIBoth2007ELGAN-1246, ELBW-1051Braimah 2020AfricaGhanaLMIBoth2018-2019ELGAN-28, ELBW-20Buenos Aires 2012South AmericaArgentinaUMIBoth2008-2010ELGAN-426, ELBW-451Carneiro 2012South AmericaBrazilUMIELBW2007-201057Castro 2007South AmericaBrazilUMIELBW2002-2003270Caucharagon 2017North AmericaMexicoUMIELBW2010-2013235Cenkcelebi 2014MideastTurkeyUMIELBW2011-2013197Chaudhari 2009AsiaIndiaLMIBoth2000-2006ELGAN-58, ELBW-58Chen 2019AsiaChinaUMIELBW2016-2018284Chen 2012AsiaChinaUMIELGAN205-200695Chen 2015AsiaChinaUMIELBW2010-2012161Chiabi 2014AfricaCameroonWIELGAN2005-201695	Bokade 2018	Asia	India	LMI	ELBW	2016-2017	47
Bonotto 2007South AmericaBrazilUMIELGAN1992–199912Boo 2012AsiaMalaysiaUMIBoth2007ELGAN-1246, ELBW-1051Braimah 2020AfricaGhanaLMIBoth2018–2019ELGAN-28, ELBW-20Buenos Aires 2012South AmericaArgentinaUMIBoth2008–2010ELGAN-426, ELBW-451Carneiro 2012South AmericaBrazilUMIELBW2007–201057Castro 2007South AmericaBrazilUMIELGAN2002–2003270Cauicharagon 2017North AmericaMexicoUMIELGAN2005–20142Cenkcelebi 2014MideastTurkeyUMIELBW2010–2013235Cetinkaya 2014MideastTurkeyUMIELBW2011–2013197Chaudhari 2009AsiaIndiaLMIBoth2009–2006ELGAN-58, ELBW-58Chen 2019AsiaChinaUMIELBW2016–2018284Chen 2015AsiaChinaUMIELGAN2005–200695Chiabi 2014AfricaCameroonUMIELBW2010–2012161	Bolat 2012	Middle East	Turkey	UMI	ELBW	2009-2011	59
Boo 2012AsiaMalaysiaUMIBoth2007ELGAN-1246, ELBW-1051Braimah 2020AfricaGhanaLMIBoth2018-2019ELGAN-28, ELBW-20Buenos Aires 2012South AmericaArgentinaUMIBoth2008-2010ELGAN-426, ELBW-451Carneiro 2012South AmericaBrazilUMIELBW2007-201057Castro 2007South AmericaBrazilUMIELBW2002-2003270Cauicharagon 2017North AmericaMexicoUMIELBW2010-2013235Cenkcelebi 2014MideastTurkeyUMIELBW2011-2013197Chaudhari 2009AsiaIndiaLMIBoth2000-2006ELGAN-58, ELBW-58Chen 2019AsiaChinaUMIELBW2016-2018284Chen 2012AsiaChinaUMIELGAN2005-200695Chen 2015AsiaChinaUMIELBW2010-2012161Chiabi 2014AfricaCameroonBoth2003-2011ELGAN-75, ELBW-74	Bonotto 2007	South America	Brazil	UMI	ELGAN	1992-1999	12
Braimah 2020AfricaGhanaLMIBoth2018–2019ELGAN-28, ELBW-20Buenos Aires 2012South AmericaArgentinaUMIBoth2008–2010ELGAN-426, ELBW-451Carneiro 2012South AmericaBrazilUMIELBW2007–201057Castro 2007South AmericaBrazilUMIELBW2002–2003270Cauicharagon 2017North AmericaMexicoUMIELGAN2005–20142Cenkcelebi 2014MideastTurkeyUMIELBW2010–2013235Cetinkaya 2014MideastTurkeyUMIELBW2011–2013197Chaudhari 2009AsiaIndiaLMIBoth2006–2006ELGAN-58, ELBW-58Chen 2019AsiaChinaUMIELBW2016–2018284Chen 2015AsiaChinaUMIELGAN2005–200695Chiabi 2014AfricaCameroonELBW2010–2012161	Boo 2012	Asia	Malaysia	UMI	Both	2007	ELGAN-1246, ELBW-1051
Buenos Aires 2012South AmericaArgentinaUMIBoth2008-2010ELGAN-426, ELBW-451Carneiro 2012South AmericaBrazilUMIELBW2007-201057Castro 2007South AmericaBrazilUMIELBW2002-2003270Cauicharagon 2017North AmericaMexicoUMIELGAN2005-20142Cenkcelebi 2014MideastTurkeyUMIELBW2010-2013235Cetinkaya 2014MideastTurkeyUMIELBW2011-2013197Chaudhari 2009AsiaIndiaLMIBoth2000-2006ELGAN-58, ELBW-58Chen 2019AsiaChinaUMIELBW2016-2018284Chen 2015AsiaChinaUMIELGAN2005-200695Chiabi 2014AfricaCameroonUMIELBW2010-2012161	Braimah 2020	Africa	Ghana	LMI	Both	2018-2019	ELGAN-28, ELBW-20
Carneiro 2012South AmericaBrazilUMIELBW2007-201057Castro 2007South AmericaBrazilUMIELBW2002-2003270Cauicharagon 2017North AmericaMexicoUMIELGAN2005-20142Cenkcelebi 2014MideastTurkeyUMIELBW2010-2013235Cetinkaya 2014MideastTurkeyUMIELBW2011-2013197Chaudhari 2009AsiaIndiaLMIBoth2000-2006ELGAN-58, ELBW-58Chen 2019AsiaChinaUMIELBW2016-2018284Chen 2015AsiaChinaUMIELBW2005-200695Chiabi 2014AfricaCameroonVMIELBW2010-2012161	Buenos Aires 2012	South America	Argentina	UMI	Both	2008-2010	ELGAN-426, ELBW-451
Castro 2007South AmericaBrazilUMIELBW2002-2003270Cauicharagon 2017North AmericaMexicoUMIELGAN2005-20142Cenkcelebi 2014MideastTurkeyUMIELBW2010-2013235Cetinkaya 2014MideastTurkeyUMIELBW2011-2013197Chaudhari 2009AsiaIndiaLMIBoth2000-2006ELGAN-58, ELBW-58Chen 2019AsiaChinaUMIELBW2016-2018284Chen 2015AsiaChinaUMIELBW2005-200695Chiabi 2014AfricaCameroonBoth2003-2011ELGAN-75, ELBW-74	Carneiro 2012	South America	Brazil	UMI	ELBW	2007-2010	57
Cauicharagon 2017North AmericaMexicoUMIELGAN2005-20142Cenkcelebi 2014MideastTurkeyUMIELBW2010-2013235Cetinkaya 2014MideastTurkeyUMIELBW2011-2013197Chaudhari 2009AsiaIndiaLMIBoth2000-2006ELGAN-58, ELBW-58Chen 2019AsiaChinaUMIELBW2016-2018284Chen 2012AsiaChinaUMIELGAN2005-200695Chen 2015AsiaChinaUMIELBW2010-2012161Chiabi 2014AfricaCameroonBoth2003-2011ELGAN-75, ELBW-74	Castro 2007	South America	Brazil	UMI	ELBW	2002-2003	270
Cenkcelebi 2014MideastTurkeyUMIELBW2010-2013235Cetinkaya 2014MideastTurkeyUMIELBW2011-2013197Chaudhari 2009AsiaIndiaLMIBoth2000-2006ELGAN-58, ELBW-58Chen 2019AsiaChinaUMIELBW2016-2018284Chen 2012AsiaChinaUMIELGAN2005-200695Chen 2015AsiaChinaUMIELBW2010-2012161Chiabi 2014AfricaCameroonBoth2003-2011ELGAN-75, ELBW-74	Cauicharagon 2017	North America	Mexico	UMI	ELGAN	2005-2014	2
Cetinkaya 2014MideastTurkeyUMIELBW2011-2013197Chaudhari 2009AsiaIndiaLMIBoth2000-2006ELGAN-58, ELBW-58Chen 2019AsiaChinaUMIELBW2016-2018284Chen 2012AsiaChinaUMIELGAN2005-200695Chen 2015AsiaChinaUMIELBW2010-2012161Chiabi 2014AfricaCameroonBoth2003-2011ELGAN-75, ELBW-74	Cenkcelebi 2014	Mideast	Turkey	UMI	ELBW	2010-2013	235
Chaudhari 2009         Asia         India         LMI         Both         2000-2006         ELGAN-58, ELBW-58           Chen 2019         Asia         China         UMI         ELBW         2016-2018         284           Chen 2012         Asia         China         UMI         ELGAN         2005-2006         95           Chen 2015         Asia         China         UMI         ELBW         2010-2012         161           Chiabi 2014         Africa         Cameroon         Both         2003-2011         ELGAN-75, ELBW-74	Cetinkaya 2014	Mideast	Turkey	UMI	ELBW	2011-2013	197
Chen 2019         Asia         China         UMI         ELBW         2016-2018         284           Chen 2012         Asia         China         UMI         ELGAN         2005-2006         95           Chen 2015         Asia         China         UMI         ELBW         2010-2012         161           Chiabi 2014         Africa         Cameroon         Both         2003-2011         ELGAN-75, ELBW-74	Chaudhari 2009	Asia	India	LMI	Both	2000-2006	ELGAN-58, ELBW-58
Chen 2012         Asia         China         UMI         ELGAN         2005–2006         95           Chen 2015         Asia         China         UMI         ELBW         2010–2012         161           Chiabi 2014         Africa         Cameroon         Both         2003–2011         ELGAN-75, ELBW-74	Chen 2019	Asia	China	UMI	ELBW	2016-2018	284
Chen 2015         Asia         China         UMI         ELBW         2010–2012         161           Chiabi 2014         Africa         Cameroon         Both         2003–2011         ELGAN-75, ELBW-74	Chen 2012	Asia	China	UMI	ELGAN	2005-2006	95
Chiabi 2014     Africa     Cameroon     Both     2003–2011     ELGAN-75, ELBW-74	Chen 2015	Asia	China	UMI	ELBW	2010-2012	161
	Chiabi 2014	Africa	Cameroon		Both	2003-2011	ELGAN-75, ELBW-74

AUTHOR/YEAR	REGION	COUNTRY	INCOME CLASSIFICATION	ELGAN / ELBW	PERIOD OF STUDY	SAMPLE SIZE	
Chidiebere 2018	Africa	Nigeria	LMI	ELBW	2013-2016	20	
Chioukh 2018	Africa	Tunisia	LMI	ELGAN	2012-2013	109	
Coyles 2020	Africa	South Africa	UMI	ELBW	2013-2015	104	
Dearaujo 2007	South America	Brazil	UMI	Both	1998-2004	ELGAN-30, ELBW-61	
Debritoa 2003	South America	Brazil	UMI	Both	1997-2000	ELGAN-70, ELBW-79	
Decarvalho 2007	South America	Brazil	UMI	ELGAN	2002-2004	108	
Demello 2007	South America	Brazil	UMI	Both	1991-2000	ELGAN-51, ELBW-60	
Gebeşçe 2016	Middle East	Turkey	UMI	ELBW	2007-2011	18	
Gezmu 2020	Africa	Botswana	UMI	Both	2018-2019	ELGAN-37, ELBW-32	
Gharaibeh 2011	Middle East	Jordan	UMI	ELBW	2006-2007	11	
Ghaseminejad 2011	Middle East	Iran	UMI	ELBW	2006-2008	7	
Golestan 2008	Middle East	Iran	UMI	ELBW	2004	35	
Goncalves 2014	South America	Brazil	UMI	ELBW	2009-2011	24	
Gooden 2013	Caribbean	Jamaica	UMI	ELBW	2005-2006	46	
Gordana 2019	Europe	Serbia	UMI	Both	2006-2011	ELGAN-220, ELBW-157	
Goulart 2011	South America	Brazil	UMI	ELBW	1997-2003	36	
Gupta 2020	Asia	India	LMI	Both	2017	ELGAN-30, ELBW-49	
Hadi 2013	Middle East	Egypt	LMI	ELGAN	2010-2012	15	
Haghighi 2013	Middle East	Iran	UMI	ELBW	2010-2011	52	
Hakeem 2012	Middle East	Egypt	LMI	ELBW	2009-2010	3	
Hendriks 2014	Africa	South Africa	UMI	ELBW	2006-2009	97	
Но 2001	Asia	Malaysia	UMI	Both	1996	ELGAN-168, ELBW-136	
Hussain 2012	Middle East	Iraq	UMI	ELGAN	2018-2019	44	
Jiang 2020	Asia	China	UMI	ELGAN	2015-2016	320	
Jirapaet 2010	Asia	Thailand	UMI	ELBW	1998-2001	5	
Jodeiry 2012	Middle East	Iran	UMI	ELGAN	NA	51	
Kalimba 2013	Africa	South Africa	UMI	ELBW	2006-2010	382	
Karabulut 2019	Middle East	Turkey	UMI	ELGAN	2015-2018	87	
Kareem 2011	Middle East	Iraq	UMI	ELBW	2003-2009	48	
Karkhaneh 2008	Middle East	Iran	UMI	Both	2003-2007	ELGAN-199, ELBW-117	
Kidamba 2018	Africa	South Africa	UMI	Both	2013	ELGAN-15, ELBW-15	
Kift 2016	Africa	South Africa	UMI	ELGAN	2009-2014	98	
Kirsten 2012	Africa	South Africa	UMI	ELGAN	2007-2009	309	
Klingenberg 2003	Africa	Tanzania	LMI	ELBW	1999	11	
Koksal 2002	Middle East	Turkey	UMI	ELBW	NA	12	
Kong 2016	Asia	China	UMI	ELGAN	2013-2014	148	
Kong 2020	Asia	China	UMI	ELGAN	2013-2014	50	
Kulali 2019	Middle East	Turkey	UMI	ELGAN	2011-2015	165	
Lara-Molina 2013	North America	Mexico	UMI	ELBW	2008-2010	44	
Lermann 2008	South America	Brazil	UMI	Both	2002-2004	ELGAN-7, ELBW-28	
Li 2018	Asia	China	UMI	ELGAN	2010-2015	79	
Li 2019	Asia	China	UMI	ELGAN	2010-2016	307	
Lin 2015	Asia	China	UMI	ELBW	2011	258	
Liu 2014	Asia	China	UMI	Both	2009-2012	ELGAN-85, ELBW-24	
Liu 2005	Asia	China	UMI	ELBW	1996-2000	37	
Lomuto 2008	South America	Argentina	UMI	ELBW	2008	190	
Luthuli 2019	Africa	South Africa	UMI	Both	2011-2014	ELGAN-53, ELBW-105	
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Mabhandi 2019AfricaSouth AfricaUMIELBW2015-201789Montano Perez 2019North AmericaMexicoUMIELBW2010-201452Martinez-Cruz 2012North AmericaMexicoUMIELBW2000-2008139Martinez 2010North AmericaMexicoUMIELBW2005-2006152Mcgready 2018AsiaThailandUMIELGAN1995-2015132	5
Montano Perez 2019North AmericaMexicoUMIELBW2010-201452Martinez-Cruz 2012North AmericaMexicoUMIELBW2000-2008139Martinez 2010North AmericaMexicoUMIELBW2005-2006152Mcgready 2018AsiaThailandUMIELGAN1995-2015132	5
Martinez-Cruz 2012North AmericaMexicoUMIELBW2000-2008139Martinez 2010North AmericaMexicoUMIELBW2005-2006152Mcgready 2018AsiaThailandUMIELGAN1995-2015132	5
Martinez 2010         North America         Mexico         UMI         ELBW         2005–2006         152           Mcgready 2018         Asia         Thailand         UMI         ELGAN         1995–2015         132	5
Mcgready 2018AsiaThailandUMIELGAN1995-2015132	5
	5
Medina-Valenton 2016         South America         Brazil         UMI         Both         2012–2014         ELGAN-23, ELBW-2	
Mekasha 2020 Africa Ethiopia LI ELBW 2016–2018 164	
Miles 2017         Asia         Vietnam         LMI         Both         2011–2012         ELGAN-5, ELBW-63	
Moghaddam 2015Middle EastIranUMIELBW2010-2014108	
Muhe 2019AfricaEthiopiaLIBoth2016–2018ELGAN-104, ELBW-	165
Mukhopadhyay 2013 Asia India LMI ELBW 2001–2010 436	
Nakubulwa 2020 Africa Uganda LI ELBW 2017–2018 18	
Navaei 2010 Middle East Iran UMI Both 2005–2006 ELGAN-122, ELBW-	107
NEOCOSUR 2002 South America Multi-Country UMI Both 1997–1998 ELGAN-95, ELBW-1	26
Nepal 2020 Asia Nepal LMI Both 2019 ELGAN-2, ELBW-3	
Nevacinovic 2020 Europe Bosnia UMI ELBW NA 49	
NNPD 2004 Asia India LMI ELBW 2000 101	
Ntuli 2020         Africa         South Africa         UMI         Both         2015         ELGAN-25, ELBW-5	0
Ogunlesi 2011 Africa Nigeria LMI ELBW 2008 15	
Okello 2019 Africa Uganda LI ELBW 2015–2017 36	
Omoigberale 2010 Africa Benin LMI Both 2003–2006 ELGAN-190, ELBW-	151
Omer 2014 Africa Sudan LI ELBW 2012–2013 6	
Onalo 2015 Africa Nigeria LMI ELBW 2006–2010 42	
Onyiriuka 2009 Africa Nigeria LMI ELBW 2000–2003 9	
Oomen 2019AsiaIndiaLMIELBW2010–201230	
Osorno-Covarrubiasa 2002 North America Mexico UMI Both 1995–1999 ELGAN-50, ELBW-1	62
Ozcan 2015 Middle East Turkey UMI ELGAN 2014–2015 18	
Pervin 2015 Asia Bangladesh LMI Both 2007–2010 ELGAN-14, ELBW-1	5
Pinheiro 2010         South America         Brazil         UMI         ELBW         1999–2006         445	
Piriyapokin 2020 Asia Thailand UMI ELGAN 2005–2015 67	
Poudel 2010 Asia Nepal LMI Both 2005–2008 ELGAN-9, ELBW-23	
Pourarian 2016 Middle East Iran UMI ELBW 2014 28	
Prabha 2014 Asia India LMI Both 2008–2013 ELGAN-7, ELBW-6	
Pradhan 2019 Asia Bhutan LMI ELGAN 2017 18	
Qazi 2011 Asia Pakistan LMI ELGAN 2009 3	
Qian 2008AsiaChinaUMIELGAN2004–200545	
Rezaeizadeh 2018 Middle East Iran UMI Both 2013–2016 ELGAN-85, ELBW-1	27
Roy 2006         Asia         India         LMI         ELBW         2001–2005         36	
Ruiz-Pelaez 2014 South America Colombia UMI Both 2004 ELGAN-81, ELBW-8	6
Rylance 2013 Africa Malawi LI ELBW 2010 71	
Sivanandan 2016 Asia India LMI Both 1999–2014 ELGAN-39, ELBW-1	25
Sabzehei 2013 Middle East Iran UMI Both 2007–2010 ELGAN-84, ELBW-5	3
Saucedo 2008 North America Mexico UMI ELBW 2002–2006 727	
Sackey 2019 Africa Ghana LMI Both 2011–2015 ELGAN-539. ELBW-	560
Sahin 2014 Middle East Turkey UMI ELGAN 2010–2012 109	
Sahoo 2020 Asia India LMI Both 2013–2018 ELGAN-95. ELBW-2	31
Saeidi 2009     Middle East     Iran     UMI     ELBW     2005–2006     52	

AUTHOR/YEAR	REGION	COUNTRY	INCOME CLASSIFICATION	ELGAN / ELBW	PERIOD OF STUDY	SAMPLE SIZE
Saeidi 2017	Middle East	Iran	UMI	ELBW	2013-2015	14
Saini 2016	Asia	India	LMI	Both	NA	ELGAN-7, ELBW-17
Salahuddin 2018	Asia	Pakistan	LMI	ELGAN	2015-2016	11
Saygili 2016	Middle East	Turkey	UMI	Both	2010-2013	ELGAN-203, ELBW-110
Sehgal 2004	Asia	India	LMI	Both	2000-2001	ELGAN-9, ELBW-52
Seid 2019	Africa	Ethiopia	LI	Both	2014-2017	ELGAN-25, ELBW-29
Serce 2014	Middle East	Turkey	UMI	Both	2010-2011	ELGAN-156, ELBW-179
Shrestha 2010	Asia	Nepal	LMI	ELGAN	2005	12
Singh2020	Asia	India	LMI	ELBW	2016	9
Siswanto 2018	Asia	Indonesia	UMI	Both	2005-2015	ELGAN-185, ELBW-182
Sousa 2017	South America	Brazil	UMI	ELBW	2014-2015	158
Sritipsukho 2017	Asia	Thailand	UMI	ELBW	2003-2006	21
Sun 2013	Asia	China	UMI	Both	2010	ELGAN-32, ELBW-28
Tamene 2020	Africa	Ethiopia	LI	Both	2017-2018	ELGAN-15, ELBW-23
Taqui 2008	Asia	Pakistan	LMI	Both	2003-2006	ELGAN-15, ELBW-14
Thakre 2017	Asia	India	LMI	ELBW	2011-2013	7
Thakur2013	Asia	India	LMI	Both	2010-2012	ELGAN-81, ELBW-283
Tosif 2019	Asia	Solomon Island	LMI	ELBW	2014-2016	45
Tran 2015	Asia	Vietnam	LMI	Both	2010-2011	ELGAN-29, ELBW-26
Trotman 2012	Caribbean	Jamaica	UMI	ELBW	1999-2010	286
Trotman 2006	Caribbean	Jamaica	UMI	Both	1995-2000	ELGAN-4, ELBW-7
Trotman 2007	Caribbean	Jamaica	UMI	ELBW	1987-2001	40
Trotman 2007a	Caribbean	Jamaica	UMI	Both	2002-2003	ELGAN-14, ELBW-47
Tshehla 2019	Africa	South Africa	UMI	ELBW	2016-2017	71
Ugwu 2010	Africa	Nigeria	LMI	ELBW	2002-2009	149
Undela 2019	Asia	India	LMI	Both	2017	ELGAN-6, ELBW-10
Velaphi 2005	Africa	South Africa	UMI	ELBW	2000-2002	453
Viau 2015	South America	Brazil	UMI	ELGAN	2006-2007	671
Vilanova 2019	South America	Brazil	UMI	ELBW	2000-2015	1325
Vural 2007	Middle East	Turkey	UMI	ELBW	2003-2005	19
Wang 2012	Asia	China	UMI	ELBW	2009-2010	160
Welbeck 2003	Africa	Ghana	LMI	Both	1995	ELGAN-382, ELBW-128
Winkler 2020	Africa	Tanzania	LMI	ELBW	2014-2018	8
Wu 2018	Asia	China	UMI	ELBW	2012-2015	60
Wu 2019	Asia	China	UMI	Both	2008-2017	ELGAN-2051, ELBW-1303
Xu 2013	Asia	China	UMI	Both	2010-2012	ELGAN-285, ELBW-99
Xu 2019	Asia	China	UMI	ELGAN	2013-2014	148
Yadav 2019	Asia	Nepal	LMI	Both	2019	ELGAN-6, ELBW-5
Yakoob 2014	Asia	India	LMI	ELGAN	1998-2003	38
Yau 2014	Asia	China	UMI	ELBW	2007-2012	131
Zea-Vera 2019	South America	Peru	UMI	ELBW	2012-2014	69
Zepeda Romero 2016	North America	Mexico	UMI	ELGAN	2012-2014	9
Zhang 2011	Asia	China	UMI	Both	1999-2009	ELGAN-29, ELBW-39
Zhang 2016	Asia	China	UMI	Both	2011-2012	ELGAN-13, ELBW-10
Zhang 2019	Asia	China	UMI	Both	2016-2017	ELGAN-89, ELBW-55
Zhang 2020	Asia	China	UMI	Both	2007-2016	ELGAN-32, ELBW-100
Zhou 2014	Asia	China	UMI	ELGAN	2010-2011	72
		1			1	1

AUTHOR/YEAR	REGION	COUNTRY	INCOME CLASSIFICATION	ELGAN / ELBW	PERIOD OF STUDY	SAMPLE SIZE
Zhu 2020	Asia	China	UMI	ELGAN	2010-2019	441
Ziadeh 2000	Middle East	Jordan	UMI	ELBW	1996-1999	12
Ziylan 2006	Middle East	Turkey	UMI	ELBW	1998-2003	114
Zuniga 2013	Africa	Burundi	LI	ELBW	2011	11

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NDI prevalence of 29% (23% - 37%) for ELGANs. The prevalence of CP in ELGAN population was 3% (1% - 9%) (S12-S14 Figs in S1 File)

**Cardio-respiratory outcomes.** *3a. PDA.* There was considerable variation in the reported rates of PDA requiring intervention between countries which was 15% (7% - 30%) for ELBW neonates and 50% (35% - 65%) for ELGANs (S15-S19 Figs in S1 File).

*3b. Requirement of invasive mechanical ventilation.* Higher rates of requirement of mechanical ventilation was reported from China which was 78% (65% - 92%) for ELBW neonates and 75% (65% - 84%) for ELGANs (S20 and S21 Figs in S1 File)

*3c. BPD assessed as oxygen requirement at 36 weeks' PMA*. For ELBW neonates, BPD prevalence was 39% (30% - 48%). One study from South Africa had reported a relatively lower rate of 17% (6% - 33%). The overall prevalence of BPD was 37% (29% - 47%) in ELGANs. Three centers from China, India and Turkey had reported a higher rate of more than 60% (S22-S25 Figs in S1 File).

**Sepsis.** The rates of any sepsis and culture proven sepsis in ELBW neonates was 37% (28% - 48%) and 28% (21% - 35%), respectively. Rates of any and culture proven sepsis in ELGANs was 40% (25% - 57%) and 21% (12% - 32%), respectively (S26-S31 Figs in S1 File).

**NEC stage II or more.** The rates of NEC were uniform across countries with its prevalence being 8% (7% - 10%) for ELBW neonates as well as ELGANs. Publication bias was detected for studies reporting on NEC in ELBW neonates (S32-S35 Figs in S1 File).

**EUGR.** Two studies from the African sub-continent had reported on EUGR rates in ELBW neonates which was 88% (80% - 93%) (S36 Fig in <u>S1 File</u>).

**ROP.** Amongst ELBW neonates, any stage ROP, severe ROP and ROP requiring intervention rates was 49% (42% - 55%), 24% (19% - 30%) and 18% (12% - 27%), respectively. One study each from India, Iran and Pakistan had reported severe ROP rate of more than 50%. Also, some reports from China, Turkey and Jordan had ROP requiring intervention rates of more than 30%.

In ELGANs, any stage ROP, severe ROP and ROP requiring intervention was reported in 53% (46% - 59%), 22% (16% - 30%) and 20% (13% - 29%) of neonates, respectively. Single center reports from Thailand and Brazil had rates exceeding 40%.

Data related to ROP is given in S37-S48 Figs in S1 File.

**Sensitivity analyses.** *4a. Excluding studies with low sample size.* Analysis of survival outcome after excluding studies with low sample size did not result in any significant changes in the effect estimate when compared to the primary analysis for both ELBW neonates and ELGANs (S49 and S50 Figs in S1 File).

*4b.* Comparison of survival between epoch 1: 2000–2009 and epoch 2: 2010–2019. There was no significant difference in the survival rates between the two epochs for ELBW neonates (Test of moderators p value– 0.83) and ELGANs. (Test of moderators p value– 0.78) (S51 and S52 Figs in S1 File).

4c. Analysing studies which had evaluated neonates with varying baseline sickness. While of most of the studies were single centre studies, survival rates were reported by five studies for

Study or Subgroup ARGENTINA	Events	Total	Weight	IV, Random, 95% C	I IV, Random, 95% CI
BUENOS AIRES 2012	182	451	1.5%	0.40 [0.36; 0.45]	
BANGLADESH PERVIN 2015 ALI 2016 Total (95% CI)	1 43	15 113 128	0.3% 1.3% 1.7%	0.07 [0.00; 0.32] 0.38 [0.29; 0.48] 0.21 [0.03; 0.68]	• <u> </u>
BENIN OMOIGBERALE 2009	99	151	1.4%	0.66 [0.57; 0.73]	:
BOSNIA NEVACINOVIC 2020	21	49	1.2%	0.43 [0.29; 0.58]	*
BRAZIL PINHEIRO 2010 AZEREDO CARDOSO 2013	146 151	445 305	1.5%	0.33 [0.28; 0.37] 0.50 [0.44; 0.55]	•
CARNEIRO 2012 DE BRITO 2003 DE MELLO 2007	27 38 28	57 79 60	1.2%	0.47 [0.34; 0.61] 0.48 [0.37; 0.60] 0.47 [0.34; 0.60]	
DE ARAÚJO 2007 VILANOVA 2019 CASTRO 2007	19 596	61 1325 270	1.2%	0.31 [0.20; 0.44] 0.45 [0.42; 0.48] 0.20 [0.16: 0.26]	-
Total (95% CI) BURUNDI ZUNIGA 2013	1	2602	0.3%	0.39 [0.32; 0.47]	
CAMEROON CHIABI 2014	3	74	0.7%	0.04 [0.01; 0.11]	:
CHINA LIN 2015	129	258	1.4%	0.50 (0.44: 0.56)	-
SUN 2013 WU 2019 ZHANG 2011 ZHANG 2020	10 598 18 68	28 1303 39 100	1.0% 1.5% 1.1% 1.3%	0.36 [0.19; 0.56] 0.46 [0.43; 0.49] 0.46 [0.30; 0.63] 0.68 [0.58; 0.77]	- <b>1</b>
Total (95% CI) COLOMBIA RUIZ-PELAEZ 2014	40	1728	6.3%	0.50 [0.42; 0.58]	-
ERITREA ANDEGIORGISH 2020	13	22	0.9%	0.59 (0.36; 0.79)	• •
ETHIOPIA					
SEID 2019 MUHE 2019 TAMENE 2020 MEKASHA 2020 Total (95% CI)	28 0 28	29 165 23 164 381	0.5% 1.3% 0.2% 1.3% 3.4%	0.07 [0.01; 0.23] 0.17 [0.12; 0.24] 0.00 [0.00; 0.15] 0.17 [0.12; 0.24] 0.15 [0.11; 0.21]	-
GHANA SACKEY 2019 ABDUL-MUMIN 2020	113 3	560 21	1.5%	0.20 [0.17; 0.24]	
WELBECK 2003 Total (95% CI) INDIA	21	128 709	1.3% 3.4%	0.16 (0.10; 0.24) 0.19 (0.17; 0.22)	•
SINGH 2020 SEHGAL 2004 ROY 2006	1 30 24	9 52 36	0.3%	0.11 [0.00; 0.48] 0.58 [0.43; 0.71] 0.67 [0.49; 0.81]	
BAJAJ 2020 MUKHOPADHYAY 2013 SAINI 2016	29 134 2	97 436 17	1.3%	0.30 [0.21; 0.40] 0.31 [0.26; 0.35] 0.12 [0.01; 0.36]	
BASU 2008 BOKADE 2018 THAKUB 2013	16 17 173	45 47 283	1.1% 1.2% 1.4%	0.36 [0.22; 0.51] 0.36 [0.23; 0.51] 0.61 [0.55; 0.67]	<b>*</b> .
NNPD 2004 SAHOO 2020 GUPTA 2020	21 143	101 231 49	1.3%	0.21 [0.13; 0.30] 0.62 [0.55; 0.68] 0.31 [0.18; 0.45]	
Total (95% CI) INDONESIA SISWANTO 2018	94	1403	13.4%	0.39 [0.29; 0.50]	-
IRAN		107		0.64 10 46-0.693	-
GOLESTAN 2008 NAVAEI 2010	2 25	35	0.5%	0.06 [0.01; 0.19] 0.23 [0.16; 0.33]	
AFJEH 2013A BASIRI 2015 HAGHIGHI 2013 Total (95% CI)	49 11 11	147 64 52 532	1.4% 1.1% 1.1% 6.7%	0.33 [0.26; 0.42] 0.17 [0.09; 0.29] 0.21 [0.11; 0.35] 0.25 [0.15; 0.39]	ŧ
IRAQ ALTAMEEMI 2019 KAREEM 2011 Total (95% CI)	7 17	32 48 80	0.9% 1.2% 2.1%	0.22 [0.09; 0.40] 0.35 [0.22; 0.51] 0.30 [0.18; 0.44]	*
JAMAICA TROTMAN 2012 TROTMAN 2007 GOODEN 2013 Total (95% CI)	96 20 4	286 47 46 379	1.4% 1.2% 0.8% 3.4%	0.34 [0.28; 0.39] 0.43 [0.28; 0.58] 0.09 [0.02; 0.21] 0.28 [0.15; 0.46]	• <b>•</b> •
KOSOVO AHMETI 2010	0	73	0.2%	0.00 [0.00; 0.05]	:
MALAWI RYLANCE 2013 AHLSEN 2015 Total (95% CI)	8 3	71 45 116	1.0% 0.7% 1.7%	0.11 [0.05; 0.21] 0.07 [0.01; 0.18] 0.10 [0.05; 0.17]	ŧ
MEXICO MARTINEZ 2010 OSORNO-COVARRUBIAS 2002	54	152 162	1.4%	0.36 [0.28; 0.44] 0.48 [0.40; 0.56]	+.
SAUCEDO 2008 MONTANO PEREZ 2019 Total (95% CI) MULTI-COUNTRY	334 20	727 52 1093	1.5% 1.2% 5.4%	0.46 [0.42; 0.50] 0.38 [0.25; 0.53] 0.43 [0.37; 0.49]	-
NEOCOSUR 2002	60	126	1.4%	0.48 [0.39; 0.57]	*
POUDEL 2010 ADHIKARI 2017 NEPAL 2020 Total (95% CI)	8 26 0	23 38 3 64	0.9% 1.1% 0.2% 2.2%	0.35 [0.16; 0.57] 0.68 [0.51; 0.82] 0.00 [0.00; 0.71] 0.45 [0.18; 0.75]	
NIGERIA ONALO 2015 AMADI 2015	11 2	42	1.1%	0.26 [0.14; 0.42] 0.09 [0.01; 0.29]	
OGUNLESI 2011 UGWU 2010 CHIDIEBERE 2018 Total (95% CI)	1 6 4	15 149 20 248	0.3% 1.0% 0.7% 3.6%	0.07 [0.00; 0.32] 0.04 [0.01; 0.09] 0.20 [0.06; 0.44] 0.11 [0.05; 0.26]	<u>-</u>
PAKISTAN ALI 2019	0	200	0.2%	0.00 [0.00; 0.02]	:
SERBIA GORDANA 2019	89	157	1.4%	0.57 [0.49; 0.65]	<b>±</b>
SOLOMON ISLAND TOSIF 2019	10	45	1.1%	0.22 [0.11; 0.37]	<b>±</b>
SOUTH AFRICA	52	105	1.3%	0.50 [0.40; 0.59]	
BALLOT 2012 BALLOT 2012 BALLOT 2017	28 224	95 546	1.3%	0.29 [0.27; 0.43] 0.29 [0.21; 0.40] 0.41 [0.37; 0.45]	- <b></b>
KIDAMBA 2018 HENDRIKS 2014 KALIMBA 2013	5 9 101	15 97 382	0.8%	0.33 [0.12; 0.62] 0.09 [0.04; 0.17] 0.26 [0.22; 0.31]	
TSHEHLA 2019 NTULI 2020 VELAPHI 2005 Tota1 (95% CI)	36 26 186	71 50 453 1957	1.3% 1.2% 1.5% 12.6%	0.51 [0.39; 0.63] 0.52 [0.37; 0.66] 0.41 [0.36; 0.46] 0.36 [0.30; 0.43]	<u>,</u>
TANZANIA WINKLER 2020 KLINGENBERG 2003 Total (95% CI)	3 5	8 11 19	0.5% 0.7% 1.2%	0.38 [0.09; 0.76] 0.45 [0.17; 0.77] 0.42 [0.23; 0.85]	
THAILAND SRITIPSUKHO 2007	11	21	0.9%	0.52 [0.30; 0.74]	-
TURKEY SERCE 2014 ATALAY 2013	56 8	179 20	1.4%	0.31 [0.25; 0.39] 0.40 [0.19; 0.64]	+
CETINKAYA 2014 ATASAY 2003 Total (95% CI)	102 16	197 31 427	1.4% 1.1% 4.7%	0.52 [0.45; 0.59] 0.52 [0.33; 0.70] 0.43 [0.31; 0.57]	-
OKELLO 2019 OKELLO 2019 Total (95% CI)	7 14	28 36 64	0.9% 1.1% 2.0%	0.25 [0.11; 0.45] 0.39 [0.23; 0.57] 0.33 [0.21; 0.48]	<b>*</b>
VIETNAM MILES 2017 TRAN 2015 Total (95% CI)	31 1	63 26 89	1.2% 0.3% 1.6%	0.49 [0.36; 0.62] 0.04 [0.00; 0.20] 0.19 [0.01; 0.84]	
Total (95% Cl) Heterogeneity: Tau2 = 0.3000; Chi? -	931,46, 44	13667 = 92 (P	100.0%	0.34 [0.31; 0.37] - 90%	· · · · · · · · · · · · · · · · · · ·
					u 0.2 0.4 0.6 0.8 1 Proportion

Fig 2. Survival until discharge for ELBW neonates based on country of origin.

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Study or Subgroup E	vents	Total	Weight	IV, Random, 95% C	IV, Random, 95% Cl
BUENOS AIRES 2012	225	426	2.1%	0.53 [0.48; 0.58]	
BANGLADESH PERVIN 2015	2	14	1.0%	0.14 [0.02; 0.43]	-
BENIN OMOIGBERALE 2009	128	190	2.1%	0.67 [0.60; 0.74]	<b>‡</b>
BHUTAN PRADHAN 2019	5	18	1.4%	0.28 [0.10; 0.53]	-
BRAZIL DE BRITO 2003	30	70	1.9%	0.43 [0.31; 0.55]	
DE MELLO 2007 DE ARAÚJO 2007 DECARVALHO 2007 Total (95% CI)	24 8 34	51 30 108 259	1.9% 1.6% 2.0% 7.4%	0.47 [0.33; 0.62] 0.27 [0.12; 0.46] 0.31 [0.23; 0.41] 0.37 [0.29; 0.47]	- <b>-</b>
CAMEROON CHIABI 2014	6	75	1.6%	0.08 [0.03; 0.17]	<b>:</b>
CHINA LI 2019	159	307	2.1%	0.52 [0.46; 0.58]	<b>-</b>
KONG 2020 KONG 2016	235 35 101	50 148	2.1%	0.70 [0.55; 0.82]	
SUN 2013 WU 2019	1076	32	1.6%	0.22 [0.09; 0.40]	
XU 2019 ZHANG 2011	101	148 29	2.0%	0.68 [0.60; 0.76] 0.38 [0.21: 0.58]	
ZHANG 2020 ZHOU 2014	20 50	32 72	1.7% 1.9%	0.62 [0.44; 0.79] 0.69 [0.57; 0.80]	
ZHU 2020 Total (95% CI)	308	<b>441</b> 3630	2.1% 21.2%	0.70 [0.65; 0.74] 0.61 [0.53; 0.68]	-
COLOMBIA RUIZ-PELAEZ 2014	43	81	2.0%	0.53 [0.42; 0.64]	*
ETHIOPIA SEID 2019	2	25	1.0%	0.08 [0.01; 0.26]	
MUHE 2019 TAMENE 2020 Total (95% CI)	15 0	104 15 144	1.9% 0.4% 3.3%	0.14 [0.08; 0.23] 0.00 [0.00; 0.22] 0.13 [0.08; 0.20]	•
SACKEY 2019 ABDUL-MUMIN 2020	141 4	539 20	2.1%	0.26 [0.22; 0.30]	-
WELBECK 2003 Total (95% CI)	176	382 941	2.1%	0.46 [0.41; 0.51] 0.32 [0.18; 0.50]	
SEHGAL 2004 ROY 2006	47	9 14	1.1% 1.4%	0.44 [0.14; 0.79] 0.50 [0.23; 0.77]	
MUKHOPADHYAY 2013 SAINI 2016	19 1	169 7	1.9% 0.6%	0.11 [0.07; 0.17] 0.14 [0.00; 0.58]	
BASU 2008 THAKUR 2013	11 28	46	1.7%	0.24 [0.13; 0.39] 0.35 [0.24; 0.46]	
SAHOO 2020	43	95	2.0%	0.33 [0.04; 0.78] 0.45 [0.35; 0.56]	
GUPTA 2020 Total (95% CI)	8	30 495	1.6%	0.27 [0.12; 0.46] 0.30 [0.20; 0.41]	
INDONESIA SISWANTO 2018	94	185	2.1%	0.51 [0.43; 0.58]	<b>±</b>
IRAN BEZAFIZADEH 2018	40	85	2.0%	0.47 (0.36: 0.58)	
NAVAEI 2010 AEJEH 2013	29	122	2.0%	0.24 [0.17; 0.32]	-
BASIRI 2015 Total (95% CI)	24	68 471	1.9% 7.9%	0.35 [0.24; 0.48] 0.35 [0.27; 0.45]	<b>±</b>
MEXICO OSORNO-COVARRUBIAS 2002	11	50	1.8%	0.22 [0.12; 0.36]	<b>±</b>
MULTI-COUNTRY NEOCOSUR 2002	43	95	2.0%	0.45 [0.35; 0.56]	-
NEPAL POUDEL 2010	2	9	0.9%	0.22 [0.03; 0.60]	
NEPAL 2020 Total (95% CI)	1	11	0.4% 1.4%	0.50 [0.01; 0.99] 0.28 [0.09; 0.60]	
NIGERIA ADINMA 2013	0	2	0.4%	0.00 [0.00; 0.84]	
PAKISTAN QAZI 2011	0	3	0.4%	0.00 [0.00; 0.71]	
SERBIA GORDANA 2019	141	220	2.1%	0.64 [0.57; 0.70]	<b>‡</b>
SOUTH AFRICA LUTHULI 2019	14	53	1.8%	0.26 [0.15; 0.40]	
KIDAMBA 2018 KIRSTEN 2012	5 231	15 309	1.3%	0.33 [0.12; 0.62] 0.75 [0.70; 0.80]	-
Total (95% CI)	9	402	6.9%	0.43 [0.17; 0.74]	
THAILAND- MYANMAR BORDER MCGREADY 2018	2	132	1.1%	0.02 [0.00; 0.05]	•
THAILAND PIRIYAPOKIN 2020	50	67	1.9%	0.75 [0.63; 0.84]	=
TUNISIA CHIOUKH 2018	27	109	2.0%	0.25 [0.17; 0.34]	*
SERCE 2014	54	156	2.0%	0.35 [0.27; 0.43]	
KULALI 2019 Total (95% CI)	46	165 358	2.0% 5.8%	0.28 [0.21; 0.35]	-
VIETNAM MILES 2017	2	5	0.8%	0.40 [0.05; 0.85]	
TRAN 2015 Total (95% CI)	2	<b>29</b> 34	1.0% 1.8%	0.07 [0.01; 0.23] 0.17 [0.02; 0.64]	
Total (95% CI)		8412	100.0%	0.39 [0.34; 0.44]	· · · · · · · · · · · · · · · · · · ·
Heterogeneity: Tau2 = 0.4977; Chi =	877.88	, df = 0	50 (P < 0.)	.01); I2 = 93%	0 0.2 0.4 0.6 0.8 1 Proportion

Fig 3. Survival until discharge for ELGANs based on country of origin.

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ELBW neonates and ELGANs with RDS. ELBW survival was 33% (20% - 50%) and ELGANs survival was 37% (28% - 47%) for RDS. While 41% (28% - 56%) of ELBW neonates who underwent invasive ventilation survived, the survival rate was 23% (9% - 48%) for ELGANs.

#### Certainty of evidence

CoE for the primary outcome measure of survival until discharge for ELGANs was moderate and for ELBW neonates was low. While most of the included studies reporting on the primary outcome measure were prospective in design and started with high CoE, they were downgraded for serious inconsistency by one level. The outcome of survival until discharge for ELBW neonates was further downgraded by one level for publication bias. The CoE for other secondary outcomes were very low to low, with retrospective study design and heterogeneity being reasons for downgrading the CoE. The CoE is given in Table 2.

# Discussion

This systematic review and meta-analysis included 192 studies (ELBW neonates– 22,278; ELGANs– 18,338) from LMICs situated in different geographical regions across the globe. To the best of our knowledge, this is the only systematic review evaluating survival and morbidities in ELGANs or ELBW neonates from LMICs.

The primary outcome of the review was the proportion of neonates who had survived until discharge. The results of this study indicate that the overall survival until discharge of ELBW neonates was 34% and ELGANs was 39%, with significant heterogeneity between studies based on the income status, region as well as country of origin. These survival rates are much lower than that reported from HICs [22]. Myrhaug et al. in their meta-analysis (2019) had reported a survival rate of 74% at 25 weeks' and 90% at 27 weeks' amongst neonates born alive in HICs [22]. Such stark differences in survival between LMICs and HICs can be explained by many reasons. Attitudes towards providing life-saving intervention to these immature infants are quite different between LMICs and HICs. In LMICs, the focus of healthcare programmes to reduce NMR comprise predominantly of cost-effective high impact interventions comprising of early essential newborn care services which are predominantly targeted to address mortality in relatively bigger neonates [6, 26]. Decreasing mortality rates in ELGANs in LMICs through establishment of higher level NICUs might impose further financial burden as well as risk of inequity, diverting resources from the relatively more mature neonates. Further, absence of healthcare insurance schemes in LMICs result in financial constraints for parents who eventually have to bear most of the costs incurred [27]. Finally, 'denominator bias' due to lack of surveillance data and consequent inconsistent reporting from LMICs regarding live births versus NICU admissions might also result in significant variability in survival rates in LMICs when compared to HICs [28, 29].

There was significant variation in survival between LMICs as well. Similar findings are also seen in the studies published from HICs [30]. While some studies from HICs have pointed out factors such as differing gestational age cut-offs for instituting active care, selective versus comprehensive care and variations in clinical care practices for babies born at less than 25 weeks' gestation being some of the reasons for varying survival rates between different countries, such comparative studies are lacking for LMICs [31–33]. Differing survival rates between studies from the same LMIC might be explained by the survival gap between rural and urban areas [34]. Whether there are any differences in survival between private versus public sector systems in LMICs still remains a contested topic, it was beyond the scope of our review to look into the same [35]. Differences in health policy, financial resources, access to and use of health

Outcomes	Number of studies	Number of neonates evaluated	Rate (95% CI)	Predominant type of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	СоЕ
ELGANs		1				1				
Survival	66	8,412	39% [34%- 44%]	Prospective	Not serious	Serious	Not serious	Not serious	None	Moderate
Severe IVH	8	2,001	14% [11%- 19%]	Retrospective	Serious	Not serious	Not serious	Serious	-	Very low
PVL	7	1,905	6% [5%- 7%]	Retrospective	Not serious	Not serious	Not serious	Serious	-	Very low
NDI	4	243	29% [23%- 37%]	Retrospective	Not serious	Not serious	Not serious	Serious	-	Very low
СР	2	105	3% [1%- 9%]	Prospective	Not serious	Not serious	Not serious	Very serious	-	Low
PDA requiring intervention	5	511	50% [35%- 65%]	Prospective	Not serious	Very serious	Not serious	Serious	-	Very low
BPD	7	2,809	37% [29%- 47%]	Retrospective	Not serious	Serious	Not serious	Serious	None	Very low
Any sepsis	7	855	40% [25%- 57%]	Retrospective	Not serious	Serious	Not serious	Serious	-	Very low
Culture positive sepsis	7	2,301	21% [12%- 32%]	Retrospective	Not serious	Not serious	Not serious	Serious	-	Very low
NEC stage ≥II	14	4,094	8% [7%- 10%]	Retrospective	Not serious	Not serious	Not serious	Serious	-	Very low
Severe ROP	14	6,003	22% [16%- 30%]	Retrospective	Not serious	Serious	Not serious	Not serious	None	Very low
ROP requiring intervention	14	1,796	20% [13%- 29%]	Retrospective	Not serious	Not serious	Not serious	Not serious	None	Low
Outcomes			Rate (95% CI)	Predominat type of studies	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall Certainty of Evidence
ELBW neonates										
Survival	92	13,667	34% [31%- 37%]	Prospective	Not serious	Serious	Not serious	Not serious	Serious	Low
Severe IVH	11	1.098	14% [9%- 20%]	Retrospective	Not serious	Not serious	Not serious	Not serious	None	Low
PVL	8	616	7% [4%- 11%]	Retrospective	Not serious	Not serious	Not serious	Serious	-	Very low
NDI	1	30	17% [6%- 35%]	Prospective	Not serious	-	Not serious	Very serious	-	Low
PDA requiring intervention	4	486	15% [7%- 30%]	Retrospective	Not serious	Serious	Not serious	Serious	-	Very low

#### Table 2. Certainty of evidence for the primary outcome and all secondary outcomes for ELBW neonates and ELGANs.

BPD	10	594	39% [30%- 48%]	Retrospective	Not serious	Serious	Not serious	Serious	None	Very low
Any sepsis	12	1,284	37% [28%- 48%]	Prospective	Not serious	Serious	Not serious	Serious	None	Low
Culture positive sepsis	11	1,465	28% [21%- 35%]	Retrospective	Not serious	Serious	Not serious	Serious	None	Very low
NEC stage ≥II	14	2,914	8% [7%- 10%]	Retrospective	Not serious	Not serious	Not serious	Serious	Serious	Very low
EUGR	2	107	88% [80%- 93%]	Retrospective	Serious	Not serious	Not serious	Serious	-	Very low
Severe ROP	17	5,413	24% [19%- 30%]	Retrospective	Not serious	Not serious	Not serious	Not serious	None	Low
ROP requiring intervention	11	1,293	18% [12%- 27%]	Retrospective	Not serious	Not serious	Not serious	Not serious	None	Low

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services, infrastructure, and economic development might also explain the significant variability in survival between countries of similar economic status [36-38].

Sensitivity analysis indicated that there was no significant differences in the survival rates between the two epochs (epoch 1: 2000–2009 and epoch 2: 2010–2019). Similar findings were noted in the meta-analysis by Myrhaug et al. for HICs [22]. However, some neonatal network studies from other HICs have shown both an improving as well as static trend for survival in the past few decades [39-43]. The rates of some secondary outcomes such as NEC and PVL were comparable with data from HICs [40-42]. This might be due to the fact that many of the HICs provide active care for neonates born from 22 weeks' gestation who are at the highest risk of major brain injury, whilst most of the ELBW neonates and ELGANs enrolled in studies from LMICs were of higher gestational ages ranging from 25–27 weeks [31, 33, 40, 44]. However, rates of all other morbidities were higher in LMICs when compared to HICs. Information from limited studies in the meta-analysis have shown that the rates of NDI was 17% (7% -34%) and 29% (23% - 37%) in ELBW neonates and ELGANs, respectively. Milner et al. in their systematic review and meta-analysis of long-term neurodevelopmental outcomes of preterm VLBW neonates in resource limited settings had reported a lower NDI rate of 21.4% (11.6% -30.8%) [12]. This could be because of the fact that Milner et al.'s study consisted of neonates who were gestationally more mature. Also, many studies from HICs such as Croatia, Korea, Poland and Taiwan were included in their study.

This systematic review had some limitations. There was considerable heterogeneity in the various outcome measures despite performing multiple sensitivity and sub-group analyses to address the same. The analysis might be limited by denominator bias as survival rates could not be assessed based on different denominators such as live births versus NICU admissions, due to inconsistent reporting in studies. Accurate gestational age assessment is still a major issue in LMICs and might have influenced our final estimates. Further, analysis by stratification on the basis of gestational age or birth weight could not be performed for ELGANs and ELBW neonates. Important confounders determining survival such as antenatal corticosteroid use, multiple gestation, SGA status, gender, chorioamnionitis and level of NICU care were not reported by majority of the included studies, thus precluding any sensitivity analysis based on

these parameters. The overall CoE was very low to low for all the secondary outcomes. Finally, though the literature search included the standard databases as recommended by the Cochrane group, studies from LMICs might be more likely to be published in alternative databases as well.

# Conclusion

Mortality and morbidity of ELBW neonates and ELGANs is still a huge burden in LMICs, with significant differences in their occurrence between countries of similar economic status and geographical region of location. For ELBW neonates, the survival for LI, LMI and UMI countries was 18% (11% - 28%), 28% (21% - 35%) and 39% (36% - 42%), respectively. For ELGANs, it was 13% (8% - 20%) for LI, 28% (21% - 36%) for LMI and 48% (42% - 53%) for UMI countries. These are significantly lower than the survival rates reported from HICs. The CoE for most of the outcomes was very low to low, emphasizing the need for surveillance and high quality prospective cohort studies from LMICs on this sub-group of vulnerable neonates. Such studies should provide data related to still births, live births, delivery room deaths, important baseline characteristics such as antenatal corticosteroid use, multiple gestation status, SGA, gender, chorioamnionitis and level of NICU care, and sub-group data on different gestational ages or birth weights for ELGANs or ELBW neonates. Such data would not only quantify the burden of mortality and morbidity in these preterm infants, but also enable evaluating the post-implementation impact of important public health interventions.

# Supporting information

**S1 Checklist. PRISMA checklist for reporting of the review.** (DOC)

**S1** File. This file with tables and figures showing various outcomes assessed, literature search strategy, risk of bias of included studies and references of included studies. (PDF)

# **Author Contributions**

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#### References

- Walani SR. Global burden of preterm birth. Int J Gynaecol Obstet. 2020; 150(1):31–33. https://doi.org/ 10.1002/ijgo.13195 PMID: 32524596
- WHO, March of Dimes, PMNCH, Save the Children. 15 million preterm births: Priorities for action based on national, regional and global estimates. In: Howson CP, Kinney MV, Lawn J, eds. Born Too Soon: The Global Action Report on Preterm Birth. 2012.
- Chawanpaiboon S, Vogel JP, Moller AB, Lumbiganon P, Petzold M, Hogan D, et al. Global, regional, and national estimates of levels of preterm birth in 2014: A systematic review and modelling analysis. *Lancet Glob Health.* 2019; 7:e37–e46. https://doi.org/10.1016/S2214-109X(18)30451-0 PMID: 30389451
- Blencowe H, Cousens S, Oestergaard M, Chou D, Moller AB, Narwal R, et al. National, regional and worldwide estimates of preterm birth. *Lancet*. 2012; 379:2162–2172. <u>https://doi.org/10.1016/S0140-6736(12)60820-4</u> PMID: 22682464
- WHO, Every Newborn: an action plan to end preventable deaths. 2014 <a href="https://www.who.int/maternal\_child\_adolescent/documents/every-newborn-action-plan/en/">https://www.who.int/maternal\_child\_adolescent/documents/every-newborn-action-plan/en/</a> Accessed 10th January 2021.
- 6. Lawn JE, Cousens S, Zupan J. Neonatal survival 1–4 million neonatal deaths: When? Wher? Why? Lancet. 2005; 365:891–900. https://doi.org/10.1016/S0140-6736(05)71048-5 PMID: 15752534
- Gilbert C. Retinopathy of prematurity: a global perspective of the epidemics, population of babies at risk and implications for control. *Early Hum Dev.* 2008; 84:77–82. https://doi.org/10.1016/j.earlhumdev. 2007.11.009 PMID: 18234457
- Mwaniki MK, Atieno M, Lawn JE, Newton CR, et al. Long-term neurodevelopmental outcomes after intrauterine and neonatal insults: a systematic review. *Lancet*. 2012; 379 (9814):445–452. https://doi. org/10.1016/S0140-6736(11)61577-8 PMID: 22244654
- Narang A, Kumar P, Kumar R. Chronic lung disease in neonates: emerging problem in India. Indian Pediatr. 2002; 39:158–162. PMID: 11867845
- Patwardhan SD, Azad R, Gogia V, Chandra P, Gupta S, et al. Prevailing clinical practices regarding screening for retinopathy of prematurity among pediatricians in India: a pilot survey. *Indian J Ophthalmol.* 2011; 59:427–430. https://doi.org/10.4103/0301-4738.86307 PMID: 22011485
- Pascal A, Govaert P, Oostra A, Naulaers G, Ortibus E, Van den Broeck C. Neurodevelopmental outcome in very preterm and very-low-birthweight infants born over the past decade: a meta-analytic review. *Dev Med Child Neurol.* 2018; 60(4):342–355. <u>https://doi.org/10.1111/dmcn.13675</u> PMID: 29350401
- 12. Milner KM, Neal EF, Roberts G, Steer AC, Duke T. Long-term neurodevelopmental outcome in highrisk newborns in resource-limited settings: a systematic review of the literature. *Paediatr Int Child Health.* 2015; 35(3):227–42. https://doi.org/10.1179/2046905515Y.0000000043 PMID: 26138273
- Gladstone M, Oliver C, Van den Broek N. Survival, morbidity, growth and developmental delay for babies born preterm in low and middle income countries—a systematic review of outcomes measured. *PLoS One.* 2015; 10(3):e0120566. https://doi.org/10.1371/journal.pone.0120566 PMID: 25793703
- 14. Viraraghavan Vadakkencherry Ramaswamy, Abiramalatha Thangaraj, Tapas Bandyopadhyay, Debasish Nanda, Prathik Bandya. Morbidity and mortality of extremely low gestational age neonates in lowand middle- Income Countries–A Systematic Review and meta-analysis. <u>https://www.crd.york.ac.uk/</u> prospero/display\_record.php?RecordID=222873. Accessed 8th January 2021
- Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Med.* 2009; 6(7): e1000100. https://doi.org/10.1371/journal.pmed. 1000100 PMID: 19621070
- Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. Systematic Reviews. 2016 5:210. <u>https://doi.org/10.1186/s13643-016-0384-4</u> PMID: 27919275
- World Bank Country and Lending Groups. https://datahelpdesk.worldbank.org/knowledgebase/articles/ 906519-world-bank-country-and-lending-groups. Accessed 8th January 2021.
- Papile LA, Burstein J, Burstein R, Koffler H. Incidence and evolution of subependymal and intraventricular hemorrhage: a study of infants with birth weights less than 1500 gm. *J Pediatr.* 1978; 92 (4):529–534. https://doi.org/10.1016/s0022-3476(78)80282-0 PMID: 305471
- Bell MJ, Ternberg JL, Feigin RD, Keating JP, Marshall R, Barton L, et al. Neonatal necrotizing enterocolitis: therapeutic decisions based upon clinical staging. *Ann Surg.* 1978; 187(1):1–7. https://doi.org/10. 1097/0000658-197801000-00001 PMID: 413500

- International Committee for the Classification of Retinopathy of Prematurity. The International Classification of Retinopathy of Prematurity revisited. Arch Ophthalmol. 2005; 123(7):991–999. <a href="https://doi.org/10.1001/archopht.123.7.991">https://doi.org/10.1001/archopht.123.7.991</a> PMID: 16009843
- Hayden JA, van Der Windt DA, Cartwright JL, Côté P, Bombardier C. Assessing bias in studies of prognostic factors. *Ann Intern Med.* 2013; 158(4):280. <u>https://doi.org/10.7326/0003-4819-158-4-</u> 201302190-00009 PMID: 23420236
- 22. Myrhaug HT, Brurberg KG, Hov L, Markestad T. Survival and Impairment of Extremely Premature Infants: A Meta-analysis. *Pediatrics*. 2019; 143(2):e20180933. https://doi.org/10.1542/peds.2018-0933 PMID: 30705140
- Egger M, Smith D, Altmand DG. Systematic reviews in health care: Meta-analysis in context. 2. London: BMJ Publishing Group; 2001.
- 24. Iorio A, Spencer FA, Falavigna M, Alba C, Lang E, Burnand B, et al. Use of GRADE for assessment of evidence about prognosis: rating confidence in estimates of event rates in broad categories of patients. BMJ. 2015; 350:h870 https://doi.org/10.1136/bmj.h870 PMID: 25775931
- Hayashino Y, Noguchi Y, Fukui T. Systematic evaluation and comparison of statistical tests for publication bias. J Epidemiol. 2005; 15(6):235–43. https://doi.org/10.2188/jea.15.235 PMID: 16276033
- **26.** Bhat BV, Adhisivam B. Editorial: Improving neonatal survival in India. *Int J Adv Med Health Res.* 2015; 2:1–2.
- Martinez AM, Khu DT, Boo NY. Barriers to neonatal care in developing countries: parents' and providers' perceptions. J Paediatr Child Health. 2012; 48 (9):852–858. https://doi.org/10.1111/j.1440-1754. 2012.02544.x PMID: 22970681
- Guillen U, DeMauro S, Ma L, Zupancic J, Wang E, Gafni A, et al. Survival rates in extremely low birthweight infants depend on the denominator: avoiding potential bias by specifying denominators. *Am J Obstet Gynecol.* 2011; 205(4):329.e1–7. https://doi.org/10.1016/j.ajog.2011.05.032 PMID: 21741613
- 29. Best KE, Seaton SE, Draper ES, Field DJ, Kurinczuk JJ, Manktelow BN, et al. Assessing the deprivation gap in stillbirths and neonatal deaths by cause of death: a national population-based study. Arch Dis Child Fetal Neonatal Ed. 2019; 104(6):F624–F630. <u>https://doi.org/10.1136/archdischild-2018-316124</u> PMID: 30842208
- Shah PS, Lui K, Sjörs G, Mirea L, Reichman B, Adams M, et al. International Network for Evaluating Outcomes (iNeo) of Neonates. Neonatal Outcomes of Very Low Birth Weight and Very Preterm Neonates: An International Comparison. *J Pediatr.* 2016; 177:144–152.e6 https://doi.org/10.1016/j.jpeds. 2016.04.083 PMID: 27233521
- Watkins PL, Dagle JM, Bell EF, Colaizy TT. Outcomes at 18 to 22 Months of Corrected Age for Infants Born at 22 to 25 Weeks of Gestation in a Center Practicing Active Management. J Pediatr. 2020; 217:52-58.e1. https://doi.org/10.1016/j.jpeds.2019.08.028 PMID: 31606151
- Backes CH, Söderström F, Ågren J, Sindelar R, Bartlett CW, Rivera BK, et al. Outcomes following a comprehensive versus a selective approach for infants born at 22 weeks of gestation. *J Perinatol.* 2019; 39(1):39-47. https://doi.org/10.1038/s41372-018-0248-y PMID: 30353079
- Isayama T. The clinical management and outcomes of extremely preterm infants in Japan: past, present, and future. *Transl Pediatr.* 2019; 8(3):199-211. https://doi.org/10.21037/tp.2019.07.10 PMID: 31413954
- **34.** Indian Newborn Action Plan 2014. https://nhm.gov.in/index4.php?lang=1&level=0&linkid=153&lid=174. Accessed 13th January 2021.
- Hanson C, Singh S, Zamboni K, Tyagi M, Chamarty S, Shukla R, et al. Care practices and neonatal survival in 52 neonatal intensive care units in Telangana and Andhra Pradesh, India: A cross-sectional study. *PLoS Med.* 2019; 16(7):e1002860. <u>https://doi.org/10.1371/journal.pmed.1002860</u> PMID: 31335869
- Cheah IGS. Economic assessment of neonatal intensive care. *Transl Pediatr.* 2019; 8(3):246–256. https://doi.org/10.21037/tp.2019.07.03 PMID: 31413958
- Burstein R, Henry NJ, Collison ML, Marczak LB, Sligar A, Watson S, et al. Mapping 123 million neonatal, infant and child deaths between 2000 and 2017. *Nature*. 2019 t; 574(7778):353–358 <u>https://doi.org/ 10.1038/s41586-019-1545-0 PMID: 31619795</u>
- Saugstad OD. Reducing global neonatal mortality is possible. Neonatology. 2011; 99(4):250–7. <a href="https://doi.org/10.1159/000320332">https://doi.org/10.1159/000320332</a> PMID: 21088433
- Norman M, Hallberg B, Abrahamsson T, Björklund LJ, Domellöf M, Farooqi A, et al. Association Between Year of Birth and 1-Year Survival Among Extremely Preterm Infants in Sweden During 2004– 2007 and 2014–2016. JAMA. 2019; 321(12):1188–1199 https://doi.org/10.1001/jama.2019.2021 PMID: 30912837

- 40. Kono Y, Yonemoto N, Nakanishi H, Kusuda S, Fujimura M. Changes in survival and neurodevelopmental outcomes of infants born at <25 weeks' gestation: a retrospective observational study in tertiary centres in Japan. *BMJ Paediatr Open*. 2018; 2(1):e000211 https://doi.org/10.1136/bmjpo-2017-000211 PMID: 29637189
- Ancel PY, Goffinet F; EPIPAGE-2 Writing Group, Kuhn P, Langer B, Matis J, et al. Survival and morbidity of preterm children born at 22 through 34 weeks' gestation in France in 2011: results of the EPI-PAGE-2 cohort study. *JAMA Pediatr.* 2015; 169(3):230–8 <u>https://doi.org/10.1001/jamapediatrics.2014</u>. 3351 PMID: 25621457
- 42. Stoll BJ, Hansen NI, Bell EF, Walsh MC, Carlo WA, Shankaran S, et al. Eunice Kennedy Shriver National Institute of Child Health and Human Development Neonatal Research Network. Trends in Care Practices, Morbidity, and Mortality of Extremely Preterm Neonates, 1993–2012. JAMA. 2015; 314 (10):1039–51. https://doi.org/10.1001/jama.2015.10244 PMID: 26348753
- Costeloe KL, Hennessy EM, Haider S, Stacey F, Marlow N, Draper ES. Short term outcomes after extreme preterm birth in England: comparison of two birth cohorts in 1995 and 2006 (the EPICure studies). *BMJ.* 2012; 345: e7976. https://doi.org/10.1136/bmj.e7976 PMID: 23212881
- Mactier H, Bates SE, Johnston T, Lee-Davey C, Marlow N, Mulley Ket al. Perinatal management of extreme preterm birth before 27 weeks of gestation: a framework for practice. Arch Dis Child Fetal Neonatal Ed. 2020; 105(3):232-239. https://doi.org/10.1136/archdischild-2019-318402 PMID: 31980443