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Effect of Physical Stimulation on Premature Very Low Birth Weight Infants

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Abstract Globally, prematurity is the leading cause of death in children under the age of 5. And in almost all countries with reliable data, preterm birth are increasing .Therefore, the purpose of the study was to identify the effect of physical stimulation on the weight of premature very low birth weight infants as well as their period of hospitalization .This study was conducted in NICUs of El-Menoufia University hospital and El Gamia El-sharaia NICU in Shebin El-kom city at El-Menoufia Governorate, Egypt. A quasi experimental design was used. A purposive sample of 60 premature very low birth weight infants was included. Newborn were randomly assigned into two equal groups**.** A structured questionnaire was used for data collection; it included newborn gestational age, birth weight, gender, feeding routes, vital signs, associated medical problems and oxygen saturation. The findings of this study revealed that, a daily physical stimulation led to a better weight gain of premature very low birth weight infants (PVLBWI).. In conclusion, implementation of a physical stimulation intervention was associated with a greater weight gain in premature VLBW infants. It is recommended that, physical stimulation intervention should be included in the standard care of premature very low birth weight infants in neonatal intensive care unit.

Keywords: *physical stimulation, premature, very low birth weight infants*

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1. Introduction

A birth is considered "preterm" when a child is born before 37 weeks of pregnancy have been completed. Other categories of preterm birth include late preterm "34–36 weeks", moderately preterm "32–36 weeks", and very preterm "less than 32 weeks" [1] .Premature infants are at a greater risk for short and long term complications [2].

Globally, 15 million babies are born prematurely every year. This is equivalents to 1 in 10 birth. The rate of preterm births has increased over the last 20 years. It thought that, this is because of increased maternal age, increased rate of pregnancy related complications .The global prevalence of LBW is 15.5 % which amount about 20 million LBW infants born each year, 96.5 % of them in developing countries [3]. Very low birth weight was noted in 1.48% of all births, approximately 63,137 US births were reported in 2006 [4].

The shorter the term of pregnancy, the greater the risks of mortality and morbidity for the baby. Preterm-premature babies have an increased risk of death in the first year of life primarily due to the related prematurity, In the U.S. where many infections and other causes of neonatal death have been markedly reduced, prematurity is the leading cause of neonatal mortality at 25% [5].The importance of growth in preterm infants is receiving increased attention due to its relationship to long-term neurodevelopment as well as overall health outcomes**.** Unfortunately, growth often is a secondary issue when the emphasis in NICU is on stabilization and management of acute illness [6].

The nurse must provide gentle rhythmic stimulation in the form of gentle touch, massage, cuddling, stroking and flexing. Soothing auditory stimuli can be given to preterm baby in the form of family voices or music. Visual input provided with the help of coloured objects, diffuse light and eye to eye contact [7].

Experience from developed, low and middle income countries has clearly shown that appropriate care of LBW infants including feeding, temperature maintenance, hygienic cord and skin care and early detection and treatment of infections and complications can reduce mortality [8] and [9]. Because of advances in treatment modalities in newborn medicine, the survival rate of premature infants has steadily increased. Premature born infants have a high chance of neuro-developmental delay as compared to full term born infants. The neonatal intensive care unit environment is rather dangerous than safe due to the noise from many machines and lights, thus leading to infants stress, physiological instability and neurobehavioral delay and so on [10].

In an effort to decrease the immediate adversities and developmental deficits associated with prematurity, numerous researchers have investigated the effects of various types of supplemental stimulation to compensate for environmental deprivation or accelerate the development of premature infants [11] and [12] .

Studies have shown that absence of adequate physical contact leads to increased instability in premature infants and suggested that direct contact by the intervention was

needed to provide the premature infants in NICU with the proper stimulation to compensate for the intrauterine stimulation [13]. Moyer-Mileur et al., 2000 have reported that a daily physical activity program promotes greater gains in body weight and forearm length in premature infants [14]. However little is known about the effects of physical stimulation on premature very low birth weight infants in Egypt.

2. Purpose of the Study

Identify the effect of physical stimulation on the weight of premature very low birth weight infants (PLBWI) as well as their period of hospitalization.

3. Hypotheses

Infants who will participate in physical stimulation intervention will have better weight gain than infants who will not.

Infants who will participate in physical stimulation intervention will have short period of hospitalization than infants who will not.

4. Operational Definition of Physical Stimulation

The physical stimulation intervention is based on the Moyer-Mileur et al., (1995) protocol [15], briefly, this protocol involves extension and flexion and range of motion daily movements with passive resistance of both the upper and lower extremities. Both extension and flexion were performed five times at the wrist, elbow, shoulder, ankle, knee and hip joints. The daily movements were performed 5-10 minutes, five times per week for three weeks by the same trainer.

5. Subject and Method

5.1. Research Design

A Quasi experimental design was used.

5.2. Setting

The study was conducted in neonatal intensive care units (NICU) of El-Menoufia University hospital and El Gamia El-sharaia NICU in Shebin El-kom city at El-Menoufia Governorate, Egypt.

5.3. Sample

It included a purposive sample of 60 newborn whose gestational age is less than 38 weeks of gestation . The sample was assigned randomly into two equal groups. A study group (30 newborn) and control group (30 newborn) .Sample size has been calculated using the following equation: $N= (z^2 \times p \times q)/D^2$ at CI 95% and power 80%. The sample size will be 60 newborn. All newborn who met inclusion criteria were selected.

5.3.1. Inclusion Criteria

- Gestational age below 38 weeks.
- Weight below 1500 gm at study entry.
- Stable vital sings.
- No chromosomal, metabolic and musculoskeletal abnormalities.

5.3.2. Exclusion Criteria

- Newborn on mechanical ventilation.
- Newborn with unstable vital sings.

5.4. Instrument of the Study

One instrument was utilized for data collection.

A structured interview questionnaire used for data collection. It was developed by the researcher to assess characteristics of the newborn and their medical condition that is collected from medical records .The questionnaire consists of newborn gestational age., birth weight, sex, postnatal age, date of admission to neonatal intensive care unit, vital sings, method of feeding, number and amount of feeding per day, oxygen saturation, other associated problems with prematurity and newborn weight before intervention

6. Method

6.1. Written Permission

An official permission to carry out the study was obtained from the directors of NICUs at the study settings after submitting an official letter from the Dean of the Faculty of Nursing, El Menoufia University explaining the purpose of the study. Meetings were conducted first with the director of each unit and head nurse to obtain permission for conducting the research and explaining aim and expected outcome of the study.

6.2. For Protection of Human Rights

Parents were informed about the privacy of their information, the study was voluntary, harmless, and anonymous and confidentiality of responses would be respected. Parents had the full right to refuse to participate in the study at any time. A formal consent from parents was obtained.

6.3. Instrument Development

Instrument was developed by the researcher for data collection after a review of past and current, local and international literature related to very low birth weight infants and prematurity using books, articles, periodicals and magazines to get acquainted with the various aspects of the research problem.

6.3.1. For validity assurance purpose, Instrument was submitted to a jury of three pediatric nursing and medical experts "two professors in pediatric nursing, one professor of neonatology".

6.4. A Pilot Study

It was carried out on 6 preterm very low birth weight infants "10" % of the sample and their parents to test the

clarity, feasibility, and simplicity of the study tool, and time needed for data collection. No modifications were done as revealed from the pilot study. The sample of pilot study was included in the total sample.

7. Procedure

Data was collected over a period of 12 months starting from January 2014 to December 2014.

The program was delivered 5-10 minutes per day, 5 days per week for 3 weeks.

7.1. A. Preparatory Phase

An interview was conducted with mothers to collect characteristics of the infants, then medical records of the infants were used to collect medical data about the infants' .After wards, an assessment of body weight at study entry, vital sings and oxygen saturation of preterm very low birth weight infants in the study and control groups was performed.

7.2. Implementation Phase

-Simple random sampling was used to assign newborn into physical stimulation intervention group

(n=30) and control group (n=30)

-The physical stimulation intervention was based on Moyer- Mileur et.al., (1995) protocol. Briefly, this protocol involves extension, flexion and range of motion daily movements with passive resistance of the upper and lower extremities. Both extension and flexion were performed five times at wrist, elbow, shoulder, ankle, knee and the hip joints. The intervention session was performed for 5 -10 minutes per day, five days per week for 3 weeks by the same researcher. The intervention was performed 15 minutes before feeding, in front of baby mother to provide opportunity for mother to observe intervention and therefore she can perform the intervention in the home after baby discharge from INCU .The researcher performed this intervention in the infants` incubator while keeping a watch on the vital sings displayed on the monitors. Intervention was discontinued when the infant` vital sings became unstable (cyanosis, tachycardia, tachypnea, significant apnea with bradycardia).

-Meanwhile, Infants` in the control group only received routine care of neonatal intensive care unit.

7.3. Evaluation Phase

Posttest was done after the implementation of intervention (3 weeks). They included reassessment of body weight daily at a standard time each day before feeding with digital electronic scale and was approximated to the nearest gram, vital sings and oxygen saturation were monitored five minutes after each daily intervention for newborn in the study group. Also, date of neonate discharge was recorded.

8. Data Analysis

Data was coded and analyzed by using SPSS version 16. Graphics were done using Excel program. Quantitative data was presented by mean and standard deviation. It was analyzed by using T test for comparison between study and control groups. U-test or Mann Whitney U test is used for not normally distributed data. Qualitative data was in the form of number and percentage. It was analyzed by chi-square ($\chi 2$) test. Level of significance was set as P value < 0.05 for all statistical tests

9. Results

Table 1 showed that 63.3% and 46.7 % of the newborn was male in the study and control groups respectively. Regarding gestational age, the same table clarified that the mean and SD was 31.27 ± 2.99 and 31.2 ± 2.07 week in the study and control groups respectively. Also, this table showed that, no statistical significant difference was found between the study and control groups regarding all items.

Table 1. Characteristics of Premature Very Low Birth Weight Infants In The Study And Control Groups

Items	Study No=30		Control No=30		Statistical tests	P-value
	No	**%**	**No**	**%**		
Sex						
Male	19	63.3	14	46.7	$\mathbf{X^2}$=1.68ns	0.19
Female	11	36.7	16	53.3		
Diagnosis						
Preterm	4	13.3	1	3..3	$\mathbf{X^2}$=4.89ns	0.08
Preterm & RDS I	14	46.7	22	73.3		
Preterm &RDS II	12	40.0	7	23..3		
Gestational age by weeks (X ± SD)	31.57 ± 2.99		31.2 ± 2.07		t =0.55ns	0.58
Postnatal age by days (X ± SD)	4.07 ± 3.69		5.07 ± 4.37		t =1.13ns	0.26
Birth weight by gram (X ± SD)	1522.04± 4.27		1500.3 ± 2.44		t =0.24ns	>.05

NB : ^{ns} p>0.05.

Figure 1 clarified that no statistical significant difference was found between the study and control groups regarding newborn sex.

Figure 2 illustrated that 46.7 % of preterm infants was associated with respiratory distress syndrome type I in the study group compared to 73.3 % in the control group.

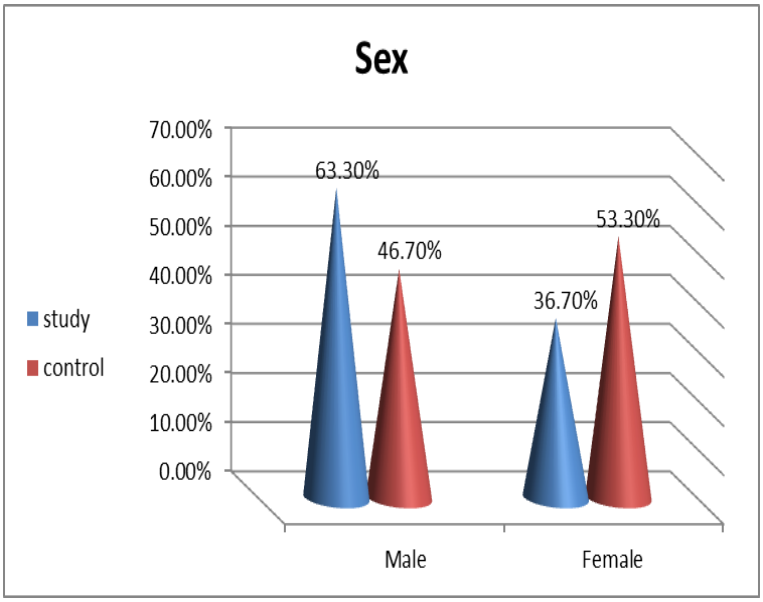

Figure 1. newborn sex

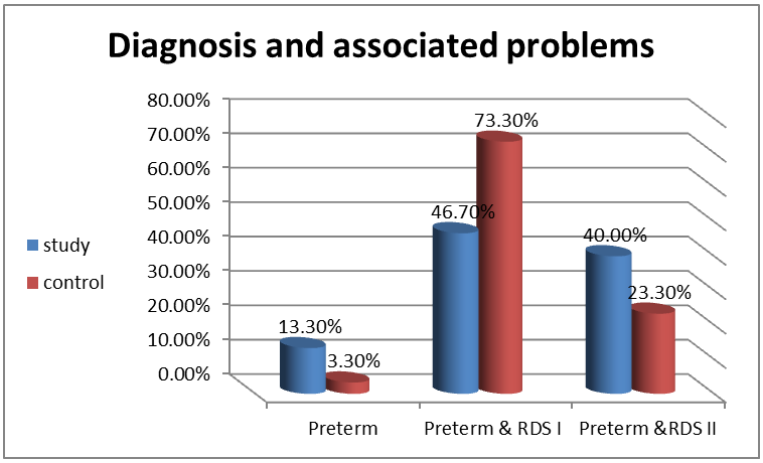

Figure 2. Associated problems with prematurity

Table 2. Comparison Between The Study And Control Groups Regarding To Period Of Hospitalization

Item	Study X ± SD	Control X ± SD	U-test	P
Period of hospitalization .	27.9 ±7.5	39.03±11.99	4.8**	<0.001

U-test=Mann Whitney U test NB : **p< 0.001.

Table 2 illustrated that a highly statistical significant difference was found between the study and control groups regarding mean and SD of length of hospitalization.

Table 3 illustrated that no statistically significant differences were found between the study and control groups regarding mean and SD of pulse and respiratory rate at pre and post intervention .Also, this table showed that statistically significant differences between mean pulse and respiratory rate at pre and post intervention in the study group.

Table 3. Means And Standard Deviations Of Physiological Measures In The Study And Control Groups At Pre And Post Intervention

Items	study X ± SD	Control X ± SD	t-test	P- value
Respiratory rate				
Pre	38.83 ± 5.28	37.9 ± 3.12	0.83ns	>0.05
Post	39.27 ± 5.09	37.97 ± 2.89	1.21ns	>0.05
t-test	3.62*	0.29ns		
P-value	<0.05	>0.05		
Pulse				
Pre	134.33 ± 6.97	136.93 ±4.17	1.75ns	>0.05
Post	135.43 ± 6.5	137.63 ±3.78	1.6ns	>0.05
t-test	3.66*	1.62ns		
P-value	<0.05	>0.05		

NB: ns p>0.05 * p< 0.05.

Table 4 revealed that no statistical significant differences were found between the study and control groups regarding mean weight of newborn before intervention. Mean-while, after intervention, a statistically significant difference was found between the study and control groups regarding mean weight of newborn, mean weight of newborn in the study group was 1668.33±2.81.1gm compared to 1513.33±141.4 gm in the control group.

Table 4. Means and standard deviation of Weight of Premature Very Low Birth Weight infant's in the study and control groups at pre and post intervention

Weight in gm	Study X ± SD	Control X ± SD	t-test	P
Before intervention	1528.67±340.25	1487±234.02	0.69ns	>0.05
Post intervention	1668.33±281.09	1513.33±141.38	2.69*	<0.05

NB: ns p>0.05 * p<0.05.

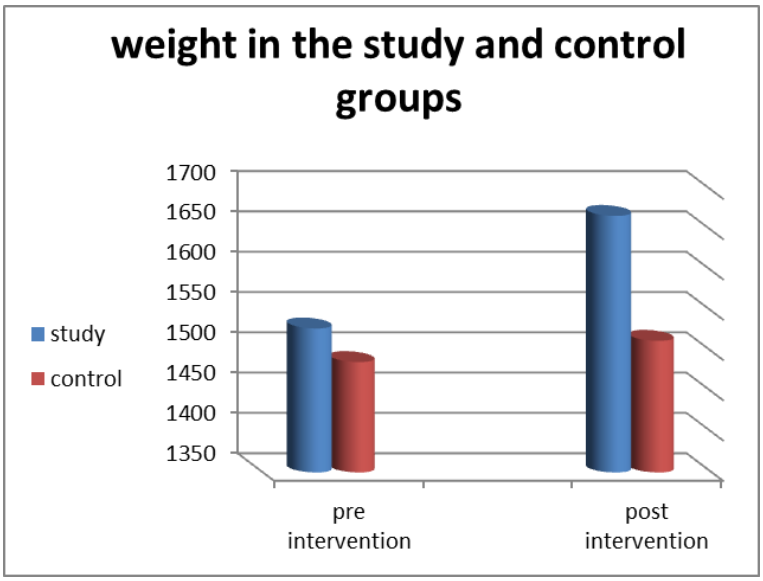

Figure 3. Weight of premature Very Low Birth Weight infants in the study and control groups at pre and post intervention

Figure 3 showed a better weight gain of premature low birth weight infants in the study group more than in control group on posttest.

Table 5 clarified that a statistically significant difference was found between the study and control groups regarding newborn feeding routes.

Table 5. Comparison Between Study And Control Groups Regarding Premature Very Low Birth Weight Infants Feeding Routes

Items	Study		Control		X^2	P-value
	No	%	No	%		
breast feeding	3	10.0	0	0.0	14.04*	0.003
artificial feeding	13	43.3	9	30.0		
gavage feeding	12	40.0	7	23.3		
IV fluids	2	6.7	14	46.7		
Total	30	100	30	100		

NB: * p< 0.05.

Table 6 indicated that a highly statistically significant difference was found between the study and control groups regarding newborn oxygen saturation at pre and post intervention.

Table 6. Mean And Standard Deviation Of Premature Very Low Birth Weight Infants Oxygen Saturation In The Study And Control Groups At Pre And Post Intervention

Oxygen saturation in the first five minutes after feeding.	Study X±SD	Control X±SD	t-test	P-value
Pre	96.93 ±0.98	95.17 ± 2.65	3.42**	<0.001
Post	97.97 ±0.89	95.27 ± 2.86	4.93**	<0.001
t-test	6.66**	0.65ns		
P-value	<0.001	>0.05		

NB : ns p >0.05 **p< 0.001.

Table 7. Correlation between Premature Very Low Birth Weight infants post intervention weight and their Period of hospitalization in the study and control groups

Item	Post intervention weight			
	Study group		Control group	
	r	P -value	r	P -value
Period of hospitalization	-.586**	.001	.170	.370

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7 clarified a highly negative correlation between newborn post intervention weight and their period of hospitalization.

Table 8 revealed that, a highly positive correlation between newborn associated problems and their period of hospitalization..

Table 8. Correlation between Premature Very Low Birth Weight infants associated problems and their Period of hospitalization in the study and control groups

Item	Associated problems			
	Study group		Control group	
	r	P -value	r	P –value
Period of hospitalization	.653**	.000	.092	0.63

**. Correlation is significant at the 0.01 level (2-tailed).

Table 9. Correlation between Premature Very Low Birth Weight infants associated problems and post intervention weight in the study and control groups

Item	Associated problems			
	Study group		Control group	
	r	P -value	r	P –value
Post intervention weight	-.496**	.005	-.097-	0.61

**. Correlation is significant at the 0.01 level (2-tailed).

Table 9 showed that, a negative correlation between newborn associated problems and their post intervention weight.

10. Discussion

Physical activity stimulates bone formation and increase bone mineral density. This is particularly important for premature infants since during the prolonged hospitalization in the NICU, their standard care involves minimal sensory and / or tactile stimulation. Therefore, the limited physical activity of hospitalized premature infants increases the risk of developing bone demineralization and osteopenia of prematurity [16].

The current study revealed a greater weight gain of premature very low birth weight infants (PVLBWI) who received physical stimulation intervention on post test. This finding support the first research hypotheses "Premature very low birth weight infants who will receive physical stimulation intervention will have a better weight gain than infants who will not".

Regarding demographic characteristics of newborn infants, the current study revealed that, no statistically significant differences were found between the study and control groups regarding all items. This may be interpreted as the sample was selected from the same settings with similar medical conditions.

Concerning to period of hospitalization of the newborn in the study and control groups, the present study indicated that newborn in the study group have a short period of hospitalization. This finding supports the second research hypotheses "Premature very low birth weight infants who will receive physical stimulation intervention will have a short period of hospitalization than infants who will not ". This can be rationalized as the newborn in the study group have discharged early from NICU due to better weight gain as a result of implementing physical stimulation intervention. This finding was supported by [17] in their study about **"The Effects of Exercise on Body Weight and Circulating Leptin in Premature Infants"** who reported that a possible beneficial effect of applying a daily movement protocol may include earlier discharge from the NICU due to increased weight gain.

As regard comparison between the study and control groups with respect to physiological measures, the current study revealed a statistically significant difference was found in the study group at pre and post intervention. However, no statistically significant difference was found in the control group. This may be interpreted as the physical stimulation intervention resulted in improving respiratory and cardiac function of the PVLBW.

Regarding mean weight of premature VLBW infant, the present study revealed that, the weight of the PVLBWI in the study group was increased after 3 weeks of physical stimulation intervention**.** However, no significant change was found between weights of the PVLBWI in the control group. This finding come in agreement with [17] in their study about **"The Effects of Exercise on Body Weight and Circulating Leptin in Premature Infants" and [18]** in their study about **" A Daily Physical Activity Program Increased the Rate of Weight Gain and Bone Mass in Preterm Very Low Birth Weight Infants"** who reported that, a daily physical activity program increased the rate of gain in body weight in VLBW preterm infants. Also, **Reference [14]** studied **"Daily Physical Activity Program Increases Bone Mineralization and Growth in Preterm very low-Birth weight Infants"** provide evidence to support a positive correlation between a daily physical activity program and growth and bone mass in VLBW premature infants. This may be rationalized as the daily range of motion movement of upper and lower extremities of VLBW premature infants was associated with increase in body weight resulted from an increase in adipose tissue and muscle mass.

As regard comparison between the study and control groups with respect to feeding routes, the current study revealed a statistically significant difference was found between PVLBWI feeding routes. This may be interpreted as most newborn in the study group take breast feeding, artificial, and gavage feeding, while the minority takes IV fluids. Also, this means that PVLBWI who take breast, artificial and gavage feeding have better weight gain than PVLBWI who take IV fluids.

Concerning premature VLBW infants' oxygen saturation at pre and post intervention in the study and control groups, the current study revealed a statistically significant difference was found in the study group regarding oxygen saturation. However, no statistical significant difference was found in the control group. This may be rationalized as the daily physical stimulation intervention leads to improvement of newborn oxygen

saturation resulted from enhancement of respiratory function.

Regarding correlation between PVLBWI post intervention weight and their period of hospitalization, the study finding indicated a highly negative correlation was found. This can be interpreted as the increasing weight of premature VLBW infants in the study group is responsible for their early discharge from NICU. This finding come in agreement with [17] in their study about **"The Effects of Exercise on Body Weight and Circulating Leptin in Premature Infants"** who stated that, a possible beneficial effect of applying a daily movement protocol may include earlier discharge from NICU due to increased weight gain.

Concerning correlation between PVLBWI associated problems and their period of hospitalization, the current study indicated a highly positive correlation was found. This can be rationalized as the presence of medical problems associated with prematurity such as respiratory distress syndrome has led to long period of hospitalization in NICU.

Regarding correlation between PVLBWI associated problems and their post intervention weight, the current study revealed a negative correlation was found. This means that PVLBWI, who have associated problems other than prematurity, have a slower rate of weight gain.

11. Conclusion

Based on the findings of this study and research hypotheses, it concluded that, implementation of a physical stimulation intervention was associated with a greater weight gain in premature VLBW infants as well as had a short period of hospitalization in NICU.

12. Recommendations

Based on the findings of the current study, the following recommendations can be suggested:-

1- Physical stimulation intervention can be included in the standard care of premature very low birth weight infants in neonatal intensive care unit (NICU).

2- Provide in-service educational program for nurses related to physical stimulation of premature infants in the NICU.

3- For generalizability purpose, the study must be conducted on a larger sample of premature infants without any associated medical problems.

4- Further research is required to determine if there are any adverse effects of physical stimulation on premature very low birth weight infants.

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