

Castor Oil Safety and Effectiveness on Labour Induction and Neonatal Outcome

Sahar Mansour Lamadah^{1,4}, Hoda Abed El-Azim Mohamed^{2,4}, Sahar Mahmood El-Khedr^{3,4}

1 Lecturer of Obstetric and Gynecological Nursing, Faculty of Nursing, Alexandria University, Alexandria, Egypt

2 Assistance professor of Obstetric and Gynecological Nursing, Faculty of Nursing, El Minia University, El Minia, Egypt

3 Assistance professor of Pediatric Nursing, Faculty of Nursing, Tanta University, Tanta, Egypt

4 Faculty of Nursing, Umm Al Qura University, Makkah Al- Mukarramah, KSA

E-mail of the corresponding author: dr.saharlamadah@yahoo.com

Abstract:

Background: Castor oil is one of the most popular methods for labour induction. The use of castor oil to induce labor is controversial. The irregular, painful contractions of castor oil-induced labor can be stressful on the mother and fetus. The use of castor oil may stimulate passage of meconium, and thus, neonatal respiratory distress that may result from meconium aspiration. So, the aim of this study was to assess safety and effectiveness of castor oil on labour induction and neonatal outcome. **Subjects and Methods:** a quasi-experimental design was used. The study was conducted in a private hospital at Makkah Al Mukaramah. One hundred pregnant women who attended the hospital for giving birth was selected from the previously mentioned setting. The sample was divided as follow: 50 women already took castor oil and 50 women didn't take castor oil at the time of birth. **Results:** there were a lot of maternal complications that had been occurred among castor oil group in comparison with control group such as fatigue (12.0%), nausea & vomiting (20.0%) and excessive uterine activity (12.0%) compared to (8.0%, 4.0% ,4.0%) from the control group respectively. About one fifth 18 % of castor oil group had amniotic fluid mixed with meconium. In addition, a highly statistical significant difference was found between the two groups at the first minute APGAR score ($t=2.65$ at $p=0.009$). **Conclusion:** It can be concluded that, the probability of labour initiation increases during the first 24 hours after using castor oil. In addition, taking castor oil increases the chances of meconium stained amniotic fluid. Most side effects caused by taking castor oil are fatigue, nausea, vomiting and diarrhea. Also, castor oil affected newborn's APGOR score at the first minute.

Key words: Castor oil, labour induction, neonatal outcome

1. Introduction:

Labor is a process through which the fetus moves from the intrauterine to the extra uterine environment. It is a clinical diagnosis defined as the initiation and perpetuation of uterine contractions with the goal of producing progressive cervical effacement and dilation (Pillitteri A 2010, Ricci S 2009, Josie I 2003). In an attempt to start labor, some women will drink a mixture of castor oil and juice. The various recipes for this mixture are generally called a "midwife cocktail." The recommended dosage of castor oil varies. It can be between 2 to 4 ounces. Repeated doses may also be needed (Gao et al 1998). Because castor oil is unpalatable alone, it is mixed with orange juice, grape juice, or tea. Some recipes encourage large volumes of juice to dull the flavor of the oil. Other recipes use only equal amounts of oil and juice so the mother has less to drink. This is only one of several non-medical techniques used to try to induce labor, and may be used in combination with other natural techniques (Davis L 1984).

Castor oil has long been used throughout history. In some countries, castor oil is used to terminate pregnancy if it is unwanted or unplanned. In Mexico, women eat the seeds of the castor bean in order to cause permanent sterility. Women in India eat the seeds the day following birth in order to prevent pregnancy for the next nine months. It was reportedly used for medicinal purposes in Ancient Egypt and in the early middle ages in Europe. It was then regarded as a folk medicine (Leino, L 2009).

The United States Food and Drug Administration (FDA) has categorized castor oil as "generally recognized as safe and effective" for over-the-counter use as a laxative, with its major site of action the small intestine (Thomson M 2007). Although it may be used for constipation, it is not a preferred treatment, because it can produce painful cramps, fecal incontinence and explosive diarrhea. Its action can go on for hours, sometimes unpredictably and powerfully causing an involuntary bowel movement at inconvenient locations and during

sleep (Gana, A et al 2013). The use of castor oil to induce labor is controversial. One study showed that women who received castor oil have an increased likelihood of initiation of labor within 24 hours compared to women who did not receive. Following administration of castor oil, 30 of 52 women (57.7%) began active labor compared to 2 of 48 (4.2%) receiving no treatment) (Garry D et al 2000). Castor oil, when ingested, triggers cramping in the bowel, making it an effective laxative. Thus, it is intended that such cramping extends to the uterus. One reason castor oil might work on the uterus to stimulate contractions, is its effect on the smooth muscle tissue, of which the uterus is composed of. In an overdue pregnancy in which the mother's cervix is already effacing and partially dilated, this cramping can lead to labor contractions (Burdock GA et al 2006).

Significance of the study:

The irregular, painful contractions of castor oil-induced labor can be stressful on the mother and fetus. It also leaves the laboring woman quite dehydrated as a result of the vomiting and diarrhea which result when the recommended dose of castor oil for labor induction is taken, about 4 tbsp (Davis L 1984). This leaves mother without access to the energy she could otherwise derive from food or drink throughout her labor process. In addition, the use of castor oil to induce labor may stimulate passage of meconium, and thus, neonatal respiratory distress that may result from meconium aspiration. Using castor oil for induction is not recommended without consulting a medical practitioner and is not recommended in a complex pregnancy (Sullivan M 2010).

2. Aim of the study:

The aim of this study was to assess safety and effectiveness of castor oil on labour induction and neonatal outcome.

3. Hypothesis of the study:

- Women who drink castor oil will have labour initiation within 24 h.
- Women who drink castor oil will experience maternal and neonatal complications during labor than those who do not drinking castor oil.

4. Subjects and Methods:

4.1 Research design:

Research design used for the study was a quasi-experimental design.

4.2 Research setting:

The study was conducted in a private hospital at Makkah Al Mukaramah.

4.3 Research subjects:

One hundred pregnant women who attended the hospital for giving birth was selected from the previously mentioned setting; the sample was divided as follow:

- 50 women already took castor oil
- 50 women didn't take castor oil at the time of birth.

The women were recruited for this study according to the following criteria:

Inclusion criteria:

- Cephalic presentation.
- No contraindications to vaginal delivery.
- Not use other induction agents.

4.4 Tools of data collection:

Tools used for data collection consisted of:

- **An Interviewing Assessment Sheet:** It was designed by the researchers and consisted of three parts:

Part I: is concerned with socio - demographic data such as age, level of education, occupation and residence.

Part II: is concerned with obstetrical history. It consisted of closed ended questions related to number of pregnancy, deliveries, abortions and previous delivery problems if present.

Part III: is concerned with history of the present pregnancy, delivery and castor oil intake and its effect on labour induction and neonatal outcome.

▪ **Partograph:** It is a standardized design done by **WHO (1994)** to help in the management of labor.⁽¹²⁾

This Partograph is basically a graphic representation of the event of labor plotted against time. The fetus is monitored closely on the Partograph by regular observation of the fetal heart rate and color of liquor. Uterine contractions (intensity, duration and frequency in 10 minutes) and maternal vital signs are also assessed.

▪ **Apgar scoring:** it is designed by **Apgar (1966)** for rapid evaluation of the infant's cardio respiratory adaptation after birth and for evaluating the newborns' need for resuscitation.⁽¹³⁾ This method (Apgar score) consists of five variables (heart rate, muscles tone, respiratory effort, reflex irritability and color) are evaluated at one and five minutes after birth.

Scoring of Apgar:

A score of 0, 1, 2, is assigned for each variable. A score of 10 indicates that the newborn in the best possible condition and needs only brief oral and nasal suction to clear the airway. A score below 7 indicates that the infant requires immediate further attention by the physician usually a pediatrician.

4.5 Preparatory phase

Researchers reviewed the current local and international related literature using textbooks, articles, and scientific magazines. This helped the researchers to be acquainted with the problem and guided them in the process of tools designing.

4.6 Validity & Reliability:

To measure content validity of the tools, the researchers assure that items of an instrument adequately represent what are supposed to measure by presented it to experts for revision and validation. Also, using partograph to monitor maternal, fetal condition and progress of labor and using Apgar scoring system for evaluating the newborns' need for resuscitation are considering a standard evidence that support validity of the tools.

To measure the stability of the responses from the same woman and is a form of test retest reliability, the researchers make two separate assessment at two different times. These two data sets from the same woman are then compared with each other using r value. In general r value consider good if they equal response.

4.7 Administrative design:

An official letter clarifying the purpose of the study was directed to the manager of the private hospital requesting his approval for data collection to conduct the study.

4.8 Pilot Study:

A pilot study was conducted with a representative sample of ten women representing 10% of the total study sample to assess the reliability and applicability of the tool. The results of the pilot study helped in the necessary modifications of the tool in which omission of unneeded or repeated questions, adding missed questions was done. The sample of the women who shared in the pilot study was excluded from the main study sample.

4.9 Field work:

The researchers attended the selected hospital two days per week, from 8.00 am. to 12.00 pm. The researchers introduced themselves to the selected women and briefly explained the nature of the study. Then women's consent was obtained. Each woman was interviewed to collect socio- demographic and obstetrical history. After that, for women in castor oil group, the researchers asked them by using closed ended questions about castor oil intake that were received at the time of birth. The researchers immediately recorded all women's answers and expressions. Each interview took for 15-20 minutes with each woman in control and castor oil groups and then women were observed throughout labor.

The effect of castor oil intake on labor induction and neonatal outcome were assessed. The effectiveness of castor oil to induce labour was expressed as time of beginning true uterine contractions after taking oil until birth. Measures associated with safety monitored with a WHO Partograph included fetal distress, Meconium-stained amniotic fluid, tachysystole (excessive uterine activity), abnormal maternal blood pressure during labour, mode of delivery, APGAR score, neonatal resuscitation, post-partum hemorrhage and severe diarrhea. The fetal heart rate is observed through electronic fetal monitoring. Fetal distress was defined as a fetal heart beat repeatedly above 160 or below 120 beats per minute. Uterine tachysystole was defined as more than five contractions within ten minutes. Maternal blood pressure was defined as abnormal when it is above 140/90, or below 90/60 mmHg, and severe diarrhea as diarrhea necessitating intravenous fluid replacement. The researchers

observed complications that occurs during labor and recorded it and estimated duration of labor for both groups. The field work lasted for six months. It started from January 2013 to June 2013.

4.10 Ethical consideration:

- Obtaining the acceptance of women to participate in the study.
- All women were informed that participation is voluntary and that the collected data would be only used for purpose of the study, as well as for their benefit.
- A code number was used for every woman to maintain confidentiality.

4.11 Statistical Design:

Data was collected, coded, tabulated and analyzed, using the SPSS computer application for statistical analysis. Descriptive statistics was used to calculate percentages and frequencies. Significance test was used to estimate the statistical significant differences. A significant P-value was considered when P- value less than 0.05 and it was considered highly significant when P- value less than or equal 0.01.

5. Limitations of the study:

Little number of the researches related to the effectiveness of castor oil to induce labour so further extensive and intensive researches is needed in this area.

6. Results:

6.1 Socio-demographic characteristics of the women:

As shown in **table (1)**, the mean age of castor oil group was 27.52+5.856 compared to 30.2+5.806 of control group. More than one half of both groups (56.0%) had primary, intermediate and /or secondary education. In addition, most of the women from castor oil and control group (80.0%, 88.0%) respectively were housewives. Moreover, more than three quarters of women from castor oil group (76.0%) lived in rural area compared to 64.0% of control group.

6.2 Obstetrical history:

As shown in figure (1), only (10%) of women from castor oil group delivered by cesarean section compared to 6.0% from control group. Furthermore, there were a lot of maternal complications that had been occurred among castor oil group in comparison with control group such as fatigue (12.0%), nausea & vomiting (20.0%) and excessive uterine activity (12.0%) compared to (8.0%, 4.0%, 4.0%) from the control group respectively. In addition, 10.0 % of women from castor oil group suffered from severe diarrhea compared to none of the control group (0.0%). As regards to neonatal complications, 16.0% of newborn from castor oil group suffered from suffocation as compared to 8.0% from control group. In addition, 32.0 % of newborn from castor oil group suffered from bluish coloration in all body compared to 12.0% from control group (Table 2).

6.3 Fetal condition:

As regards to fetal condition, the results of the study showed that the mean fetal heart rate among the castor oil group were (139 +13.7) as compared to (113.6 + 20.77) in the control group with statistically significant differences between the two groups (t. =7.21 at p=0.000) while there is no statistically significant differences between the two groups regarding to fetal movement. As regarding neonatal APGAR scores, the results of the present study showed that highly statistical significant difference was found between the two groups at the first minute APGAR score (t=2.65 at p=0.009). (Table 3)

6.4 Amniotic fluid condition:

Majority of the women in control group had transparent amniotic fluid (94%) as compared to (82%) in the castor oil group. Only 6.0% in control group and 18 % of castor oil group had amniotic fluid mixed with meconium. A highly statistical significant difference was found between the two groups (Z=2.41 at p=0.01). (Figure 2)

6.5 Castor oil:

As shown in figure (3), the most common cause for taking castor oil was labour induction (35%) followed by facilitating labour process (28%) while lubrication to empty the intestine (25%) and 12% of women received castor oil after they became postdate. Table (4) illustrates castor oil intake, it can be observed that, the most common person who prescribed castor oil were the relatives and friends (42.0%) followed by the physician

(28.0%). Less than two thirds of women (60.0%) received castor oil after 40 weeks of gestation. In addition, (74.0%) of women used 50 ml of the oil, most of them (82.0%) mixed it with juice. Uterine contractions began after 2 hours from castor oil intake among (44.0%) of women.

6.6 Labour duration:

As shown in **table (5)**, the mean duration of first, second and third stage of labor in the castor oil group was shorter than in the control group (5.16, 49.28 & 24.78) compared to (6.84, 60 & 30) respectively. A statistically significant difference were found between the two groups in relation to first, third stages of labor and the total duration of labor. (t. = -2.39 at p=.01), (t. =2.87 at p=.005) and (t. =2.93 at p=.004) respectively

6.7 Labor characteristics:

Regarding the relationship between amounts of castor oil taken and labor characteristics, table (6) showed 10.0 % of women who drank 100 ml castor oil had amniotic fluid mixed with meconium and 8.0 % of them delivered by cesarean section, this correlation was highly statistically significant ($X^2 = 16.26$ & $p = .001$) and ($X^2 = 14.49$ & $p = .002$) respectively. Moreover, 14.0 % of women who drank 100 ml castor oil had uterine contractions began immediately after taking oil. However, the difference is statistically highly significant ($X^2 = 25.89$ at $p = .01$).

Table (1): Distribution of the women by their socio-demographic characteristics

<i>Socio-demographic characteristics</i>	Castor oil group (N = 50)		Control group (N = 50)	
	N.	%	N.	%
Mean Age	27.52+5.856		30.2+5.806	
Level of education:				
• Illiterate /Read and write	5	10.0	8	16.0
• Primary/Intermediate/Secondary	28	56.0	28	56.0
• University	17	34.0	14	28.0
Occupation :				
• Working	10	20.0	6	12.0
• House wife	40	80.0	44	88.0
Residence				
• Urban	12	24.0	18	36.0
• Rural	38	76.0	32	64.0

Figure (1): Distribution of the women according to mode of present delivery

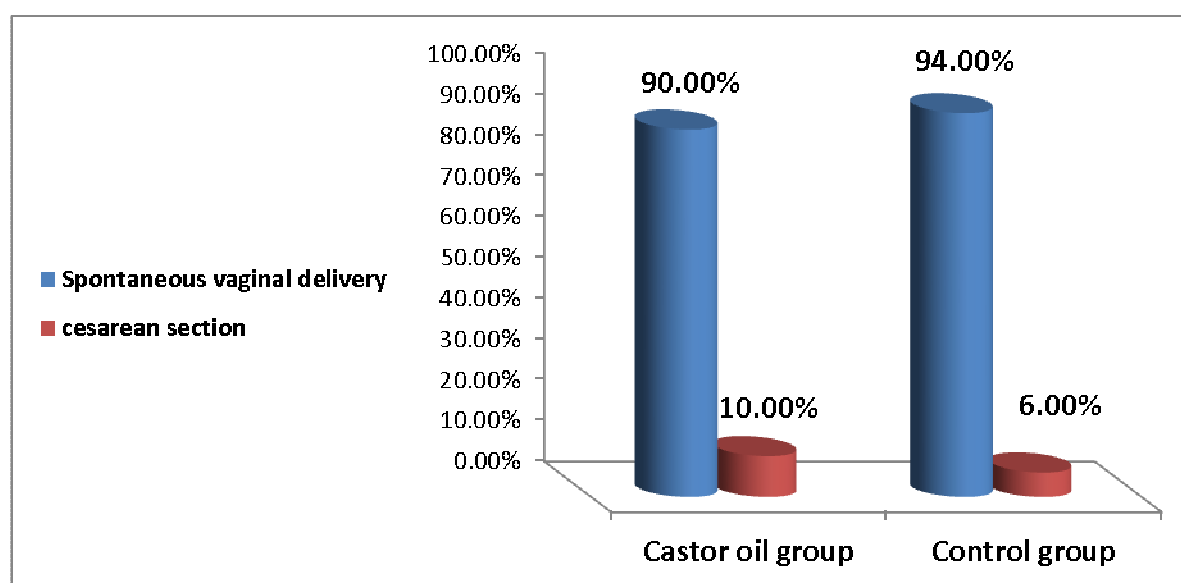


Table (2): Distribution of women according to their complications during labor

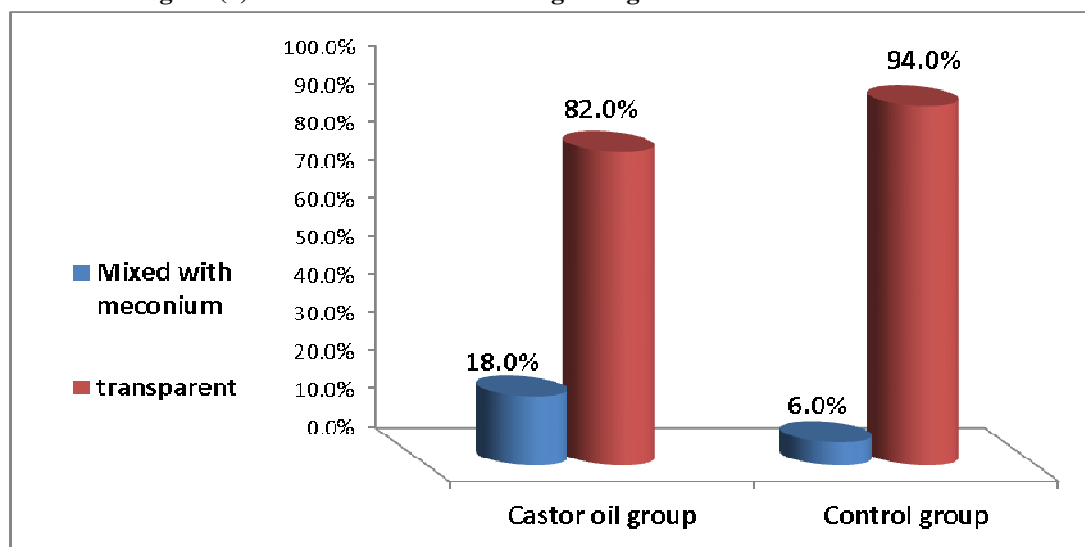
Items	Castor oil group (N = 50)		Control group (N = 50)	
	N.	%	N.	%
Maternal complications*				
• No complications	20	40.0	30	60.0
• Prolonged labor	4	8.0	7	14.0
• Bleeding	1	2.0	3	6.0
• Fatigue	6	12.0	4	8.0
• Nausea and vomiting	10	20.0	2	4.0
• Excessive uterine activity	6	12.0	2	4.0
• Hypertension	2	4.0	1	2.0
• Cervical laceration	2	4.0	2	4.0
• Severe diarrhea	5	10.0	0	0.0
Neonatal complications*				
• No complications	34	68.0	40	80.0
• Suffocation	8	16.0	4	8.0
• Bluish coloration in all body	16	32.0	6	12.0
• Respiratory distress	5	10.0	1	2.0

*Multiple response questions

Table (3): Distribution of women according to fetal condition

Items	Castor oil group (N = 50)		Control group (N = 50)		t.	P. value
	X	±S.D	X	±S.D		
• Fetal heart rate	139	13.7	113.6	20.77	7.21	*.000
• Fetal movement	3.38	1.17	3.84	2.15	1.32	.188
• First minute Apgar score	7.32	.767	7.66	.478	2.65	*.009
• Fifth minute Apgar score	8.26	.650	8.48	.677	1.53	.127

Figure (2): Distribution of women regarding condition of amniotic fluid



(Z=2.41 at p=0.01).

Figure (3): Causes of taking castor oil as reported by the women

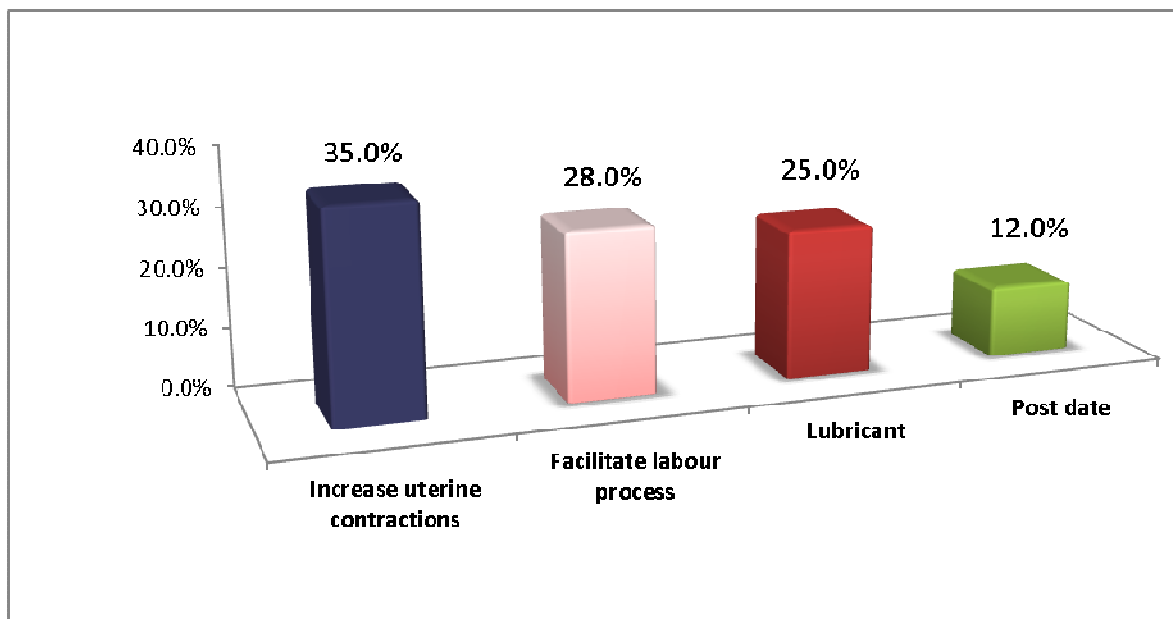


Table (4): Distribution of the women in relation to castor oil intake

Items	Castor oil group (n = 50)	
	N.	%
Person who prescribe the castor oil		
• Physician	14	28.0
• Relatives and friends	21	42.0
• Nurses	9	18.0
• Mothers	6	12.0
Time of taking castor oil		
• After 37 weeks of gestation	3	6.0
• After 40 weeks of gestation	30	60.0
• With the beginning of labor pain.	17	34.0
Amount of castor oil taken		
• 20 ml	3	6.0
• 50 ml	37	74.0
• 100ml	9	18.0
• 150 ml	1	2.0
Mixing castor oil with juice		
• Yes	41	82.0
• No	9	18.0
Onset of uterine contractions after taking oil		
• Immediately	17	34.0
• After 2 hours	22	44.0
• After 4 hours	4	8.0
• After 6 hours	2	4.0
• After 8 hours	5	10.0

Table (5): Comparison between castor oil group and control group in relation to labour duration

Items	Castor oil group (N = 50)		Control group (N = 50)		t.	P. value
	X	±S.D	X	±S.D		
• First stage (hrs)	5.16	3.77	6.84	3.21	-2.39	*.01
• Second stage (min)	49.28	33.40	60	9.69	.59	.55
• Third stage (min)	24.78	6.97	30	3.77	2.87	*.005
• Total duration of labor (hrs)	5.88	3.82	12.5	3.29	2.93	*.004

Table (6): Relationship between amounts of castor oil intake and labor characteristics

Items	Amount of Castor oil (%)				Total	X ²	P. value
	20ml	50ml	100ml	150ml			
	6.0%	74.0%	18.0%	2.0%			
Condition of amniotic membrane							
• Transparent	6.0	68.0	8.0	0.0	82.0	16.26	*.001
• Mixed with meconium	0.0	6.0	10.0	2.0	18.0		
Mode of delivery							
• Normal	6.0	72.0	10.0	2.0	90.0	14.49	*.002
• Cesarean section	0.0	2.0	8.0	0.0	10.0		
Time of beginning of uterine contractions after taking oil							
• Immediately	4.0	16.0	14.0	0.0	34.0	25.89	*.01
• After 2 hours	2.0	40.0	0.0	2.0	44.0		
• After 4 hours	0.0	8.0	0.0	0.0	8.0		
• After 6 hours	0.0	0.0	4.0	0.0	4.0		
• After 8 hours	0.0	10.0	0.0	0.0	10.0		

7. Discussion

The aim of the present study was to assess safety and effectiveness of castor oil on labour induction and neonatal outcome. Results of the current study supported the following investigated hypothesis that women who drank castor oil had labour initiation within 24 h and neonatal complications than those who did not drink castor oil. Induction of labor is "the act of stimulating the uterus to begin labor", with the intent of bringing about the birth of a woman's baby prior to spontaneous physiologic initiation of labor. A castor oil induction consists of taking castor oil orally in an attempt to induce labor naturally (Knoche A et al 2008, Fraser D& Cooper M 2003).

As regards to the socio demographic characteristics of women, it was found that the mean age among the castor oil and control groups was (27.52 and 30.2 years) respectively. As regards to the educational level, the results showed that, more than one half of women from both groups had primary, intermediate and /or secondary education. This may reflect women's cooperation during the study. As regards to their occupation, it also found that, most of the women in both groups were house wives. Moreover, more than three quarters of women who took castor oil were from rural area. Rural women seem to hold on to their traditions more strongly than their urban counterparts. Modernization has brought with it medical dominance.

In relation to the mode of delivery, the current study referred that a minority from each group delivered by cesarean section. These results are in line with the results of a study done by Kelly et al (2010) who reported that, no evidence of a difference was found between caesarean section rates among the two groups. The results are also congruent with the results of Azhari S, et al (2006) who stated that in the castor oil group, 79.2% of cases and 52.2% of the control group had normal vaginal delivery, so there was no significant difference between delivery methods in both groups according to chi-square test ($p>0.05$). However, the results of present study contradicted with the results of a study done by Ravani et al (2006) who showed that there were nearly three times as many caesarean sections in the control group (22.5%) compared to the castor oil group (7.5%).

Leino, L. (2009) reported that drinking castor oil that is supposed to induce labor can cause strong diarrhea and vomiting in the mother. This result is accord with the result of the present study which indicated that one fifth of

woman from castor oil group complained from nausea and vomiting while 10% of them had severe diarrhea. Also Kelly et al (2010) concluded that all women who ingested castor oil felt nauseous. Moreover, The expected maternal side effects of castor oil, which includes watery stools and nausea, did occur in almost patient in the study done by Ravani M (2006).

The present study revealed that there is a highly statistically significant difference between the two groups as regards to first minute APGAR score while no significant difference were detected between two groups at five minute APGAR score, this may be due to the effect of castor oil which may cause neonatal suffocation and respiratory distress immediately after birth. This result is in agreement with the results of a study done by Ravani M., (2006) who reported that all newborn neonates had a 5- minute APGAR score greater than 7 .

About one fifth of women from castor oil group had meconium stained amniotic fluid compared to a minority from control group. A highly statistical significant difference was found between the two groups. This result is in line with the result of a study carried out by gelderen et al (1987) who found that meconium passage was more common in women who had recently taken castor oil . These results are contradicted with the results of the study done by Azhari et al (2006), who reported that the incidence of meconium-stained amniotic fluid was 3 times more common in the control group (13%) than in the castor oil group (4.3%), but the difference was not significant according to the Fisher's exact test ($p>0.05$). In addition, Garry et al (2000) did not detect a significant difference between the incidence of meconium stained amniotic fluid in castor oil and control group. Also, Boel et al (2009) concluded that no harmful effects for the mother or neonate following the use of castor oil to induce labour were observed. Moreover, a study of 100 women, which compared a single dose of castor oil versus no treatment, no evidence of a difference was found between caesarean section rates. No data were presented on neonatal or maternal mortality or morbidity. There was no evidence of a difference between either the rate of meconium stained liquor or Apgar score less than seven at five minutes between the two groups (Kelly et al 2010).

The results of present study show that more than two fifths of woman who drank castor oil had labour initiation after two hours. However, these results are supported by a study done by Garry et al. (2000) which indicated that 57.7% of women who received castor oil began active labor compared to 4.2% receiving no treatment. The bowel stimulation by the castor oil induction triggers the production of prostaglandins, which are hormones that contracts the smooth muscles of bowls and uterus. While Azhari S, etal (2006) concluded that there was no hyper stimulation of uterus in the castor oil group. Also, Boel et al (2009) reported that castor oil for induction of labour had no effect on time of birth nor were there any harmful effects observed in this large series.

The present study indicated that, a statistically significant difference were found between the two groups in relation to the duration of first, third stages and the total duration of labor. the mean duration of first, second and third stage of labor in the castor oil group was shorter than in the control group These results are contradicted with the results of another study done by Boel et al (2009), who reported that castor oil treatment was not associated with a shorter time of birth when compared to women who had not used castor oil.

8. Conclusion:

It can be concluded that, the most common cause for taking castor oil was for labour induction. The probability of labour initiation increases during the first 24 hours after using castor oil. It is associated with a shorter time of birth when compared to women who had not used castor oil. In addition, taking castor oil increases the chances of meconium stained amniotic fluid. Most side effects caused by taking castor oil are fatigue, nausea, vomiting and diarrhea. Also, castor oil affected newborn's APGOR score at the first minute.

9. Recommendations:

Based on the findings of the present study, the following recommendations are suggested:

- Choosing to take castor oil to induce labor is a decision that should not be made lightly.
- Different health education methods should be available to increase awareness of the pregnant women about not consuming any substances without doctor's order
- It is very important that women get the appropriate dosage from midwife or obstetrician before trying any castor oil induction

For further research

- Further studies should be carried out on a large number of women to examine the relationship between castor oil intake and fetal distress.

10. References:

- Apgar V. The newborn Apgar scoring system. Reflections and advice, *Pediatric Clinics of North America* 1966; 113, 645 - 650.
- Azhari S, Pirdadeh S, Lotfalizadeh M, Shakeri M. Evaluation of the effect of castor oil on initiating labor in term pregnancy. *Saudi Med J* 2006; 27: 1011–1014.
- Boel M, Lee S, Rijken M, et al. Castor oil for induction of labour: not harmful, not helpful. *Gynecology* 2009 Oct;49(5):499-503.
- Burdock GA et al. Sodium ricinoleate. *Food Chem Toxicol* 2006, 44 (10): 1689-98.
- Davis L. The use of castor oil to stimulate labor in patients with premature rupture of membranes. *J Nurs Midwifery* 1984; 29(6): 366-370.
- Fraser D, Cooper M . Myles' Textbook for Midwives , 14 ed. Churchill Livingstone (2003); 415-446.
- Gana, A, Yusuf A, Apuyor B. Castor oil plant and its potentials in transformation and industrialization of under developing nations in the world. *Advanced Journal of Agricultural Research* 2013;1(5): 72-79.
- Gao J, Sun N, Wang F, Hao N. Effect of castor oil diet on initiation of labour. *Zhongguo Yi Xue Ke Xue Yuan Xue Bao* 1998 Oct; 20(5):367-70
- Garry D, Figueroa R, Guillaume J, Cucco V. Use of castor oil in pregnancies at term. *Alternative therapies in health and medicine* 2000; 6: 77–79.
- Gelderen C, Mitri F, Hofmeyr GJ. Meconium during labour--self-medication and other associations. *S Afr Med J* 1987 Apr 4;71(7):431-3.
- Josie I, Tenore M. Methods for cervical ripening and induction of labor. *Am Fam Physician* 2003;67(10):2123-2128.
- Kelly A , Kavanagh J, Thomas J. Castor oil, bath and/or enema for cervical priming and induction of labour *Cochrane Database of Systematic Reviews* 2010, Issue 2. Art. No.: CD003099. DOI: 10.1002/14651858.CD003099.
- Knoche A, Selzer C, Smolley K. Methods of stimulating the onset of labor: An exploration of maternal satisfaction. *Journal of Midwifery and Women's Health* 2008; 53(4), 381-387.
- Leino, L. (2009): Thinking of Using Castor Oil to Induce Labor? Think Again!. Retrieved March 12, 2011, from <http://ezinearticles.com/?Thinking-of-Using-Castor-Oil-to-Induce-Labor?-Think-Again!&id=3032978>
- Pillitteri A. *Maternal and child health nursing: Care of the childbearing and childrearing family*, 6th ed. Philadelphia: Lippincott Williams &Wilkins (2010);415-446.
- Ravani M, Montazeri S, Afshari P, Souri H. A study on the safety and efficacy of castor oil for cervical ripening and labor induction. *Jundishapur Scientific Medical Journal* 2006; 5(1 (48));398-404.
- Ricci S. *Essentials of maternity, newborn and women's health nursing*.(2nd ed) Philadelphia: Lippincott Williams &Wilkins (2009); 336 -357.
- Sullivan M, Hehir M, O'Brien J, Morrison J. 17 alpha-hydroxyprogesterone caproate vehicle, castor oil, enhances the contractile effect of oxytocin in human myometrium in pregnancy. *American Journal of Obstetrics & Gynecology* 2010 ; 202(5) , 453.e1-453.e4.
- Thomson M . *Oil DRUGDEX System*. (2007). Ingredient List P-Z" . FDA p. 65.
- World Health Organization: (1994). World health organization in management of labor. *Lancet*, (343), PP. 1399-1404.