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The role of physical activity during pregnancy and its impact on the course of labour and labor outcomes - a review of literature

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ABSTRACT

Introduction:

Pregnancy is a transformative stage in a woman's life, often accompanied by questions and concerns about the safety of both the mother and the developing child. Key aspects of daily life, including physical activity, diet, and work, are frequently scrutinized, with many misconceptions persisting about what constitutes a healthy pregnancy. However, scientific evidence consistently demonstrates that an active and healthy pregnancy benefits both maternal and neonatal outcomes.

Aim of the study:

This study aims to synthesize current knowledge on the role of physical activity during pregnancy and its impact on labor outcomes. By reviewing recent research, we seek to provide a comprehensive overview of the benefits of physical activity, address barriers to exercise during pregnancy, and highlight evidence-based recommendations. The goal is to raise awareness among healthcare providers and pregnant women about the importance of incorporating physical activity into prenatal care.

Materials and methods:

This study incorporated evidence from peer-reviewed articles, meta-analyses, and randomized controlled trials. Over 55 studies, available on PubMed and Google Scholar were analysed and critically reviewed to create a comprehensive overview of the topic.

Conclusion:

Physical activity during pregnancy is a vital component of prenatal care that promotes maternal and neonatal well-being. Regular exercise reduces the likelihood of pregnancy

complications and improves delivery outcomes. Additionally, it offers long-term benefits for neonatal development. While current guidelines provide a general framework for exercise during pregnancy, personalized recommendations tailored to individual needs are essential to maximize safety and efficacy. This research emphasizes the importance of raising awareness among healthcare providers and pregnant women about the critical role of physical activity in improving health outcomes during pregnancy and beyond.

Keywords: pregnancy, physical activity, course of labour, neonatal outcomes, gestational diabetes, hypertensive disorders of pregnancy, preterm delivery, instrumental delivery, cesarean section.

1. INTRODUCTION.

Pregnancy is a unique stage in a woman's life, during which many questions and concerns emerge regarding the safety of both the mother and the child. They address various aspects of daily life, such as physical activity, diet, work and household chores. Despite countless misconceptions, It has been scientifically proven that a healthy, active pregnancy benefits both the mother and the child [1][2]. Throughout the years it has been observed that with each subsequent pregnancy, women reduce their physical activity, probably due to doubts about the safety of exercise and possible fatigue, physical discomfort or lack of time. Another obstacle reported by pregnant women was lack of professional guidance and insufficient social support [1]. This study aims to report on the current knowledge regarding the role of physical activity during pregnancy and its impact on labor outcomes. The goal of our review is to summarize outcomes of latest studies and create a comprehensive overview of the topic to raise awareness on the topic.

According to WHO [3], it is strongly recommended that pregnant and postpartum women without contraindication, should engage in regular physical activity. Both WHO and ACOG recommend at least 150 minutes of moderate-intensity physical activity during the week for healthy pregnant women [3][4]. Yang et al. [1] specify that physical activity should last at least 30 minutes at a time and less than 60 minutes per session. If implementing those recommendations is not possible, it is advised to engage in any form of physical activity to reduce sedentary time [3][4]. It is also worth mentioning that women, who engaged in vigorous-intensity aerobic activity before pregnancy, can continue that type of activity while pregnant [3]. However, there are some precautions and adjustments that should be taken under

account. Specifically, pregnant women should refrain from high-risk activities such as contact sports, high-altitude exercises and those requiring a supine position after the first trimester. Women with any medical or obstetric complications should be approached individually before any exercise recommendations [4]. It is also highly important to avoid exercising in excessive heat, ensure proper hydration and consult your healthcare provider on warning signs indicating the need to modify or stop physical activity. Regarding the post-partum period it is crucial to return to physical activity gradually and possibly consult with a healt-care provider, especially after delivery by Caesarean section [3].

2. ROLE OF PHYSICAL ACTIVITY DURING PREGNANCY

Physical activity before and during pregnancy is associated with several health benefits. It has been proven to reduce the risk of most common complications of pregnancy such as back pain, gestational weight gain, gestational diabetes, gestational hypertension and preeclampsia. Despite previous concerns and misconceptions, it has been confirmed that physical activity does not increase the risk of miscarriage or stillbirth [1][4]. In this section we aim to present and elaborate on the effect of physical activity on the course of pregnancy.

2.1 Risk of preterm birth

Preterm birth occurs before 37 weeks of gestation and poses an increasing global challenge. Every year 15 million infants are born prematurely worldwide, accounting for approximately 11% of all births [6]. While advancements in effective treatment protocols have been made and the preterms outcomes have improved, it is crucial to identify both risk groups and protective factors to prevent preterm births.

The review of several meta-analysis indicates that maternal physical activity during pregnancy is not associated with an increased risk of preterm birth [7] [8] [9] [10], moreover all of those studies suggest that women who engage in regular physical activity during pregnancy have a lower likelihood of delivering preterm compared to those with lower activity levels. One of those studies [9] focused primarily on overweight and obese women, and the results were consistent with other populations. These results support the safety of physical activity during pregnancy and highlight its potential benefit for maternal and fetal health.

2.2 Gestational diabetes

Gestational diabetes mellitus (GDM), is currently affecting around 14% pregnant women worldwide [11]. It should be noted that this statistic varies greatly between countries due to differences in diagnostic criteria and screening approach. GDM prevalence has been rising alongside obesity and type 2 diabetes [11]. Preventing, early diagnosis and appropriate treatment of GDM is crucial as there is strong evidence that management of gestational diabetes reduces the risk of several pregnancy complications [12][13]. Numerous researchers point out that performing physical activity during pregnancy has been shown to significantly reduce the risk of GDM occurrence, and therefore it presents a preventive potential [1][2][14][15][16][17][18][19]. Paulsen et al. included more than 5700 participants in their meta-analysis and besides confirming the correlation between physical activity and GDM, they compared the effect of exercise modality on GDM. The study states that exercise consisting of aerobic, aerobic and resistance combined, or mind–body exercise have been equally effective and safe in reducing the risk of GDM [16]. The study by Du et al. [17] focused on a population of overweight and obese pregnant women. The results were conclusive with research on the general population and stated that beside significantly lower risk of GDM (RR = 0.71, 95% CI = [0.57-0.89], P = 0.004), the gestational weight gain was also reduced (mean difference=-1.14 kg, 95% CI = [-1.67 to -0.62], P < 0.0001). Meanwhile there are authors that do not confirm those findings. A systematic review by Keating et al, pointed out variable effects regarding exercise as a form of GDM management with no significant influence on pregnancy outcomes, the study included 758 women. [20]. Another meta-analysis by Yin et al also presented insufficient outcomes, and suggested unclear evidence of physical activity impact on GDM development [21]. In a meta-analysis by Díaz-Burrueco et al. [2], in which 6857 women were included, the heterogeneity index (I^2=48%) indicated moderate heterogeneity, suggesting some variability between studies, however the overall analysis remains reliable and the study confirms that physical activity has a protective effect on gestational diabetes (overall OR 0.65, 95 % CI: 0.43, 0.98, I^2 48 %). Despite some ambiguities, the vast majority of researchers agree and confirm that physical activity among pregnant women reduces the risk of GDM.

2.3 Hypertensive disorders of pregnancy

Hypertensive disorders of pregnancy include chronic hypertension, gestational hypertension, pre-eclampsia and chronic hypertension with superimposed pre-eclampsia. All of the above

are recognized as major contributors to maternal and perinatal mortality globally [22]. ACOG also states that despite lower maternal mortality in high-income countries, 16% of maternal deaths are associated with hypertensive disorders [22]. Therefore aside from appropriate treatment and early diagnosis, it is essential to implement preventive strategies and decrease the incidence of hypertensive disorders during pregnancy.

In a meta-analysis previously mentioned [2], in which 6857 women were included, physical activity had a protective effect not only on gestational weight gain and gestational diabetes but also on hypertensive disorders (overall OR 0.51, 95 % CI: 0.31, 0.83, I2 0%). Davenport et al. reported that exercise-only interventions significantly lowered the risk of developing both gestational hypertension (n=5316; OR 0.61, 95% CI 0.43 to 0.85) and preeclampsia (n=3322; OR 0.59, 95% CI 0.37 to 0.9)[23]. In a study focusing primarily on preeclampsia by Aune et al. a reduced risk of preeclampsia was observed with increasing levels of physical activity [24]. Another meta-analysis by Barakat et al. concluded that physical activity improves both SBP and DBP and reduces the risk of hypertensive disorders (RR = 0.44, 95% CI = 0.30, 0.66). However, this study demonstrated unclear evidence on the relationship between physical activity and preeclampsia (RR = 0.81, 95% CI = 0.59, 1.11; p = 0.20). [25]. Similar conclusions were reported in a systematic review and meta-analysis by Magro-Malosso et al. The researchers found that women who engaged in aerobic exercise for 30–60 minutes multiple times per week had a significantly lower risk of gestational hypertensive disorders. However, the incidence of preeclampsia was comparable between the exercise and control groups [26]. Majority of researchers agree that physical activity can significantly decrease the risk of hypertensive disorders during pregnancy [1][3][23][24][25][26], including preeclampsia [1][3][23][24] and therefore contributes to improvement of maternal health.

3. INFLUENCE OF PHYSICAL ACTIVITY ON THE COURSE OF LABOR

3.1 Correlation between activity and perineal incision rates

Recent research has investigated the impact of physical activity, particularly pelvic floor muscle training, on perineal outcomes during childbirth. Stefano Uccella and colleagues conducted a study categorizing women into three groups based on their pre-pregnancy physical activity levels: highly active, moderately active, and inactive. They found that women in the highly and moderately active groups were more likely to continue exercising during pregnancy. Notably, those who emphasized perineal muscle training exhibited a

reduced risk of perineal rupture, which may be attributed to increased flexibility of perineal tissues induced by physical activity [27]. A meta-analysis by Zhang et al., encompassing 30 studies with 6,691 pregnant women, demonstrated that pelvic floor muscle training significantly reduced the incidence of third- and fourth-degree perineal ruptures. However, it did not establish a clear relationship between physical activity and episiotomy rates [28].

These findings suggest that targeted physical activity during pregnancy, particularly exercises focused on the pelvic floor muscles, may enhance perineal tissue elasticity and reduce severe perineal trauma. Further research is warranted to explore the effects of exercise intensity and type on episiotomy rates and other obstetric outcomes.

3.2 Correlation between activity and instrumental delivery rate (forceps, vacuum)

The impact of physical activity during pregnancy on operative delivery has been the subject of several studies. A meta-analysis involving 3,160 women - 1,576 in the intervention group and 1,584 in the control group - found that engaging in physical activity during the second and third trimesters significantly reduced the rate of operative deliveries. All participants were healthy pregnant women with singleton pregnancies and uncomplicated pregnancy courses, free from maternal or fetal disease [29]. Similarly, a meta-analysis conducted by Davenport et al., which analyzed 20 randomized trials involving 38,919 women, demonstrated that physical activity during pregnancy reduced the risk of surgical deliveries by up to 24%. However, the authors noted that the quality of evidence was moderate [5]. A large-scale study conducted among Japanese women (n = 86,295) categorized participants into four groups based on weekly physical activity levels (measured in METs-hr/week): Very Low (0–1.1 METs-hr/week), Low (1.1–8.2 METs-hr/week), Medium (8.2–23.1 METs-hr/week), and High (>23.1 METs-hr/week). Compared to the Medium group, no significant differences in instrumental delivery rates were observed in the Low group. However, both the Very Low (OR:1.12; 95% CI:1.03–1.22; p=0.011) and High (OR:1.12; 95% CI:1.02–1.22; p=0.014) groups showed a higher incidence of instrumental delivery [30].

These findings suggest that moderate physical activity during pregnancy may reduce the likelihood of operative deliveries, while very low or excessively high levels of activity may be associated with increased risks of instrumental delivery. Further research in this field is needed.

3.3 Correlation between activity and rate of the cesarean section

The relationship between physical activity during pregnancy and the incidence of cesarean section (CS) has been extensively studied, yielding consistent findings across multiple investigations.

Chen and colleagues examined 197 pregnant women, categorizing their physical activity levels using counts per minute (CPM) measured by accelerometer in four groups: sedentary time (ST, <100 CPM), light physical activity (LPA, 100–1951 CPM), moderate physical activity (MPA, 1952–5724 CPM), and vigorous physical activity (VPA, ≥5725 CPM). Participants were divided into natural childbirth (n = 120) and cesarean section groups (n = 77). The study revealed that MPA significantly reduced the risk of CS. Specifically, engaging in MPA for at least 37.8 minutes/day during the first trimester was associated with a lower risk of CS (adjusted odds ratio [aOR] 2.62; 95% CI: 1.09–6.32; p = 0.031). However In the second trimester, the threshold was reduced to 17.9 minutes/day (aOR 3.01; 95% CI: 1.57–5.75; p = 0.001). Neither LPA nor ST had a significant impact on CS risk, while VPA was rare (<0.1 min/day) and showed no significant association [31]. Another prospective study by Chen et al., involving 401 participants, found that maintaining a higher mean daily step count during pregnancy significantly reduced the incidence of CS. A threshold of 2,093.5 steps/day was identified as critical for lowering CS risk (odds ratio [OR] 0.22; 95% CI: 0.104–0.465), suggesting that regular walking may be beneficial for promoting vaginal delivery [32].

A meta-analysis of sixty-two studies confirmed these findings, demonstrating that physical activity during pregnancy decreased the incidence of CS with a relative risk (RR) of 0.81 (95% CI: 0.74–0.88; p<0.001). This protective effect was particularly pronounced among overweight and obese women (RR: 0.78; 95% CI: 0.65–0.93) compared to those with normal weight (RR: 0.82; 95% CI: 0.74–0.90). Additionally, younger women benefited more from physical activity in terms of reduced CS rates compared to older age groups [33].

These findings underscore the importance of promoting physical activity as part of prenatal care to improve obstetric outcomes and reduce surgical interventions during childbirth.

3.4 Correlation between activity and duration of labor

Wang et al. conducted a meta-analysis of nine studies (n=2,199) to evaluate the impact of exercise intervention on labor duration. No statistically significant reduction was observed in the duration of the first stage of labor among women who engaged in exercise compared

to controls (mean difference: -27.92 minutes; 95% CI: -70.60 to 14.76; P=0.20). Similarly, analysis of the second stage of labor across 2,119 participants revealed no significant difference between intervention and control groups (mean difference: 0.63 minutes; 95% CI: −4.47 to 5.74; P = 0.81)[34].

A prospective study of 226 pregnant women demonstrated a non-linear, U-shaped association between physical activity during pregnancy and the duration of the first stage of labor. An inflection point was identified at 142.28 MET-h·wk^{-1}. Above this threshold, each additional standard deviation increase in physical activity was associated with a 149.85-minutes reduction in the first stage duration (β: -149.85; 95% CI: -247.54 to -52.17; P=0.0080). Below the inflection point, no significant association was observed (β: 103.91; 95% CI: -38.93 to 246.75; P=0.1565) [35].

Watkins and colleagues analyzed 811 pregnant women using the Kaiser Physical Activity Survey (KPAS) during the third trimester, categorizing them into high physical activity (≥75th percentile KPAS score) and low physical activity (<75th percentile). They have noticed that women with higher physical activity levels experienced a significantly shorter active stage of labor (5.77 ± 4.97 hours vs. 7.43 ± 6.29 hours; $P < 0.01$). They also had a 55% reduced risk of prolonged first-stage labor (adjusted relative risk [aRR]: 0.55; 95% CI: 0.34-0.83; $P < 0.01$). There were no significant differences in the duration of the second stage of labor between the groups (1.29 ± 2.94 vs. 0.97 ± 2.08 hours; $P = 0.15$). These results remained consistent when analyzing KPAS scores from the first and second trimesters, indicating that higher physical activity levels throughout pregnancy were associated with shorter active labor stages and reduced risks of prolonged first-stage labor [36].

A prospective study conducted in Japan assessed habitual physical activity in 103 pregnant women using the Japanese version of the Baecke Physical Activity Questionnaire (BQ). Participants were divided into high-activity (HA) and low-activity (LA) groups based on median BQ scores. Results showed that among nulliparous women, there were no significant differences in the duration of the first stage, second stage, or total labor time between HA and LA groups, even after adjusting for confounding variables. Interestingly among multiparous women, the duration of the second stage of labor was significantly shorter in the HA group compared to the LA group (median: 11 minutes vs. 20 minutes; $P = 0.04$). No significant effects were observed for the first stage or total duration of labor in multiparous women [37].

While evidence supports recommending physical activity during pregnancy for its general health benefits, its impact on labor duration remains inconsistent across studies. Further

research involving larger, more homogeneous cohorts is needed to clarify these relationships and establish standardized guidelines for prenatal physical activity tailored to optimize labor outcomes.

3.5 Correlation between activity and the rate of preinduction/induction of labor

Aspect that has been explored is physical activity's effect on spontaneous labor. The quasi-experimental study conducted at Hospital Senhora da Oliveira between October 2015 and February 2017 examined the impact of a supervised exercise program during pregnancy on labor outcomes in 255 women. Participants were divided into an intervention group (n = 99) and a control group (n = 156), with data collected during the first trimester and after delivery. Women in the control group had significantly higher odds of requiring labor induction compared to those in the intervention group (OR: 2.71; 95% CI: 1.42–5.17; p = 0.003). This suggests that prenatal physical activity may reduce the likelihood of labor induction [38]. However, a study conducted by Wojtyla and coauthors on 300 pregnant women did not show a relevant correlation between physical activity during pregnancy measured by KPAS questionnaire and less frequent occurrence of induced labor [39]. Further research with larger sample sizes and standardized protocols is needed to clarify its specific effects on labor onset, duration, and mode of delivery.

4. INFLUENCE OF PHYSICAL ACTIVITY DURING PREGNANCY ON THE NEONATE

Physical activity during pregnancy has been extensively studied for its effects on both maternal and newborn health. Studies show that engaging in regular, moderate exercise can yield several benefits for newborns, such as healthier birth weights, fewer complications, and better neurodevelopmental outcomes. In this part we want to combine insights from various studies to offer a thorough understanding of how physical activity during pregnancy influences newborn health outcomes.

4.1 Influence of maternal physical activity on NICU Admissions and Neonatal Health Outcomes

Prolonged hospitalization in the neonatal intensive care unit (NICU) following delivery is correlated with a less favorable prognosis and an elevated risk of developing various chronic conditions. These conditions may encompass respiratory, cardiac, renal, and endocrine system disorders, which can significantly impact long-term health outcomes [40]. Furthermore,

extended NICU stays are associated with an increased likelihood of developmental retardation, predisposition to chronic illnesses, and neurodevelopmental disorders [41][42]. Conversely, regular physical activity during pregnancy may contribute to a reduction in the incidence of NICU admissions among newborns, thereby potentially mitigating these adverse outcomes. A 2023 meta-analysis of approximately 11,000 pregnant women found that engaging in physical activity during pregnancy is associated with a substantial decrease in neonatal intensive care unit admissions and enhanced Apgar scores at both 1 and 5 minutes post-birth, reflecting improved health outcomes for newborns. In their statistics, the authors took into account mainly strength and aerobic exercises, although, as they themselves emphasized, the type of exercises performed by pregnant women was largely arbitrary. Further research is needed to establish the minimum and maximum levels of physical activity that are effective throughout pregnancy. According to the authors it is important for healthcare providers and institutions to promote physical activity among pregnant women to reduce delivery complications [43].

4.2 Influence of maternal physical activity on neonate neurodevelopment

Engaging in physical activity during pregnancy is linked to improved neurodevelopmental outcomes in newborns. The authors of the original research article examined the correlation between maternal physical activity and the development of the neonatal brain cortex. This investigation involved a cohort of 44 mother-neonate pairs. Maternal physical activity levels were objectively quantified using accelerometers at specific gestational intervals. Following birth, neonatal brain development was assessed via magnetic resonance imaging (MRI) at approximately two weeks postpartum. The findings revealed a positive correlation between increased maternal physical activity during the first and second trimesters and greater cortical thickness in neonates. This association suggests enhanced cortical development, which may contribute to favorable health outcomes for newborns. It is noteworthy that the benefits of physical activity during pregnancy transcend the neonatal period [44]. A randomized controlled trial investigated the effects of maternal physical activity over a 16-weeks period on the neurodevelopmental outcomes of children, involving 424 women and their children, divided into intervention (n = 141) and control (n = 283). Neurodevelopmental assessments were conducted at ages 1, 2, and 4 years, evaluating linguistic, motor, and cognitive abilities. The findings suggest that prenatal exercise may confer modest advantages in linguistic and cognitive development, underscoring the potential long-term benefits of maternal physical activity on child development [45].

4.3 The influence of gestational weight gain and metabolic factors on neonatal health

It is crucial to emphasize that the progression of pregnancy, including factors such as excessive gestational weight gain (GWG) and gestational diabetes, can profoundly influence the newborn's physiological functioning and adaptation to life. Notably, gestational weight gain that falls either below or above the recommended guidelines is associated with an elevated risk of adverse outcomes for both mothers and infants [46]. Additionally, mothers with gestational diabetes or obesity often have altered metabolic profiles, which can affect fetal development and birth weight [47]. A systematic review and meta-analysis, which included 117 randomized controlled trials (RCTs) involving over 34,000 women, revealed that lifestyle interventions combining structured diet and physical activity during pregnancy led to reduced GWG and improved health outcomes for both mothers and newborns. Interestingly, structured diet interventions had a more significant impact on GWG compared to physical activity alone or combined interventions. While diet was linked to better maternal and neonatal outcomes, physical activity was associated with reduced adverse maternal outcomes. The analysis provides compelling evidence that incorporating these interventions into standard prenatal care and policy is cost-effective, thereby improving maternal and infant health worldwide [48].

4.4 The role of maternal physical activity on fetal growth and birth weight outcomes

Physical activity during pregnancy can impact the growth of the fetus and the baby's birth weight. Research indicates that engaging in moderate to high levels of physical activity is linked to a lower risk of having babies with macrosomia (excessive birth weight) or those who are larger than typical for their gestational age (LGA) [49][50]. There is no substantial evidence indicating that physical activity during pregnancy raises the risk of low birth weight (LBW) or having infants who are smaller than typical for their gestational age (SGA) [50]. Another study revealed that pregnant women who engage in higher levels of physical activity tend to have babies with healthier growth patterns, as indicated by higher birth weight z-scores [51]. In our work, we want to emphasize that macrosomia is considered a significant risk factor for many pathological conditions in the newborn. Excessive birth weight of the child may be associated with complications such as shoulder dystocia, brachial plexus damage, hyperbilirubinemia, perinatal infection and an increased risk of metabolic disorders in the newborn, such as hypoglycemia [52][53][54][55]. Despite the lack of direct evidence, we

want to emphasize that physical activity during pregnancy may have an indirect effect on reducing the frequency of the above-mentioned conditions.

CONCLUSION

Physical activity during pregnancy plays a pivotal role in promoting maternal and neonatal health. For pregnant and postpartum women without contraindications, engaging in regular physical activity is not only safe but also highly beneficial. Current guidelines recommend incorporating at least 150 minutes of moderate-intensity physical activity per week. Such activity significantly reduces the risk of common pregnancy complications, including gestational diabetes, gestational hypertension, and preeclampsia. Importantly, physical activity does not increase the risk of preterm birth, miscarriage or stillbirth.

In terms of labor and delivery, physical activity, particularly pelvic floor muscle training, enhances perineal tissue elasticity, thereby reducing the likelihood of perineal ruptures. While evidence linking physical activity to reduced episiotomy rates remains inconclusive, some studies suggest that moderate physical activity during pregnancy may lower the likelihood of operative deliveries. Additionally, regular moderate physical activity has been associated with a reduced risk of cesarean section (CS). The impact of physical activity on labor duration is less clear, with some studies indicating shorter active labor stages and reduced risks of prolonged first-stage labor, while others show no significant differences. Prenatal physical activity may also decrease the likelihood of labor induction, as highlighted in several studies.

Neonatal outcomes are also positively influenced by maternal physical activity. Regular moderate exercise is associated with healthier birth weights, reduced incidence of NICU admissions, and improved Apgar scores, reflecting better overall health for newborns. Furthermore, maternal physical activity is linked to enhanced cortical development in neonates, potentially offering long-term cognitive and linguistic benefits for children.

In conclusion, incorporating physical activity into prenatal care can lead to significant improvements in both maternal and infant health outcomes. However, a more personalized approach to physical activity recommendations is warranted to address individual needs and circumstances. It is our aspiration that this research will enhance awareness of the multifaceted benefits of physical activity during pregnancy and encourage healthcare

providers to educate their patients on its critical role in promoting maternal and neonatal well-being.

Disclosure

Authors do not report any disclosures.

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