Paediatric residents deliver similar quality simulated neonatal resuscitation using 3:1 and 15:2 ratios

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About 10% of babies need assistance to start breathing at birth and around 1% need chest compressions (CC).[1] However the optimal CC to ventilation ratio (CC:V) remains unclear. Current recommendation: three compressions/one ventilation (3:1), is based on consensus and expert opinions[1,2]. Guidelines also state that higher ratios (15:2) can be used if the primary cause of collapse is cardiac or when arrest happen days after birth.[2]

Guidelines for newborns focus on resuscitation in delivery rooms,[2] but babies may be born outside specialist environments and even have to be resuscitated by laypeople and COVID-19 pandemic has also had impact on resuscitation training.

This study explored two CC:V rations (neonatal vs. paediatric). Our hypothesis was that cardiopulmonary resuscitation (CPR) quality would be similar with 3:1 (neonatal) and 15:2 (paediatric) sequences.

We performed a randomised crossover trial, based on a simulated scenario of initial newborn resuscitation, involving 11 fourth-year paediatric residents who worked in pairs performing four-minute CPR tests (22 with 3:1 and 22 with 15:2 ratio) on a manikin.

CPR quality was analysed with a Laerdal Resusci Baby QCPR linked to a SimPad tablet with SkillReporter Software (Laerdal Medical, Stavanger, Norway). The SimPad provided feedback on depth, release, compression and ventilation rates and volumes delivered. The 2015 European Resuscitation Council targets were used.[2] Ventilations were administered using a 500ml paediatric bag with a round neonatal face mask. Participants did not receive feedback during CPR.

Variables are described as median interquartile ranges (IQR) with 95% confidence intervals (95%CI) and were compared using Mann Whitney's non-parametric test.

CPR quality is presented in Figure S1. CC data showed no significant differences between the ratios for most of the variables (Table 1). Global CC quality, namely correct compressions without error, and the percentage of CC delivered at an adequate rate, were significantly better with the 15:2 ratio. Median CC rate with the 3:1 sequence was faster than recommended and significantly higher than the 15:2 sequence. No significant differences were found for the first five rescue breaths, except for the higher number of ventilations for the 3:1 ratio, as expected.

For decades the recommended CC:V ratio for newborns who needed CPR has been 3:1, based on expert opinion and consensus rather than solid scientific evidence.[1,2] Our results show that the 15:2 option permits similar CPR quality in simulated conditions; the somewhat higher scores for some variables could have been related to prior training or to the needed changes from ventilation to compression with the 3:1 protocol.

As expected, the 3:1 ratio resulted in a higher number of ventilations, but no significant differences were found in terms of effective ventilations. Hemway et al.'s manikin study also showed that 3:1 ratio delivered more ventilations than 5:1 and 15:2 ratios, but their effectiveness was not assessed.[3]

Main reasons for resuscitating newborns are asphyctic but the minimum number of ventilations to reverse the situation are unclear, especially when CC are indicated due to severe bradycardia.[2] Although respiration is essential and mandatory during CPR, return of spontaneous circulation (ROSC) might be compromised if CC are indicated but delivered sub-optimally.

A piglet study that tested different CC:V ratios showed no significant differences in the time to ROSC.[4] As human studies on the subject are currently lacking, randomised clinical trials with asphyxiated newborns could be justified.[5]

Based on our results and their possible practical implications, we believe that the optional paediatric 15:2 ratio could be particularly beneficial in three situations. First, when a newborn needs to be resuscitated but no neonatologists or midwives are present. Second, when only one expert rescuer is present. Third, when COVID-19 limits training. The knowledge gap on this topic suggests that new studies, ideally randomised controlled trials, are needed to assess the role of 15:2 CC:V sequence in newborn's CPR.

This study has limitations. Simulated manikin studies do not create the exact characteristics of a real birth and the participants' reactions may differ in real life. Also, newborn resuscitation is often performed by expert neonatologists not paediatric residents.

In this simulated model, paediatric residents delivered similar CPR quality with the recommended neonatal (3:1) and the paediatric (15:2) CC:V sequences. Therefore, in selected circumstances the paediatric 15:2 CC:V could be an acceptable option.

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Conflicts of interest

The authors have no conflicts of interest to declare.

Abbreviations

CC:V, chest compression to ventilation ratio; CPR, cardiopulmonary resuscitation; ROSC, return of spontaneous circulation

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Table 1. 15:2 *vs* 3:1 CPR quality elements in simulated resuscitations of a newborn needing chest compressions.

	15:2 Paediatric protocol (N=22)		**3:1 Neonatal protocol** (N=22)		*U Mann-Whitney p-value*
	Median (IQR)	**95% CI**	**Median (IQR)**	**95% CI**	
CC global quality (%)	**94.5** (89.3-98.0)	85.8-96.3	81.0 (70.5-90.3)	67.1-85.0	<0.001
% of CC with adequate depth	70.5 (53.3-85.5)	58.9-77.3	72.5 (57.5-87.5)	64.0-80.1	0.511
% of CC with adequate release	95.5 (88.0-100.00)	87.7-96.7	90.0 (74.8-98.0)	81.2-92.0	0.090
CC rate (per min)	123.0 (116.3-125.0)	116.6-130.1	**133.0** (123.8-138.5)	125.1-137.6	0.003
% of CC with adequate rate	**81.0** (72.8-90.0)	71.2-86.07	37.5 (16.5-52.0)	26.0-47.5	<0.001
% with correct hands position	99.5 (92.8-100.0)	88.4-99.6	97.5 (85.3-100.0)	79.9-96.7	0.115
Number of rescue breaths	47.0 (44.0-48.0)	44.7-47.7	**102.5** (89.3-107.5)	90.6-104.5	<0.001
% of breathings deemed effective	97.8 (91.3-100.0)	85.5-99.1	99.0 (95.5-100.0)	94.4-98.9	0.679

Note: Data expressed as median (interquartile range) and 95% confidence intervals.
Abbreviations: CC: chest compressions; IQR: interquartile range; CI: confidence interval

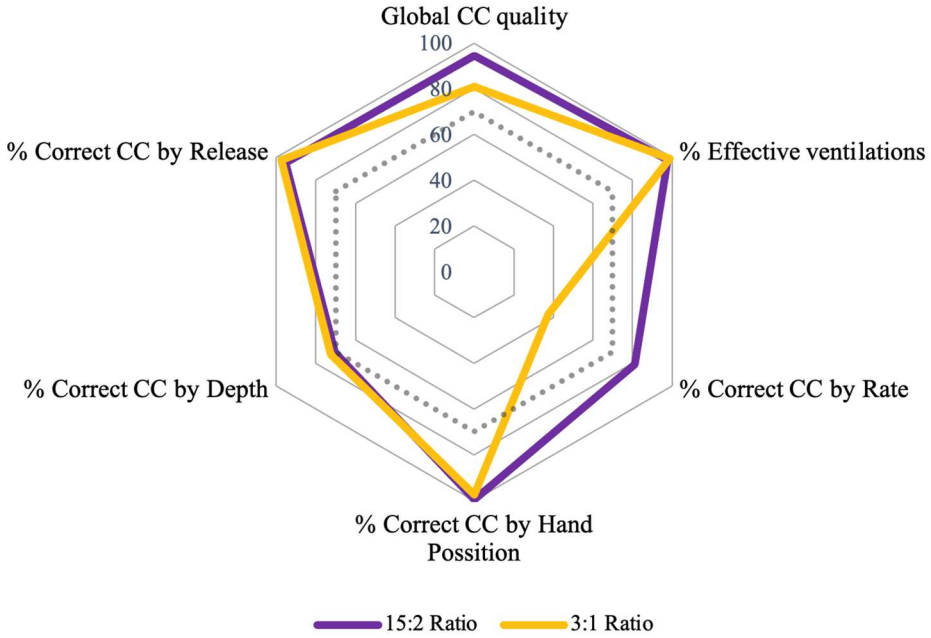

Figure S1. Quality of 44 simulated CPR performances on a manikin, using 15:2 and 3:1 ratios. The dotted line marks the arbitrarily standard cut-off point of 70% of CPR quality.