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Red ginger – date beverage improves labor progress in primigravidas

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ABSTRACT

Background: Maternal fatigue during active labor is associated with ineffective uterine contractions, prolonged labor, and increased obstetric interventions. Although date fruit and red ginger have each demonstrated potential benefits for maternal endurance and labor outcomes, no previous clinical study has evaluated their standardized combination as a functional nutritional beverage during active labor. This evidence gap limits the development of affordable complementary nutritional strategies for intrapartum care. Objective: To evaluate the effectiveness of JAKUMA, a standardized beverage containing red ginger (Zingiber officinale var. rubrum) and dates (Phoenix dactylifera L.), in reducing maternal fatigue and improving first-stage labor progress among primigravida women. Methods: A quasi-experimental, non-randomized, posttest-only control group study was conducted among 60 primigravida women during active labor. Thirty participants received JAKUMA (3 g standardized red ginger powder, 50 g seedless dates, and 250 mL warm water) in addition to standard intrapartum care, while 30 received standard care alone. Maternal fatigue was assessed using the Numerical Fatigue Scale, whereas labor progress was evaluated by active labor duration and cervical dilatation rate. Results: Compared with standard care, JAKUMA significantly reduced maternal fatigue (4.42 ± 1.47 vs. 5.58 ± 1.61; Cohen's d = 0.75; p = 0.005), shortened active labor duration (258.4 ± 41.7 vs. 289.3 ± 46.1 minutes; Cohen's d = 0.70; p = 0.008), and increased cervical dilatation rate (1.42 ± 0.23 vs. 1.25 ± 0.29 cm/hour; Cohen's d = 0.65; p = 0.013), indicating moderate clinically meaningful effects. Conclusion: This study is the first to demonstrate the effectiveness of a standardized red ginger–date beverage administered during active labor. The findings provide preliminary evidence supporting JAKUMA as an affordable, culturally acceptable complementary nutritional intervention to improve maternal endurance and physiological labor progression, while contributing to the evidence base for complementary intrapartum care and informing future clinical research.

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1. Introduction

Maternal fatigue is one of the most common physiological and psychological symptoms experienced during labor and has become an increasingly important focus of contemporary intrapartum care. Previous evidence indicates that approximately 40–80% of women experience moderate to severe fatigue during the active phase of labor, depending on the stage of labor and the assessment instrument used. Excessive maternal fatigue has been associated with reduced uterine contractility, prolonged labor, increased obstetric interventions, postpartum hemorrhage, delayed postpartum recovery, and lower maternal satisfaction with the childbirth experience. Consequently, maintaining maternal energy and endurance during labor is increasingly recognized as an essential component of evidence-based maternity care aimed at improving both maternal and neonatal outcomes (Chaisitsanguan et al., 2023; Abedi et al., 2025).

Labor is an energy-demanding physiological process characterized by coordinated uterine contractions and progressive cervical dilatation that ultimately lead to childbirth. During the active phase of the first stage of labor, women require sufficient metabolic energy to sustain effective uterine activity and active maternal participation. Inadequate energy availability may accelerate glycogen depletion, reduce muscular efficiency, and contribute to maternal fatigue, thereby weakening uterine contractions, prolonging labor, and increasing the likelihood of obstetric interventions. For this reason, the World Health Organization recommends supportive intrapartum care that includes appropriate nutritional intake to optimize physiological labor progression while preserving maternal well-being (World Health Organization, 2018; Chaisitsanguan et al., 2023; Abedi et al., 2025).

Nutritional interventions using naturally available foods have attracted increasing attention because they are inexpensive, culturally acceptable, and easily incorporated into routine maternity care. Date fruit (*Phoenix dactylifera* L.) is recognized as a rich source of rapidly absorbable carbohydrates that provide immediate energy during labor while also supplying potassium, magnesium, dietary fiber, and antioxidant compounds. A recent systematic review and dose-response meta-analysis demonstrated that maternal consumption of dates during the peripartum period was associated with shorter labor duration, more favorable cervical dilatation, and an increased likelihood of spontaneous vaginal birth without increasing maternal or neonatal complications (Salajegheh et al., 2024).

Another natural product with potential benefits during labor is red ginger (*Zingiber officinale* var. *rubrum*). Red ginger contains biologically active compounds, including gingerols, shogaols, and zingerone, which exhibit antioxidant and anti-inflammatory properties. Previous systematic reviews have suggested that ginger supplementation may reduce oxidative stress and improve physical well-being, thereby potentially helping women maintain endurance during prolonged muscular activity. Although these studies primarily evaluated general health outcomes rather than labor performance, their findings provide a biological rationale for investigating ginger as a complementary nutritional intervention during childbirth (Morvaridzadeh et al., 2020; Tiani et al., 2024).

Considering their complementary physiological mechanisms, combining dates and red ginger into a single functional beverage may provide greater benefits than administering either ingredient alone. Dates primarily provide readily available carbohydrates to support maternal energy metabolism during labor, whereas red ginger contributes antioxidant and anti-inflammatory bioactive compounds that may reduce oxidative stress associated with sustained uterine activity. Together, these mechanisms may help preserve maternal endurance, improve uterine contraction efficiency, and facilitate physiological labor progression (Cunningham et al., 2022; Fraser & Cooper, 2021).

Although previous studies have investigated the effects of date consumption or ginger supplementation separately, evidence regarding their combined administration during labor remains unavailable. To the best of our knowledge, no published clinical study has evaluated a standardized functional beverage containing both ingredients administered during the active phase of labor. Therefore, this study addresses an important evidence gap by evaluating a practical nutritional intervention that integrates two natural ingredients with complementary physiological actions into a single standardized formulation. The findings are expected to contribute not only to the growing evidence on complementary nutritional strategies during labor but also to provide preliminary clinical

evidence supporting the development of affordable, culturally acceptable, and evidence-based nutritional interventions for improving maternal endurance and labor progress, particularly in low-resource maternity settings.

Therefore, this study aimed to determine the effectiveness of JAKUMA, a functional beverage prepared from date fruit (*Phoenix dactylifera* L.) and red ginger (*Zingiber officinale* var. *rubrum*), in reducing maternal fatigue and improving first-stage labor progress among primigravida women during active labor.

2. Methods

Study Design and Setting

This study employed a quasi-experimental, non-randomized, posttest-only control group design to evaluate the effectiveness of JAKUMA, a functional beverage prepared from red ginger (Zingiber officinale var. rubrum) and dates (Phoenix dactylifera L.), on maternal fatigue and first-stage labor progress among primigravida women. A randomized controlled trial was considered impractical because the intervention had to be administered immediately after participants entered the active phase of labor. Performing individual randomization during this time-sensitive clinical period could have delayed routine obstetric management and interfered with standard intrapartum care. Therefore, a quasi-experimental approach was considered the most feasible design while maintaining participant safety and routine clinical practice.

To minimize contamination between groups, participant allocation was conducted according to a predetermined recruitment schedule rather than individual randomization. Women recruited between 1 February and 15 March 2026 were assigned to the intervention group and received JAKUMA in addition to routine intrapartum care, whereas women recruited between 16 March and 30 April 2026 received routine intrapartum care alone. This sequential allocation strategy reduced the possibility of information exchange between participants and prevented inconsistencies in clinical practice within the same maternity setting. The study was conducted at Mutiara Independent Midwifery Practice, Medan, Indonesia, between February and April 2026.

The minimum sample size was calculated according to the method proposed by Charan and Biswas (2013). An anticipated moderate effect size (Cohen's d = 0.75) was selected because previous nutritional intervention studies have generally reported moderate improvements in maternal fatigue and labor-related outcomes, and this magnitude of effect was considered clinically meaningful for evaluating a complementary nutritional intervention. Assuming a two-sided significance level of 5% and statistical power of 80%, the required minimum sample size was 27 women per group. To compensate for potential participant withdrawal, 30 women were recruited into each group, resulting in a total sample of 60 participants. Eligible women were enrolled consecutively until the predetermined sample size was achieved. Baseline demographic and obstetric characteristics were compared before outcome analysis to assess group comparability (Charan & Biswas, 2013).

Participants

The study population consisted of primigravida women admitted during the active phase of the first stage of labor. Eligibility criteria included singleton pregnancy, cephalic presentation, gestational age between 37 and 42 weeks, cervical dilatation of 4–6 cm at admission, maternal age between 20 and 35 years, and the absence of obstetric complications or chronic maternal medical disorders. Restricting recruitment to women entering the active phase of labor ensured that all participants were evaluated at a comparable physiological stage before receiving the intervention, thereby reducing variability in labor progression.

Women with multiple pregnancy, fetal distress at admission, preeclampsia, diabetes mellitus, antepartum hemorrhage, planned cesarean section, allergy to ginger or dates, inability to consume oral fluids, or refusal to participate were excluded from the study. Because the intervention consisted of a freshly prepared nutritional beverage, blinding of participants and attending midwives was not feasible. However, outcome assessments were performed by trained midwives who were independent of

beverage preparation and administration and who followed standardized assessment procedures throughout data collection to minimize observer bias.

Intervention

JAKUMA was formulated using 50 g of seedless dates, 3 g of standardized red ginger (Zingiber officinale var. rubrum) powder, and 250 mL of freshly boiled warm water. The standardized red ginger powder was obtained from a single commercial manufacturer, and the same production batch was used throughout the study to ensure consistency of the intervention. The beverage was freshly prepared immediately before administration without the addition of sugar, preservatives, flavoring agents, or other ingredients to ensure uniformity across all participants.

Participants allocated to the intervention group consumed one serving (250 mL) of JAKUMA within approximately 10–15 minutes after entering the active phase of labor under the direct supervision of the attending midwife. Direct observation was used to ensure complete consumption of the beverage, and no participant failed to complete the intervention or experienced vomiting immediately after ingestion. Consequently, adherence to the intervention protocol was 100% throughout the study.

Participants assigned to the control group received routine intrapartum care according to the standard clinical protocol at the study site without JAKUMA supplementation. Following beverage administration, all women were continuously monitored for any adverse reactions or unexpected clinical events until the completion of the active phase of labor. No intervention-related adverse events were observed during the study period (Wright et al., 2021).

Outcome Measures

Maternal fatigue served as the primary outcome and was assessed at the completion of the active phase of labor using the Numerical Fatigue Scale (NFS), an 11-point self-reported scale ranging from 0 (no fatigue) to 10 (worst imaginable fatigue). The NFS was selected because it provides a rapid, simple, and clinically practical assessment of perceived fatigue. Numeric fatigue rating scales have demonstrated acceptable validity, construct validity, reliability, and responsiveness for measuring fatigue severity across clinical populations (Aaronson et al., 1999). Although the NFS has not been specifically validated in laboring women, it was considered appropriate for the present study because women were assessed during the active phase of labor, where prolonged multidimensional fatigue questionnaires are impractical and may interfere with routine intrapartum care.

Baseline fatigue was not assessed because participants were enrolled only after reaching the active phase of labor, during which rapid physiological changes and routine clinical management limited the feasibility of obtaining standardized pre-intervention fatigue measurements. To minimize potential selection bias, all participants met identical eligibility criteria and were recruited at the same stage of labor (4–6 cm cervical dilatation). Baseline demographic and obstetric characteristics were also compared between groups before outcome analysis to confirm their comparability.

The secondary outcomes were active labor duration and cervical dilatation rate. Active labor duration was defined as the time from 4 cm cervical dilatation until complete cervical dilatation and was recorded in minutes. Cervical dilatation rate was calculated by dividing the total cervical dilatation achieved during the active phase by the corresponding duration of labor and was expressed in centimeters per hour (cm/hour)

Labor progress was monitored using the World Health Organization (WHO) partograph as part of routine intrapartum care. All outcome measurements were performed and recorded by trained midwives who were independent of the preparation and administration of the intervention, following standardized clinical procedures to minimize observer bias.

Statistical Analysis

Data processing and statistical analyses were performed using IBM SPSS Statistics version 26. Continuous variables are presented as mean ± standard deviation (SD), whereas categorical variables are summarized as frequencies and percentages. Baseline comparability between the intervention and control groups was evaluated using standardized mean differences (SMDs) in addition to conventional

hypothesis testing. An SMD of less than 0.10 was considered to indicate negligible imbalance between groups.

Before inferential analyses, data normality and homogeneity of variance were assessed using the Shapiro–Wilk and Levene's tests, respectively. Continuous outcomes were compared using the independent-samples t-test because all assumptions for parametric analysis were satisfied. Categorical variables were analyzed using the chi-square test or Fisher's exact test, as appropriate.

Between-group treatment effects are presented as mean differences with 95% confidence intervals together with Cohen's d effect sizes to facilitate interpretation of both statistical and clinical significance. Because no participant withdrew from the study and all outcome data were complete, complete-case analysis was performed without data imputation.

Potential confounding was evaluated by comparing baseline characteristics between groups. Since baseline demographic and obstetric variables were well balanced, with negligible standardized mean differences, additional multivariable adjustment was considered unnecessary. Statistical significance was established at a two-sided p-value <0.05.

Ethical Considerations

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Health Research Ethics Committee of STIKes Flora Medan (Approval No. 237/STIKes-FL/TU-II/2026) before participant recruitment commenced.

All eligible participants received verbal and written explanations regarding the study objectives, intervention procedures, potential benefits, possible risks, confidentiality, and their right to withdraw from the study at any time without affecting the care received. Written informed consent was obtained from all participants before enrolment. The study was not prospectively registered in a public clinical trials registry. Although prospective registration is recommended for interventional studies, ethical approval was obtained before participant recruitment, and all participants provided written informed consent. Therefore, the absence of trial registration did not affect the ethical conduct of the study but is acknowledged as a methodological limitation.

3. Results and Discussion

Participant Flow

A total of 68 primigravida women were assessed for eligibility between February and April 2026. Eight women were excluded, including five who did not meet the eligibility criteria and three who declined to participate. The remaining 60 eligible participants were consecutively recruited and allocated to the intervention group (n = 30) or the control group (n = 30). All participants completed the intervention and outcome assessments without protocol deviations or loss to follow-up. Consequently, all 60 participants were included in the final statistical analysis, resulting in a 100% retention rate (Figure 1).

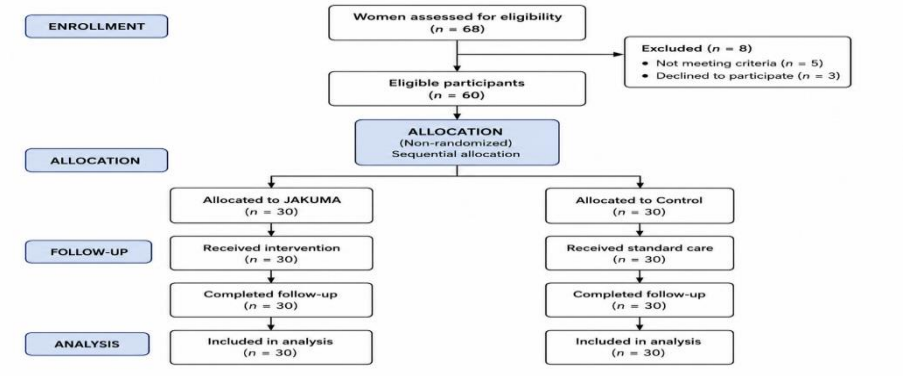

Figure 1. Flow diagram of participant enrolment, sequential allocation, follow-up, and analysis in this quasi-experimental study

Baseline Characteristics

Baseline demographic and obstetric characteristics of participants are summarized in Tables 1 and 2. Group comparability was evaluated using standardized mean differences (SMDs) together with conventional statistical tests.

Sociodemographic Characteristics

Table 1.
Sociodemographic Characteristics

Variable	Intervention (n=30)	Control (n=30)	SMD	p-value
Education, n (%)				
• High school	25 (83.3)	25 (83.3)	0.00	0.81
• College	5 (16.7)	5 (16.7)		
Employment status, n (%)				
• Housewife	18 (60.0)	19 (63.3)	0.00	0.74
• Employed	12 (40.0)	11 (36.7)		
Household monthly income, n (%)				
• Moderate	24 (80.0)	24 (80.0)	0.00	0.68
• High	6 (20.0)	6 (20.0)		

Table 2.
Obstetric Characteristics

Variable	Intervention (n = 30)	Control (n = 30)	SMD	p-value
Maternal age (years)	26.1 ± 3.9	26.5 ± 4.2	0,10	0.72
Gestational age (weeks)	39.0 ± 0.7	39.1 ± 0.8	0,13	0.58
Body mass index (kg/m²)	24.7 ± 2.4	24.9 ± 2.5	0,08	0.76
Hemoglobin (g/dL)	11.6 ± 0.8	11.5 ± 0.9	0,12	0.64
Cervical dilatation at enrollment (cm)	4.8 ± 0.5	4.9 ± 0.6	0,18	0.61
Uterine contractions (per 10 min)	3.1 ± 0.4	3.0 ± 0.4	0,25	0.53
Fetal heart rate (beats/min)	141.2 ± 7.1	140.8 ± 6.8	0,06	0.83

Data are presented as mean ± SD or n (%). p-values were obtained using the independent-samples t-test for continuous variables and the chi-square test or Fisher's exact test for categorical variables, as appropriate

No statistically significant differences were observed between the intervention and control groups with respect to sociodemographic variables, including educational attainment, employment status, and household monthly income (all $p > 0.05$). Similarly, baseline obstetric characteristics—including maternal age, gestational age, body mass index, hemoglobin concentration, cervical dilatation at enrolment, uterine contraction frequency, and fetal heart rate—did not differ significantly between groups (all $p > 0.05$). These findings indicate successful baseline comparability between the intervention and control groups, reducing the likelihood that pre-existing differences influenced the observed treatment effects.

Primary Outcomes

Mothers receiving JAKUMA demonstrated significantly lower maternal fatigue scores than those receiving routine intrapartum care (4.42 ± 1.47 vs. 5.58 ± 1.61). The mean between-group difference was −1.16 points (95% CI: −1.96 to −0.36), indicating significantly lower fatigue in the intervention group ($p = 0.005$). This corresponded to a moderate effect size (Cohen's $d = 0.75$), suggesting that JAKUMA improved maternal endurance during the active phase of labor.

Table 3.
Comparison of maternal fatigue between groups

Variable	Intervention (n=30)	Control (n=30)	Mean Difference (95% CI)	Cohen's d	p-value
Numerical Fatigue Scale (0–	4.42 ±1.47	5.58 ±1.61	−1.16 (−1.96 to −0.36)	0.75	0.005

10)

Secondary Outcomes

Compared with routine intrapartum care, women receiving JAKUMA experienced a significantly shorter active labor duration (258.4 ± 41.7 vs. 289.3 ± 46.1 minutes), with a mean difference of −30.9 minutes (95% CI: −53.6 to −8.2; p = 0.008) and a moderate effect size (Cohen's d = 0.70). In addition, the cervical dilatation rate was significantly higher in the intervention group than in the control group (1.42 ± 0.23 vs. 1.25 ± 0.29 cm/hour), with a mean difference of 0.17 cm/hour (95% CI: 0.04–0.30; p = 0.013) and a moderate effect size (Cohen's d = 0.65). Collectively, these findings demonstrate that JAKUMA was associated with more favorable labor progression during the active phase of the first stage of labor.

Table 4.
Comparison of labor progress between groups

Variable	Intervention (n=30)	Control (n=30)	Mean Difference (95% CI)	Cohen's d	p-value
Active labor duration (minutes)	258.4 ±41.7	289.3 ±46.1	−30.9 (−53.6 to −8.2)	0.70	0.008
Cervical dilatation rate (cm/hour)	1.42 ±0.23	1.25 ±0.29	0.17 (0.04–0.30)	0.65	0.013

Clinical Significance

In addition to achieving statistical significance, the observed treatment effects were also clinically meaningful. Compared with routine intrapartum care, women receiving JAKUMA reported lower maternal fatigue, completed the active phase of labor approximately **31 minutes earlier**, and demonstrated a faster cervical dilatation rate. The moderate effect sizes observed across all primary and secondary outcomes indicate that these improvements were not only statistically significant but also potentially relevant in routine clinical practice. Nevertheless, because this study employed a single-center, non-randomized quasi-experimental design, the findings should be interpreted with caution until confirmed by larger multicenter randomized controlled trials. The overall effects of the intervention on the primary and secondary outcomes are summarized in Figure 2.

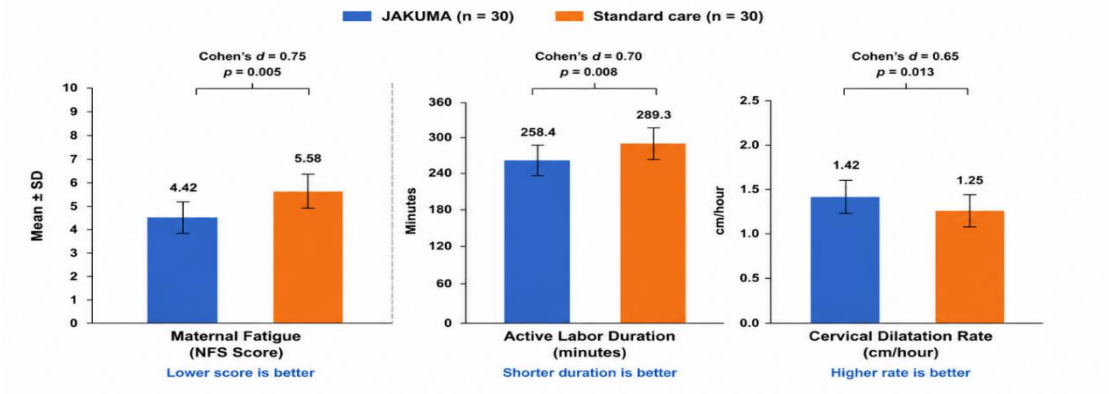

Figure 2. Comparison of maternal fatigue, active labor duration, and cervical dilatation rate between intervention and control groups

Discussion

This study demonstrated that administration of JAKUMA during the active phase of labor was associated with significantly lower maternal fatigue, a shorter active labor duration, and a faster cervical dilatation rate compared with routine intrapartum care alone. Moderate effect sizes were consistently observed across all primary and secondary outcomes, suggesting that the intervention provided

clinically meaningful improvements in maternal endurance and physiological labor progression. Collectively, these findings support the hypothesis that optimizing maternal nutritional support during labor may enhance both maternal functional capacity and the efficiency of the labor process.

The reduction in maternal fatigue observed in this study deserves particular attention because fatigue is not merely a symptom experienced during childbirth but also a factor that may influence labor performance. Women entering prolonged labor often experience progressive depletion of energy reserves, reducing their ability to maintain effective participation throughout the birthing process. In the present study, lower fatigue scores among women receiving JAKUMA may indicate that the intervention helped preserve physical capacity during the period of greatest metabolic demand. Although this study was not designed to investigate metabolic pathways directly, the observed findings are compatible with the hypothesis that improved nutritional support contributes to better maternal functional performance during labor.

The concurrent improvement in labor progression further strengthens this interpretation. Rather than viewing the shorter active labor duration and faster cervical dilatation as independent outcomes, these findings may reflect the same underlying physiological process. Adequate maternal energy availability supports sustained uterine contractility, whereas reduced physical exhaustion may enable mothers to cooperate more effectively during labor (NICE, 2023). Consequently, the beneficial effects observed after JAKUMA administration are more plausibly explained by the interaction of multiple physiological mechanisms than by a single nutritional component.

A biologically plausible explanation exists for these observations. Dates contain readily absorbable carbohydrates capable of rapidly increasing circulating glucose, thereby providing substrate for ATP production during the energy-intensive process of childbirth. At the same time, red ginger contains gingerols, shogaols, and zingerone, compounds that have demonstrated antioxidant and anti-inflammatory activities (Oladapo et al., 2018). By simultaneously improving energy availability and limiting oxidative stress associated with prolonged muscular activity, the combined formulation may create physiological conditions that support both maternal endurance and effective uterine contractions throughout the active phase of labor.

The present findings are consistent with the growing body of evidence supporting nutritional interventions during labor. A recent dose–response meta-analysis by Salajegheh et al. (2024), demonstrated that maternal consumption of dates was associated with shorter labor duration, improved cervical dilatation, and increased spontaneous vaginal birth without increasing maternal or neonatal complications. Likewise, systematic reviews by Morvaridzadeh et al. (2020) and Tiani et al. (2024), reported that ginger supplementation improves antioxidant status and may reduce inflammation, providing biological plausibility for the reduced maternal fatigue observed in the present study. Unlike previous investigations that evaluated dates or ginger separately, the current study examined a standardized combination of both ingredients administered during the active phase of labor, thereby extending existing evidence on complementary nutritional interventions.

The present findings suggest that JAKUMA has the potential to serve as an affordable and culturally acceptable complementary nutritional intervention during labor, particularly in low-resource settings where access to commercial nutritional supplements may be limited. Nevertheless, the current evidence should be regarded as preliminary. Before JAKUMA can be recommended as part of routine clinical practice, its effectiveness and safety should be confirmed through adequately powered multicenter randomized controlled trials involving more diverse obstetric populations. Future studies should also evaluate optimal dosage, timing of administration, cost-effectiveness, maternal satisfaction, neonatal outcomes, and long-term safety. Until such evidence becomes available, JAKUMA should be considered a complementary nutritional strategy rather than a replacement for established evidence-based intrapartum care.

Several methodological strengths support the validity of the present findings. The intervention protocol was standardized before implementation, labor progress was documented using the WHO partograph, outcome assessments were performed by trained midwives independent of intervention administration, and complete follow-up of all enrolled participants eliminated attrition bias.

Furthermore, comparable baseline demographic and obstetric characteristics between groups reduced the likelihood of measurable baseline confounding.

Nevertheless, several limitations should be acknowledged. First, the quasi-experimental non-randomized design introduces the possibility of residual confounding from unmeasured variables despite comparable baseline characteristics, and multivariable adjustment was not performed because no statistically significant baseline imbalances were identified. Second, recruitment from a single maternity center and the relatively modest sample size may limit the generalizability of the findings. Third, maternal fatigue was assessed using a subjective self-report instrument, and baseline fatigue measurements were not feasible because participants were enrolled only after entering the active phase of labor. Fourth, the study was not prospectively registered in a public clinical trials registry. Although ethical approval was obtained before participant recruitment and all participants provided written informed consent, the absence of prospective trial registration may reduce the transparency of the study protocol and should be considered when interpreting the findings. Consequently, the findings should be interpreted with appropriate caution until confirmed by larger multicenter randomized controlled trials.

Future multicenter randomized controlled trials involving larger and more heterogeneous populations are warranted to confirm these findings, determine the optimal formulation and timing of JAKUMA administration, evaluate maternal and neonatal safety, assess cost-effectiveness, and establish whether the intervention can be incorporated into routine evidence-based intrapartum care.

4. Conclusion

Administration of JAKUMA during the active phase of labor was associated with significantly lower maternal fatigue, shorter active labor duration, and faster cervical dilatation among healthy primigravida women compared with routine intrapartum care alone. These findings suggest that improving maternal nutritional support during labor may contribute to enhanced maternal endurance and more favorable physiological labor progression. To our knowledge, this is the first study to evaluate a standardized functional beverage combining red ginger (*Zingiber officinale* var. *rubrum*) and dates (*Phoenix dactylifera* L.) during active labor. The findings provide preliminary evidence supporting the potential of JAKUMA as an affordable and culturally acceptable complementary nutritional intervention. However, because this study was conducted using a single-center quasi-experimental design, the results should be interpreted with appropriate caution. Before JAKUMA can be recommended as part of routine clinical practice, larger multicenter randomized controlled trials are required to confirm its effectiveness, establish the optimal intervention protocol, and further evaluate maternal and neonatal safety.

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